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# THE ENGLISH MECHANIC

## AND WORLD OF SCIENCE.

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## LATHE APPLIANCES.—IV.

(*Continued from p.* 501, *Vol. LI.*)

### Drill Spindle.

THE drill spindle, driven from the overhead motion and used in the slide-rest, is useful for many purposes. Plain drilling can be managed by its aid often to better advantage than by using the lathe mandrel itself. Some work is fixed to a chuck, and the mandrel itself held stationary by a division peg, so that drilling may be done with the spindle. The holes in a division plate would be drilled in this way. The plain flat drill, used for boring holes, is sometimes replaced by a special form of cutting-tool used for fluting and otherwise ornamenting work held between the lathe-centres.

The illustrations show a drill spindle suited for use on a lathe of the type usually adopted for ornamental turning. The square shaft measures 9/16in., so as to fit a tool box of usual size. Similar appliances of much heavier construction are also used on heavy lathes, and are often driven by wheel and pinion gearing, to give more power than a simple pulley affords. These heavy drill spindles are used for such purposes as are named above, and are, in addition, useful for carrying milling cutters. With these a great quantity of work can be done, both expeditiously and accurately; cutters of suitable shape being used on the drill spindle, and the work fixed on a chuck or between the lathe centres.

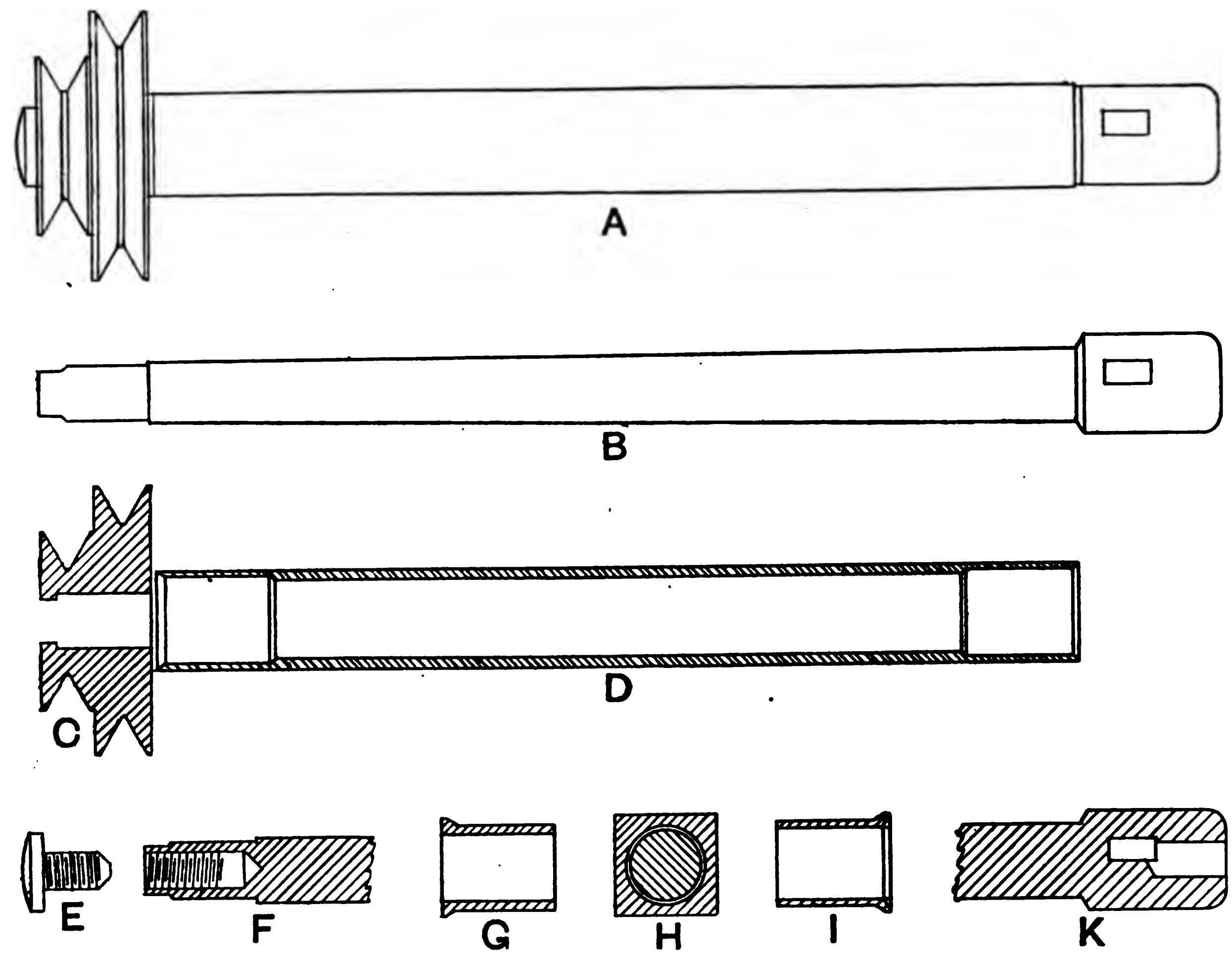
To briefly describe the illustrations: A shows the complete drill spindle, the appliance being put together ready for use; at the right-hand end the nose is bored out to take drills, &c., and is cross-mortised. The long, plain middle part is a bar of steel 9/16in. square; at the left is a pulley with two V-grooves for gut driving-band. The pulley is held on by a screw, E, the head of which is shown. B is the spindle proper, made of good cast steel. C and D are sections taken through A, with the spindle B removed, also the collars G and I and the screw E removed; C shows the sectional form of the pulley, and D that of the square bar. This latter is bored through its whole length 11/32in. diam., and each end is enlarged to admit the collars for a depth of about ⅝in. E is a screw fitted in the tail end of the spindle. In ornamental lathe appliance, Holtzapffel's screw threads are commonly used by the present firm, and by other makers who follow the same style of work. The screw E is ⅜in. long, and its diameter and thread rate are distinguished by the letter N in the Holtzapffel table. These are respectively ¼in. in diameter, and 36·1 threads per inch. Being simply a binding-screw, there is no need for special exactness in its dimensions. F is a section of the tail end of the spindle; it is bored up about ⅝in., and tapped to take the screw E. About ⅝in. of its length is turned down to 5/16in., and the pulley fits on this part. Two flats are filed on opposite sides of the cylindrical part for a length of about 3/16in., from the end, and reducing the diameter to ¼in. The pulley is fitted to this, and so prevented from rotating without the spindle. G is the back collar in section; it is made of cast steel, fitted in the square bar, hardened and ground out true with grinders, and finally ground on the spindle itself. I is a similar collar for the front end. H is a section through the middle of A; it shows the square steel bar, bored through with a 7/16in. hole, and inside this the steel spindle, about ⅜in. diameter. K is the nose end of the spindle in section, with the hole to receive the drills and the cross mortise hole; and just above the letter K is the shoulder, which takes the thrust in drilling, and stops end play.

The construction of this appliance is not a very difficult task to anyone able to do plain turning, and knowing how to harden steel properly. Nearly all the work is turning and boring, and requires care more than skill to make it successful. By following the course of procedure detailed below, there should be very little risk of complete success. All the parts are made from steel in its commercial forms, and suitable pieces can be obtained from almost any tool-shop or metal-warehouse which sells steel, and a shilling or so will pay for the whole lot. The materials comprise: a piece of 9/16in. square bar steel. 5⅛in. long; a mild steel, shear or Bessemer will suit for this; a piece of rod steel 9/16in. diameter, 8in. long; good quality cast steel, tool temper or spindle temper, which means containing from 1⅛ to 1¼ per cent. of carbon; a disc of steel, 1½in. diameter and ⅝in. thick—any quality will do for this which is to make the pulley; a piece to make the screw E. The above dimensions are smallest admissible, they being those of the finished parts.

The square bar is the part to commence with. It is first made true, each side being flat and at right angles to those adjacent. If the bar steel is selected with an eye to afterwork, and a straight piece is got, having its angles true, and not rhomboidal, as some are, a little filing will make it shapely, and a few strokes of emery paper taken lengthways will lay an even grain. A true surface-plate and a try square should be used to test the accuracy of this square bar before passing on to the next process, which is to bore a hole straight through the bar.

Both ends are accurately middled and centre-punched, then tested on the cone points, and, if necessary, altered till the bar runs quite true. The corners of the square are then just removed by a graver, so that the bar may run in a cone plate. For the actual boring a half-round, or D bit is used, and if this is carefully entered it will follow a true lead. It is, however, a good plan to bore through from both ends half-way. The hole is 11/32in. diam.; and an idea of what speed and feed can be used may be gathered from what is done on similar work at the Small Arms Factory at Enfield. There rifle barrels are bored just under ⅜in. diam. at 900 turns per minute, during which the D-bit is fed in ¼in. The barrel itself is rotated, and D bits are applied at both ends; the bits meet in the middle, making a very straight hole right through. At these rates of speed and feed, the bar 5⅛in. long should be bored through, using one bit only, in about ten minutes; but in practice it takes a little longer, if all goes well. Should it happen that either hole goes out of line, so that the two do not meet precisely concentric, a way to correct the error is by broaching.

When a hole has been made 11/32in. diam. clear through, the next process will be enlarging the ends to receive the collars in which the spindle runs. These recesses are barely ½in. diam., 15/32 being their size; they are ⅝in. deep. They may be enlarged from the through-hole by means of a pin-drill of suitable size; but a better plan is to bore them with a boring-bar between the lathe-centres, the square bar being itself fixed in its intended place on the slide-rest. This boring-bar is a steel rod ⅜in. diam., and about 7in. long. It has a cross-mortise hole about 1in. from one end, in which a small cutter is fitted and held by a wedge. By using this bar to bore the recesses for the collars, they may be made absolutely true with the line of centres when the drill spindle is in its normal position on the slide-rest. Both recesses are similar in size, and the mouth of each is coned out to about 60°. They must be bored smooth, and if a trifle tapering large at the mouth, it will be better than if quite parallel; but the reverse must be carefully avoided. A conical wooden plug, turned to suitable size, and having a piece of emery cloth wrapped round it, will suffice to give the desired amount of taper to these holes. This done, holes are to be drilled about 3/32in. diam., about ¼in. from each end through the top side of the bar into the collar recesses, for oil-holes to lubricate the collar bearings. The burr must be



cleared away from the inside of these oil holes, and they should be slightly countersunk on the outside. This finishes the square bar.

Taking the steel rod in hand next: first centre it truly and bore up one end $\frac{5}{16}$in. diameter for a length of $1\frac{1}{4}$in.; this tubular part will form the two collars, which can be cut off each $\frac{5}{8}$in. long. The piece remaining, $6\frac{5}{8}$in. long, will form the spindle proper. Carefully drill and countersink the two ends; the nose end is then bored $\frac{3}{16}$in. diam. and $\frac{3}{8}$in. deep, the tail end $\frac{5}{32}$in. diam. and about $\frac{1}{2}$in. deep; the bottom part of the hole being bored larger to facilitate tapping. After properly countersinking, this hole is to be tapped, and the countersink applied again to remove any burr. Mount the spindle between the lathe centres, and take a slide-rest cut along the rod, leaving about $\frac{7}{8}$in. full diam., and reducing the part behind to $\frac{1}{2}$in. diam. for a length of $\frac{3}{4}$in., and the tail end $\frac{7}{16}$in. diam. for a length of 5in. When roughed out so far the spindle should be carefully annealed. This is a process requiring a very large amount of practical experience to carry through successfully.

The spindle must be heated evenly, and it must be allowed to cool evenly, and during both processes it must not be allowed to feel the influence of its own weight tending to bend it. When heating the spindle, it should be suspended by a wire twisted round the shoulder, and allowed to hang vertically; and it must be protected from draught, a whiff of air might almost spoil it at this stage. During the time it is slowly cooling it also requires great care to guard against any strain, which would cause it to set. The collars may at the same time be properly annealed; but before doing so they should have their outsides turned to approximate shape and size, as shown at G and I in the illustration.

To finish the collars and fit them in their places, each should be mounted in a wood or metal chuck and carefully bored out conical about 1° 30″ from the axis, the front collar being $\frac{13}{32}$in. diam. at its smallest end, and the tail collar $\frac{11}{32}$in. diam. Each collar should be ground out smoothly with lead grinders charged with emery. Each one is then removed from its chuck and mounted on a true tapering mandrel and turned true on its outside to suit the recess in the square bar. The collar is turned to just enter the recess, so that it will require to be forced in after hardening. Before hardening, a hole is drilled through each collar to admit oil, and from this hole it is advisable to make a very shallow broad groove lengthways of the collar to form a channel for the oil to flow in and properly lubricate the whole length of the bearing. Each collar is then hardened, and though breakage is often expected in this process, yet it seldom occurs with proper care. Plenty of common yellow soap rubbed all over the collars protects them against burning, and also causes them to leave the water clean after hardening. It is well to be assured that the operation has been successful by testing with a file.

To get the collars in their places, put each one in position with the fingers, and find a bolt to go through the hole, or a rod with a nut on each end—that will do to draw the collars in their recesses. Have this ready and lay the collars in convenient places. Heat the square bar all through evenly as hot as it can be handled—in boiling water is a good way; then quickly put the collars in place; have an eye to the position of the oil-holes, so that they come opposite those in the bar; put the bolt or rod through them and screw up the nut to draw the collars home, and do all this as quickly as possible, so that the bar does not become cool, and also that the collars do not become hot. Immediately that the collars are drawn home (they may be assisted by blows from a mallet), the whole should be cooled, so that the temper of the collars may not be lowered.

The spindle may now be made to fit in its place in the bar. It is turned parallel between the bearings, and these are tu
conical to agree with the collars.
dimensions of this spindle are not gi
because they depend upon those of
parts to which it has to be fitted, and
upon making it to any linear measuren
As soon as the conical necks will go int
collars, it is convenient to use the spind
a grinder to true the hardened collars;
stone dust is used to do the grinding.
truing process may be continued till
blackness of the hardening has been enti
removed from the conical bore of the col
When this stage is reached, all trace of
abradent powder must be removed—and
is very important, for a little grit left in
hole might mar the bearings at a later s
The spindle is then turned to such shape
size as may fit it to the square stem.
tail end will be reduced to $\frac{5}{16}$in. dian
receive the pulley, and it is advisable
this before hardening the spindle.

The pulley is made from a disc of
$1\frac{1}{2}$in. diam. and $\frac{5}{8}$in. thick; a hole is b
through the centre $\frac{1}{4}$in. diam., and the
mounted on a mandrel and turned true
to approximate form. The V grooves
their sides forming an angle of 60°, and
bottom is not cut in acutely; a flat
fully $\frac{1}{32}$in. wide, is made. The hole is
enlarged to $\frac{5}{16}$in. diam. for a distance of
leaving $\frac{1}{8}$in., $\frac{1}{4}$in. diam. Two opposite
of this part are filed away to the full
diam., in order that the pulley so mad
on the spindle, which has flats filed
opposite sides to admit it between the
duced diameter of the hole, and by this
the pulley is securely fitted to always
the spindle round with it. The positic
the spindle relatively to the pulley shou
marked, so that they can always be repl
the same way, and the pulley shoul
finally turned true on the spindle itself.

The screw K needs no special descri
further than what has been given
dimensions can be taken from the draw

The spindle may now be hardened, a

this process all the previous work may be spoiled, as the spindle may be easily broken, cracked, or bent. The precautions mentioned in connection with the annealing process are to be taken in heating for hardening, and the spindle should be so heated that the bearings only will be thoroughly hardened on cooling. A person who is accustomed to hardening steel, and especially one who has had experience with steel of a certain grade, can so regulate the heat that only those parts required to be hardened are made sufficiently hot for this to occur, and the remainder of the steel is not hot enough to harden when suddenly cooled. It is just this experience that is wanted in treating the spindle. It should be held suspended by a wire from the tail end, so that it hangs quite vertical, and be then heated and lowered into water or oil, keeping the spindle vertical all the while.

When hardened, the spindle is spun on the lathe centres, and tested for truth. It may have warped in hardening, and, if so, can be straightened by paning with a hammer, and when fairly true, the bearings may be lapped to fit the collars and the shoulder brought up to bearing.

The spindle has its nose trued when running in its bearings, and the hole in which drills, &c., will be fitted, is re-bored out true, and may be lapped for greater accuracy.

This closes this somewhat minute description of the drill spindle, and the method of making it.

## ASTRONOMICAL NOTES FOR SEPTEMBER, 1890.

### The Sun.

| Day of Month. | Souths. | At Greenwich Mean Noon. | | |
|---|---|---|---|---|
| | | Right Ascension. | Declination North. | Sidereal Time. |
| | h. m. s. | h. m. s. | ° ′ ″ | h. m. s. |
| 1 | 11 59 50·87 A.M. | 10 42 15 | 8 12 55 | 10 42 24·23 |
| 6 | 11 58 13·12 ,, | 11 0 20 | 6 22 20 | 11 2 7·00 |
| 11 | 11 56 30·69 ,, | 11 18 20 | 4 29 5 | 11 21 49·76 |
| 16 | 11 54 45·62 ,, | 11 36 18 | 2 33 52 | 11 41 32·53 |
| 21 | 11 53 0·10 ,, | 11 54 15 | 0 37 23 | 12 1 15·29 |
| 26 | 11 51 16·37 ,, | 12 12 14 | 1 19 36<br>(South) | 12 20 58·06 |

The Method of finding the Sidereal Time at Mean Noon at any other station is explained on p. 353 of Vol. L.

Spots, though still small and rare, are beginning to appear a little more frequently on the Sun's disc.

At 2h. 22m. a.m. on September 23, the Sun is said, technically, to enter Libra, and Autumn is supposed to commence. At this instant he will really be just below a line joining β and η Virginis, and rather near the latter star. The 23rd is the theoretical date of the Equinox; but in London there will be no actual equality of day and night, the nearest approaches to such equality happening on the 24th, when the day is 12h. 2m. long, and the 25th, when the Sun is 11h. 58m. above the horizon.

The Zodiacal Light may now be seen in the east before sunrise.

### The Moon

enters her Last Quarter at 3h. 29·5m. a.m. on the 6th, and is New at 7h. 53·0m. in the morning of the 14th. She will enter her First Quarter at 10h. 5·5m. p.m. on the 21st, and be Full at 59·7m. after noon on the 28th.

| Day of Month. | Moon's Age at Noon. | Souths. |
|---|---|---|
| | Days. | h. m. |
| 1 | 16·8 | 1 45·1 a.m. |
| 6 | 21·8 | 5 52·7 ,, |
| 11 | 26·8 | 9 59·8 ,, |
| 16 | 2·2 | 1 34·9 p.m. |
| 21 | 7·2 | 5 41·7 ,, |
| 26 | 12·2 | 10 37·1 ,, |

The Moon will be in conjunction with Saturn (30 33′ N. of him) at 5h. a.m. on the 13th; with Mercury at midnight on the 15th (Mercury 9° 10′ S.); with Venus at 5h. a.m. on the 18th (Venus 6° 12′ S.); with Mars at 10h. p.m. on the 21st (Mars 1° 44′ S.); and with Jupiter at 6h. a.m. on the 24th (Jupiter 2° 45′ N.)

At noon on September 1st the Moon is in Cetus, out of which she passes into Pisces at 9h. o'clock the same evening, only, however, to re-enter Cetus at 6h. p.m. on the 2nd. When she finally leaves Cetus, which she does at 3h. a.m. on the 3rd, she emerges in Aries. She remains in Aries until 9h. 30m. a.m. on the 4th, and then quits it for Taurus. Her journey across Taurus terminates at 10h. a.m. on the 7th, when she enters Gemini. She is travelling over Gemini until 2h. 30m. p.m. on the 9th, at which hour she crosses the boundary into Cancer. By 7h. 30m. a.m. on the 11th she has traversed Cancer and entered Leo, and here she remains until 7h. a.m. on the 14th, when she leaves it for Virgo. It is not until 9h. p m. on the 17th that she has completed her passage through this great constellation and entered Libra. She crosses Libra, and at 6h. p.m. on the 19th arrives at the Western edge of the Northern spike of Scorpio. It takes her until 5h. 30m. next morning, and at that hour she passes into Ophiuchus. At 4h. p.m. on the 21st she passes from Ophiuchus into Sagittarius. She leaves Sagittarius for Capricornus at 1h. 30m. a.m. on the 24th; and Capricornus in turn for Aquarius, at 6h. p.m. on the 25th. By 4h. 30m. p.m. on the 27th she has finished her course through Aquarius, and has entered Pisces. Travelling through Pisces, she comes to an outlying part of Cetus at 6h. a.m. on the 28th; and through this she is journeying until 7h. a.m. on the 29th, at which hour she re-enters Pisces. This, however, is only to plunge again into another part of Cetus at 4h. a.m. on the 30th; and when she finally quits Cetus (as at the beginning of the month), at 1h. p m. on the 30th, it is to come out in Aries. There we leave her.

### Occultations of (and near Approaches to) Fixed Stars by the Moon.

| Day of Month. | Star's Name. | Magnitude. | Disappearance. | Moon's Limb. | Angle from N. Point. | Angle from Vertex. | Reappearance. | Moon's Limb. | Angle from N. Point. | Angle from Vertex. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | h. m. | | ° | ° | h. m. | | ° | ° |
| 2 | 64 Ceti | 6 | 10 40 p.m. | Bright | 3 | 42 | 11 12 p.m. | Dark | 301 | 338 |
| 2 | ξ¹ Ceti | 4½ | †11 53 ,, | NWbyN | 331 | 5 | | | | |
| 3 | B A C. 741 | 6½ | †6 32 a.m. | S S E | 155 | 122 | | | | |
| 4 | B A C. 1206 | 6 | 9 32 p.m. | Bright | 95 | 131 | 10 20 ,, | Dark | 224 | 263 |
| 5 | B A C. 1240 | 6 | 1 14 a.m. | Bright | 65 | 105 | 2 22 a.m. | Dark | 245 | 278 |
| 6 | B A C. 1801 | 6 | 11 55 p.m. | Bright | 42 | 81 | 12 42 ,, | Dark | 291 | 332 |
| 20 | 24 Ophiuchi | 6½ | 7 56 ,, | Dark | 87 | 60 | ‡9 3 ,, | Bright | 289 | 255 |
| 21 | 63 Ophiuchi | 6½ | †7 57 ,, | N | 3 | 343 | | | | |
| 24 | χ Capricorni | 6 | †11 33 ,, | N N W | 338 | 314 | | | | |
| 27 | 30 Piscium | 5 | 10 36 ,, | Dark | 47 | 57 | 11 45 p.m. | Bright | 248 | 245 |
| 28 | 33 Piscium | 5 | 12 32 a.m. | Dark | 91 | 80 | 1 28 a.m. | Bright | 204 | 184 |
| 29 | 26 Ceti | 6½ | 3 24 ,, | Bright | 64 | 34 | 4 28 ,, | Dark | 238 | 202 |
| 29 | 29 Ceti | 6½ | 5 42 ,, | Bright | 49 | 11 | 6 35 ,, | Dark | 261 | 223 |
| 29 | ν Piscium | 4½ | †7 18 p.m. | N N W | 334 | 13 | | | | |

† Near approaches. ‡ The moon has set. An illustrated explanation of the above table will be found on p. 353 of Vol. L.

### Jupiter's Satellites.

| Day of Month. | Satellite. | Phenomenon. | H. | M. | S. | Day of Month. | Satellite. | Phenomenon. | H. | M. | S. | Day of Month. | Satellite. | Phenomenon. | H. | M. | S. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | I | Tr I | 12 | 29 | A.M. | 11 | I | Sh E | 12 | 1 | A.M. | 19 | I | Sh E | 8 | 25 | P.M. |
| 2 | *I* | *Sh I* | 1 | 17 | ,, | 11 | I | Ec R | 9 | 19 | 40 P.M. | 20 | III | Oc D | 8 | 47 | ,, |
| 2 | I | Oc D | 9 | 49 | P.M. | 12 | *I* | *Sh E* | 6 | 30 | ,, | 21 | *III* | *Oc R* | 12 | 27 | A.M. |
| 2 | III | Tr I | 11 | 52 | ,, | 12 | II | Oc D | 11 | 31 | ,, | 21 | II | Tr I | 9 | 2 | P.M. |
| 3 | *I* | *Ec R* | 12 | 55 | 34 A.M. | 13 | III | Oc R | 8 | 51 | ,, | 21 | II | Sh I | 11 | 17 | ,, |
| 3 | *I* | *Tr I* | 6 | 56 | P.M. | 13 | III | Ec D | 9 | 18 | 41,, | 21 | *II* | *Tr E* | 11 | 56 | ,, |
| 3 | I | Sh I | 7 | 46 | ,, | 14 | *III* | *Ec R* | 12 | 50 | 52 A.M. | 23 | II | Ec R | 8 | 18 | 11,, |
| 3 | I | Tr E | 9 | 16 | ,, | 14 | *II* | *Tr I* | 6 | 37 | P.M. | 24 | III | Sh E | 6 | 53 | ,, |
| 3 | I | Sh E | 10 | 6 | ,, | 14 | II | Sh I | 8 | 40 | ,, | 24 | IV | Oc R | 9 | 32 | ,, |
| 4 | *I* | *Ec R* | 7 | 24 | 26,, | 14 | II | Tr E | 9 | 32 | ,, | 25 | I | Oc D | 9 | 42 | ,, |
| 5 | II | Oc D | 9 | 10 | ,, | 14 | II | Sh E | 11 | 35 | ,, | 26 | I | Tr I | 6 | 50 | ,, |
| 6 | III | Ec R | 8 | 49 | 49,, | 16 | IV | Sh I | 7 | 25 | ,, | 26 | I | Sh I | 8 | 0 | ,, |
| 7 | *II* | *Tr E* | 7 | 9 | ,, | 17 | *IV* | *Sh E* | 12 | 16 | A.M. | 26 | I | Tr E | 9 | 10 | ,, |
| 7 | II | Sh E | 8 | 58 | ,, | 17 | I | Tr I | 10 | 32 | P.M. | 26 | I | Sh E | 10 | 21 | ,, |
| 8 | *IV* | *Oc D* | 12 | 56 | A.M. | 17 | *I* | *Sh I* | 11 | 36 | ,, | 27 | I | Ec R | 7 | 39 | 4,, |
| 9 | I | Oc D | 11 | 36 | P.M. | 18 | I | Oc D | 7 | 52 | ,, | 28 | *II* | *Tr I* | 11 | 29 | ,, |
| 10 | I | Tr I | 8 | 44 | ,, | 18 | I | Ec R | 11 | 14 | 57,, | 30 | *II* | *Ec R* | 10 | 55 | 26,, |
| 10 | I | Sh I | 9 | 41 | ,, | 19 | *I* | *Sh I* | 6 | 5 | ,, | | | | | | |
| 10 | I | Tr E | 11 | 4 | ,, | 19 | I | Tr E | 7 | 20 | ,, | | | | | | |

Ec, Eclipse; Oc, Occultation; Tr, Transit of Satellite; Sh, Transit of Shadow; D, Disappearance; R, Reappearance; I, Ingress; E, Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight, or by Jupiter's proximity to the horizon.

### Mercury

Is an Evening Star until almost the end of the month. He attains his greatest elongation East of the Sun (26° 59′) at 10h. a.m. on the 3rd, and comes into inferior conjunction with the Sun at 7h. p.m. on the 29th. His South Declination militates against his observation, as, even at the beginning of September, he sets too soon after the sun to be visible with the naked eye n such a climate as the English one. His angular diameter increases from 6·8″ on September 1st to 10·2″ for a few days about the time of his conjunction; but has diminished (absolutely imperceptibly) to 10″ by the last day of the month.

| Day of Month. | Right Ascension. | Declination South. | Souths. |
|---|---|---|---|
| | h. m. | ° ′ | h. m. |
| 1 | 12 18·5 | 4 17·8 | 1 35·8 p.m. |
| 6 | 12 34·6 | 6 49·2 | 1 32·2 ,, |
| 11 | 12 45·9 | 8 42·3 | 1 23·9 ,, |
| 16 | 12 50·6 | 9 38·5 | 1 8·9 ,, |
| 21 | 12 46·3 | 9 12·0 | 0 44·9 ,, |
| 26 | 12 32·5 | 7 2·0 | 0 11·5 ,, |

The looped path thus described by Mercury lies in a part of Virgo destitute of all conspicuous stars.

### Venus

is an Evening Star throughout September, attaining her greatest elongation East of the Sun (46° 29′) at 4h. a.m. on the 24th. Unfortunately, at this time her great and increasing South Declination is terribly against the observer. In lower latitudes than ours she will be a brilliant and conspicuous object in the evening sky; but, from the cause specified, she (like Mercury) sets too soon after the sun in this country to be at all fairly seen. Soon after the middle of the month she will be dichotomised, or present the phase of the Moon when about 7·4 days old. Her angular diameter increases from 19·5″ on the 1st, to 26·6″ on the 30th.

| Day of month. | Right Ascension. | Declination South. | Souths. |
|---|---|---|---|
| | h. m. | ° ′ | h. m. |
| 1 | 13 27·4 | 10 36·2 | 2 44·5 p.m. |
| 6 | 13 47·2 | 12 56·6 | 2 44·6 ,, |
| 11 | 14 7·0 | 15 10·8 | 2 44·7 ,, |
| 16 | 14 26·7 | 17 17·4 | 2 44·7 ,, |
| 21 | 14 46·4 | 19 15·3 | 2 44·7 ,, |
| 26 | 15 5·8 | 21 3·4 | 2 44·4 ,, |

It will hence be seen that Venus, starting from a point due East of Spica Virginis, travels through the remainer of Virgo and Libra, but through a very barren region of the sky. She will be in conjunction with Uranus at 11 a.m. on the 2nd.

### Mars

may just possibly be caught close to the horizon after sunset; but as his angular diameter dwindles from about 13″ on the 1st to 11″ by the 30th, his South Declination increasing pari passu from 25° 45′ to over 26° between the 1st and the 26th, any ephemeris of him would needlessly occupy space. He is in quadrature with the Sun at 9 p.m. on the 21st.

### Jupiter

is a little better placed for the observer than Mars, and that is all that can be said. He must be looked at as near to his Meridian passage as possible, and even on the Meridian his small altitude of necessity obscures all his finer superficial detail. His angular equatorial diameter decreases from 43·7″ on the 1st, to 40·4″ on the 30th.

| Day of Month. | Right Ascension. | Declination South. | Souths. |
|---|---|---|---|
| | h. m. | ° ′ | h. m. |
| 1 | 20 23·8 | 20 10·7 | 9 39·9 p.m. |
| 6 | 20 22·3 | 20 16·0 | 9 18·7 ,, |
| 11 | 20 21·0 | 20 20·2 | 8 57·7 ,, |
| 16 | 20 20·1 | 20 23·3 | 8 37·1 ,, |
| 21 | 20 19·5 | 20 25·2 | 8 16·9 ,, |
| 26 | 20 19·2 | 20 26·0 | 7 56·9 ,, |

So that Jupiter describes a short retrogade arc in Capricornus.

### Saturn, Uranus, and Neptune

for the purposes of ordinary observers, are, one and all, invisible.

### Minima of the Variable Star Algol

will occur on the 13th at 5h. 16m. a.m., on the 16th at 2h. 15m. a.m., on the 18th at 11h. 4m. p.m., and on the 21st at 7h. 53m. p.m., as well as at other times when the phenomenon will be invisible.

### Greenwich Mean Time of Southing of Ten of the Principal Fixed Stars on the Night of September 1st, 1890.

| Star. | Souths. h. | m. | s. | |
|---|---|---|---|---|
| Vega | 7 | 49 | 32·96 | p.m. |
| ζ Aquilæ | 8 | 16 | 37·08 | ,, |
| Altair | 9 | 1 | 33·75 | ,, |
| $\alpha^2$ Capricorni | 9 | 28 | 1·74 | ,, |
| α Cygni | 9 | 53 | 41·28 | ,, |
| α Cephei | 10 | 31 | 52·00 | ,, |
| ε Pegasi | 10 | 54 | 37·51 | ,, |
| α Aquarii | 11 | 15 | 55·03 | ,, |
| Fomalhaut | *12 | 7 | 13·25 | a.m. |
| Markab | *12 | 14 | 54·20 | ,, |

* Early morning of 2nd.

The method of finding the Greenwich Mean Time of Southing of either of the stars in the above list, as also that of determining the local instant of its transit at any other station, will be found on p. 354 of Vol. L.

### Shooting Stars

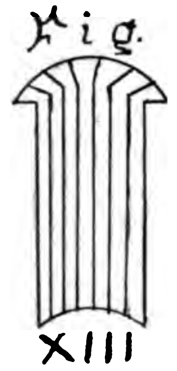
are notably more rare in September than they are in August. Still the observer may possibly be rewarded for watch kept on the nights of 1st-2nd; 6th-7th (in fact, 4th-17th), and 21st-22nd.

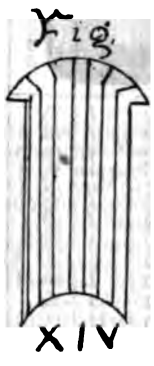
## HOW BOOKS ARE BOUND.—VI.

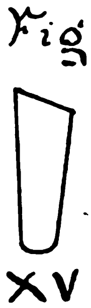
By "Practical Bookbinder."

### Jointing or Backing—Treatment of Boards—Bevelling—Case-Making.

If you have followed the instructions given in our last article, your book will now be ready for "jointing" or "backing." Before we commence to do this it will be necessary to know what thickness of board we are going to use, and this will, of course, depend upon the size of the book. I would not recommend a thick board for any book which is to have an ordinary binding. Thick boards always look clumsy, unless in the case of albums or full-bound books of a special class; then, indeed, the heavier and thicker the board the more handsome-looking will be the book. These very thick boards which are used for full-bound books are generally "made" by the binders—i.e., several thickness of board are pasted together and put into the press, and allowed to dry under pressure. There is a great art in making boards, and although every binder should be in possession of the secret, they either through carelessness or want of thought when making boards, do so in such a way as to make them when they are put to the books seem as if they wanted to part company with them—i.e., they turn up at the edges and present a very unworkmanlike appearance. This can be easily avoided by a little thought, all that is required is to take care when making boards to put a thin one to the side intended to be placed next to the book, this draws the boards to the book and makes them lie as they should. For the same reason boards for ordinary books, which consist of a single thickness of pasteboard, are lined on the inside with paper. When the proper thickness of board has been decided upon, a pair for each book is cut, and as already indicated, lined with paper and set aside to dry.



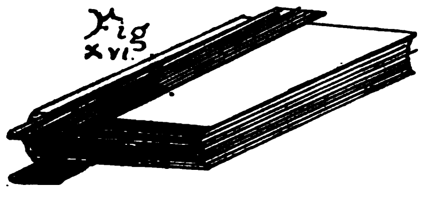


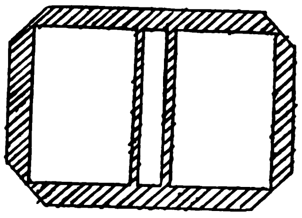


When jointing a book, it must be screwed up tightly between a pair of jointing boards in the lying press, and the back beaten with the hammer until it lies over the board from about ⅛in. to a ¼in. or more, according to the thickness of the boards to be used for the book. When doing this, care must be taken to beat the back from the centre on both sides, and not, as is often seen, a section or two on each side. Figs. 13 and 14, which are enlarged sections of a book, will show what I mean. Fig. 13 is the proper method, and Fig. 14 is the one to be avoided.

Jointing or backing-boards are simply strips of hard wood shaped like Fig. 15, which is an end view. One is placed on each side of the book as shown in Fig. 16, and the whole carefully placed in the press and tightened up. It is then hammered as directed above.

In large shops, where great quantities of work is done, the backing is done by machinery. A backing-machine consists essentially of a pair of steel jaws for gripping the work and a steel roller which takes the place of the hammer in the hand process. These machines are, of course, very useful, and do the work very speedily with very, very little labour. Messrs. Grieg, Furnival, and Krause make splendid machines of this type. The first mentioned engineer has also a splendid job backing-machine which requires no setting; it is simply a pair of steel jaws shaped like the ordinary backing-boards, the jaws are screwed up like the jaws of a vice, which tool it very much resembles; the book is then hammered, as already described. When this operation has been successfully accomplished, the book is ready for the boards; but before I give directions for this part of the work, I will ask your attention to an operation called case-making. You are all doubtless aware that the largest numbers of the books which are published at the present time are sent out to the public handsomely bound in cloth. The time was, and not so very long ago, when they were sent out, knocked together, in a paper wrapper or cover, having neither shape nor form. Cloth binding has indeed become quite a fine art. Some of the designs which are blocked upon the cases are really magnificent, the gold and colours so perfectly brought out in some instances, that even to those who are quite conversant with the process, the manipulation seems quite a marvel. Not only are the designs so perfect and worthy of praise, but the strength of the binding is so good that, with ordinary wear, the books will last no end of time.

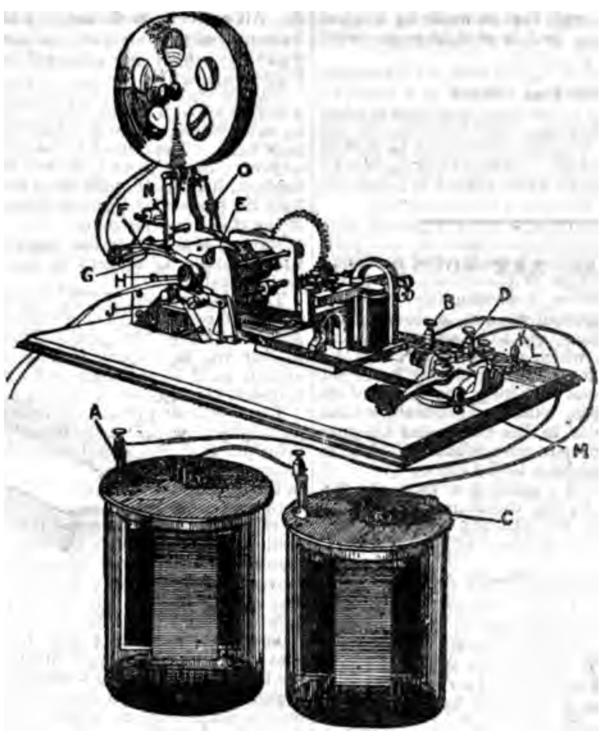




The usual method of making cases, and I specially ask the amateur to take note, for he can easily make a case for his book, is to proceed as follows:—Get one of the books of an edition, or, to save time, make up a "dummy" of plain paper, having the requisite number of pages, and prepare it by going through all the processes already described, besides cutting the edges, which is done in this instance while the book is flat. Fit a pair of boards to the book, and get a piece of cloth the proper size, glue it on, and draw it on to the book, and as the boards have not been fastened to the book, it is easy to separate them, the book is laid aside, and the edges of the cloth turned in. From this first case the sizes are taken, and whether we have 1,000 or tens of thousands of volumes, the boards are all cut the same size, and so, of course, are the books.

Well, then, the first thing is to get the boards cut. They are usually cut with the cutting machine; they must be made square, and it is best to have the four edges cut neatly, as any unevenness shows very much when the cloth has been put on.

Sometimes the edges of the boards are bevelled,



as the effect of enhancing the case. ; is, of course, done by machinery, but , and is very often, done by hand. The :hod is easily described. One board is l laid upon the table close to the edge, a in or zinc is laid upon the board straight edge, about ⅛ or more back, according :e of bevel required, a sharp knife held ;le is run from end to end, while the left :ds the strip of metal in place. This some little dexterity to be a success, as ure to haggle the board if you stop and ain. In this, as in everything else, makes perfect.

oth having been cut to the proper size, ;y of good warm glue to hand, you begin ; a piece of cloth and laying it flat upon . The experienced case-maker will look over to make sure that no lumps of hairs from the brush are left upon it. he boards is now taken from the heap ed upon the glued cloth at the left- e, leaving a margin of about ⅜in. or urn in; the back gauge is laid close d, and the other board is placed against e. The boards are now lying against , with a space between large enough to e back of the book. The gauge having ed, a lining of paper or thin board is n in the space—this is to stiffen the he case to keep it from breaking when is opened. The four corners of the cut with a pair of scissors, and the ing is now turned over upon the bench ed briskly with the hand to make the k to the board. It is again turned over case-makers generally work in sets) the next to be turned in. Fig. 17 :ase in this state. In turning in, which eans turning the cloth over to the inside se, it is usual to turn in both ends first 'oredges after; when this has been done is again turned over and rubbed very with the folder, which is a bone instru- ittle stronger than a paper-knife, and h used by all people employed in bind- s. This finishes the operation of case- Instead of the folder a machine is much rubbing down. It is simply a pair of ; indiarubber rollers, and the case is rough, the rollers press the cloth nicely boards, and, of course, leave no marks is sometimes done when the folder is he ornamenting of cloth cases will be further on.

## AUTOMATIC TELEGRAPH SENDER.

niversal automatic telegraph sender has introduced by the Electrical Novelty Co. York, and its purpose is a double one— facilitate the labours of the student of telegraphy, and, second, to afford a valuable means of self-improvement to those already expert in reading the Morse signals. Reading by sound is not an easy art to acquire, and one of the special difficulties is that the sending usually first heard by the learner is apt to be not the smooth sending of the expert telegrapher, but the painful efforts of other beginners. The difference is great, for while the first preserves the rhythmic sequence of regular telegraphic work, the second is apt to be disjointed and irregular. It is a common experience of beginners, and especially amateur telegraphers, that it is almost impossible to work up any respectable degree of speed without the assistance of a trained operator. It is this lack of proper instruction that the automatic telegraph sender is intended to supply, and it does it in a very perfect manner. The instrument consists, as will be readily seen, of the key, sounder, and sending apparatus, which latter is actuated by the little electric motor within it. A reel above supplies the sending ribbon. This latter is embossed with the practice messages. The embossing machine is practically a rather powerful tape-receiving instrument with a multiplex stylus, so that instead of a single impression on the paper a series of parallel impressions are produced which are quite deep, and consequently emboss the signals very sharply upon the paper. The office of this prepared tape is to open and close the circuit of the automatic sender by means of the embossments impressed upon it. To operate the instrument the end of the tape is passed from left to right between the brake F and the tape channel G over and around the wheel H and back between the wheels H and J. The embossments are placed upward on the tape channel. The transmitting lever, it will be seen, occupies an almost vertical position with its lower edge resting lightly on the tape with a pressure which can be nicely adjusted by means of the screw N controlling the spring. Whenever an embossed dot or dash touches the sending lever as the tape passes forward moved by the rollers, it makes contact and preserves it as long as the embossment is under the lever. It will be seen, therefore, that this sending lever is simply a key actuated by the raised portions of the tape and reduplicating in the most perfect manner the message originally impressed. At K and L is a simple switch which closes the motor circuit. The key should, of course, be closed by the lever N which automatically presses the wheels J and H together and starts the tape. The message impressed upon it will then be repeated in a sounder at any speed that should be desirable. The variation in rapidity is produced by a little brake on the fly-wheel of the motor. In learning telegraphy, then, the beginner is able to command a series of carefully-planned practice messages sent in the most perfect manner at whatever speed its proficiency will allow. The sending is perfectly smooth and regular, with every dot and dash sharply marked and distinct; such sending, in fact, as would be received from an operator particularly expert in transmitting press matter. This power of heightening speed makes the instrument exceedingly serviceable to practical telegraphers who desire to become more expert in reading. Especially should it be of service in small local offices where the operators do not get a large amount of practice and are not used to encountering fast sending.

## ODONTICS, OR THE THEORY AND PRACTICE OF THE TEETH OF GEARS.—X.*

### Twisted, Spiral, and Worm Gears.

### Stepped Gears.

WHEN two or more gears, Fig. 80, of the same pitch diameter are placed in contact on the same shaft, they will evidently act as independently of each other as if they were some distance apart, while they appear to act together as a single gear with irregular teeth. They are known as "Hooke's Gears."

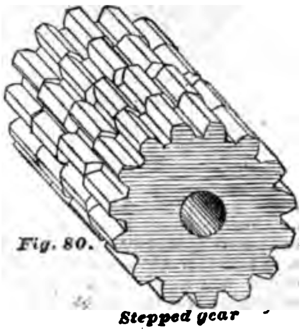
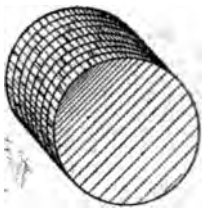


Fig. 80.

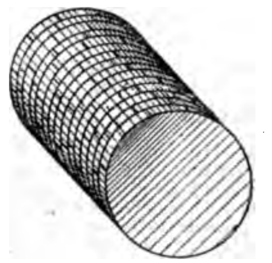
Stepped gear



Spiral arrangement

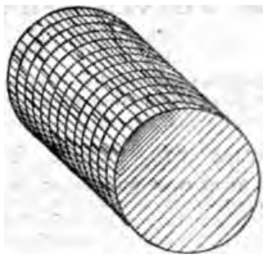
Fig. 81.

It matters not how many different kinds or numbers of teeth the several gears may have, or in what order they are arranged, if those that work together on opposite shafts are matched. They may be given an irregular arrangement, as in Fig 80; a spiral arrangement, as in Fig. 81; a double spiral, or "herring-bone" arrangement, as in Fig. 82; a circular arrangement, as in Fig. 83, or otherwise at will.



Double spiral arrangement

Fig. 82.



Circular arrangement

Fig. 83.

### Twisted Teeth.

The thickness of the component gears has nothing to do with the theoretical action of the stepped gear as a whole, and therefore we can have them as thin as required. If the thickness is infinitesimal the component character of the gear is not apparent, and it is known as a twisted gear, Fig. 84.

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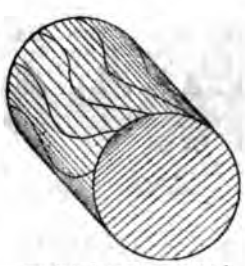
* By Geo. B. Grant, in American Machinist.

When the teeth are twisted there may always be one or more points of contact at the line of centres, where the theoretical friction is nothing, and therefore they are particularly well suited for rough-cast teeth. Furthermore, if the teeth are badly shaped the twisted arrangement tends to distribute the errors, so that they are not as noticeable.


*Twisted arrangement*
*Fig. 84.*

The oblique action of twisted teeth tends to produce a longitudinal motion of the gears upon their shafts, which must be guarded against. This end thrust may be avoided by so forming the twist that there are always two oblique bearings between the teeth, acting in opposite directions, as in the herring-bone arrangement.

The twisted form of tooth is seldom found in practice, except in the form of spiral and double spiral teeth, for the difficulty of forming other twists is great.

### Edge Teeth.

If the twist of the twisted tooth is such that some part of the twist at the pitch cylinder is always upon the line of centres, the gears will always be in action whether there are full teeth or not, and they will work with theoretical accuracy if they are reduced to thin edges in the pitch cylinder, as in Fig. 85.

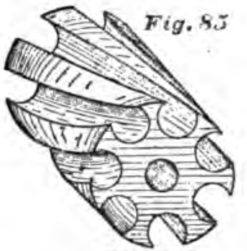


*Fig. 85*
*Edge teeth*

The friction of the edge tooth is theoretically nothing, as there is no sliding of the teeth on each other. There is but one point of contact, and that is always upon the line of centres; but if any power is carried the pressure will soon destroy the single point of contact.

If the edges are thick the action will be stronger, but there will still be but one point of contact.

### Involute Twisted Teeth.

When the form of the tooth is the involute, and the twist is such that some part of it on the pitch cylinder always crosses the line of centres, the teeth will remain in contact, when the parallel axes are separated, until their points are separated, although the contact may sometimes be very short or even point contact. The straight involute tooth will fail as soon as the arc of contact is less than the tooth arc.

Twisted involute teeth are therefore particularly valuable for gears for driving rolls, or for other purposes where the shaft distance is variable.

### Formation of the Twisted Tooth.

When the twist is a uniform spiral there are convenient methods for shaping the tooth, but the twisted tooth in general can be formed only by the processes of (27), (28) and (29), and then only when the twist is not very irregular.

The principle of the linear planing operation of (29) is the same as for the straight tooth, but the blank must be rotated according to the form of the twist adopted while the tool is cutting. The twisting motions are independent of the feeding motion, and are repeated at every stroke.

### Spiral Gears.

The spiral gear is that particular form of the twisted gear which has uniformly twisted teeth, and it is, therefore, a particular form of the common spur gear. It has such peculiar properties that it is often classed by itself as a separate form of tooth.

The normal spiral section is that section of the teeth of the spiral gear that is made by a spiral surface, called a helix, that is at right angles with the teeth.

It is the equivalent, for spiral teeth, of the normal section of the spur gear that is made by a plane, or of the normal section of the bevel gear that is made by a sphere. As with spur and bevel gears, the action of the teeth on each other should be studied upon this normal surface. As the helix cannot be represented upon a plane figure, it must be imagined, and as it is obscure, it requires close attention.

Any two spiral teeth will work together, provided their normal spiral sections are conjugate (24), and, as the shape of the normal spiral section is independent of the angle of the spiral, two spiral gears will work together, approximately, on shafts that are askew. This will be seen more clearly if the spiral section is imagined to be a flexible sheet-metal toothed helix, which can be coiled about the shaft of the gear, for it can evidently be coiled close or loose without affecting the shape of its teeth. If coiled close, with a short lead, it runs nearly at right angles to the shaft, and the gear approximates to the spur gear, while if the lead is long the gear approximates to the screw.

As the diameter of the spiral gear increases, the teeth straighten, and when the diameter is infinite and it is a rack, they are straight and in no way different from those of a common rack.

### Theory of Spiral Tooth Action.

The Willis theory of the action of spiral teeth is the one generally accepted, but it is not correct. It assumes that the action between the gears is upon a section by a plane through the axis of the gear and the common normal to the two axes, and that the section of the two gears made by the plane act together like a rack and gear.

When the axes are at right angles, and the spiral angle is great, this theory is apparently correct, the error being practically imperceptible, but, as the axes become more nearly parallel, the error is more apparent, until, when they are parallel, the error is plain enough. Willis applied his theory to worms and gears, on axes at right angles, and evidently did not consider the spiral gear in general.

The action between spiral teeth is not upon the axial section, and it is not that of a rack and gear, but when there is any action at all it is upon the normal spiral section. See the *American Machinist* for May 19, 1888.

When the axes are parallel the normal spiral sections, as well as the sections made by a plane normal to the axes, are conjugate, and therefore the action is correct and along a line of action. The action is also continuous when the axes intersect and the gears are bevel gears.

When, however, the axes are askew, the normal spiral sections are not necessarily conjugate, for they coincide only on one line, the common normal to the two axes. Therefore, there is no continuous tooth contact, except in one particular case, the teeth being in contact only for an instant as they pass the normal.

The special case for which spiral teeth on askew axes have continuous tooth contact is that case of the involute tooth when the base cylinders are tangent and the gears become spiraloidal skew bevel gears. See (175) and (176). In that particular case the teeth have a sliding conjugate action on each other. As the spiraloidal gear is fully described in its place, it will not be further considered here.

This theory is corroborated by experimental gears made by the Brown and Sharpe Manufacturing Company, for whom Mr. O. J. Beale, to whom the theory of the spiral gear is much indebted, made a pair of theoretically perfect spiral gears, exactly alike, with a spiral angle of 45°, working on shafts at right angles, and of such a large size that the action of the teeth could be plainly observed. (See Figs. 88 and 90.)

Beale's gears cannot be made to run together properly at any shaft distance; but if their ends are brought to the common normal, and their base cylinders are in contact, they are skew bevel gears, and show the action required by Olivier's theory.

But, although the action of spiral gear teeth is intermittent, and their contact is theoretically perfect at one instant only, when they are passing the common normal, they are very nearly in contact all the time, and the action is practically perfect. Spiral teeth of ordinary sizes work together with a remarkably smooth action.

### Formation of the Spiral Tooth.

As the spiral rack has an ordinary straight tooth, we can conveniently derive the spiral tooth in general from it by a method that is a form of the moulding method of (27) for spur gears.

If a plane is moved in any direction upon a cylinder it will move it, as if by friction, with a speed that depends upon the direction of the motion. If we imagine the same resulting motion between the plane and the pitch cylinder, and assume that the plane is provided with hard and straight teeth running in any direction, it will mould the plastic substance of the cylinder and form spiral teeth upon it. All spiral teeth formed by the same rack will have normal spiral sections that are approximately conjugate to each other, and they will work together interchangeably.

This process may be put into practical shape by a modification of the process of (28) for spur gears by substituting a planing tooth for the moulding rack tooth. The tooth has the shape of the normal section of the rack, and, as it is reciprocated at an angle with the axis of the gear blank being shaped, both the tool and the gear blank receive the motion of the plane and pitch cylinder. The cutting face of the tool is normal to the direction of its motion, which motion is tangent to the direction of the tooth spiral.

The linear process of (29) may be used, the plane of Fig. 20 representing, approximately, the normal spiral section of the gear. Thus, if the planing tool or the equivalent milling cutter receives a motion as if in a plane rolling upon the base cylinder, the involute tooth will be produced.

The spiral tooth may be formed by the linear planing process of (29), directly applied on the principle that the spiral tooth is a twisted spur tooth. The planing tool receives a planing motion in the direction of the axis of the gear blank, and both tool and blank receive the feeding rolling motion that would produce the spur tooth of the section that is normal to the axis. In addition, the blank receives a motion of rotation while the tool moves, that is repeated for every stroke of the tool. The cutting edge of the tool is set normal to the axis of the gear.

The spiral tooth may also be formed by a tool that is formed to the true shape of some section of the tooth, preferably its normal section, and which is guided in the tooth spiral. This is the process used to shape a worm, the tool being guided by a screw-cutting lathe.

The process generally used to mill the teeth of the spiral gear is the equivalent of the last-described operation. The milling cutter is shaped to the normal section of the tooth space, and is guided in the tooth spiral by a special feeding device that rotates the blank while the cutter is working in it.

Of these processes the planing process of (28) is the best, as it produces the tooth with theoretical perfection, and because all gears formed with the same tool are conjugate and interchangeable. But the screw-cutting and milling processes are most in use, for the reason that they are more expeditious and better adapted to the common machine tools, and it is therefore necessary to study the shape of the normal section of the tooth with some care.

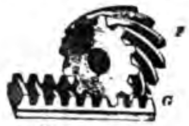
### The Normal Pitch.

The real pitch of the spiral gear is measured on a section that is normal to its axis, and, as in the case of the spur gear, it is found by dividing the number of teeth by the pitch diameter; but the shape of the tooth must be regulated by the normal pitch, or pitch of its normal section.

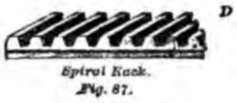
The normal pitch is found by dividing the real pitch by the cosine of the angle made by the tooth spiral with the axis of the gear. Thus if the pitch is 8, and the angle is 45°, the normal of pitch is 8 divided by ·707, or 11·3. The normal circular pitch is found by multiplying the real circular pitch by the cosine of the spiral angle.

### The Addendum.

The addendum of the spiral gear should not be determined by its real pitch, but by its normal pitch, for it is then usually possible to mill the tooth with a milling-cutter that is made from a standard spur-gear. A gear of 8 pitch and 45° angle should have an addendum of $\frac{1}{11{\cdot}3} = {\cdot}089$in. If the addendum it is determined by the true pitch when the angle is considerable, the tooth will be long and thin. Fig. 86 shows the normal pitch section of a rack to run with a pinion of 45° angle, while Fig. 87 shows the true pitch of the same rack. Fig. 88 also shows the true pitch of the pinion, and, although the tooth appears to be stunted, it is really of the standard shape.



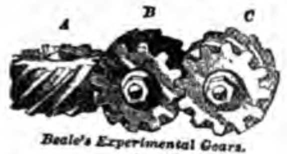
*Normal Rack.*
*Fig. 86.*



*Spiral Rack.*
*Fig. 87.*

### The Axial Pitch.

ection of the spiral gear by a plane through is that of a rack, and the axial pitch, or the rack, is found by dividing the true



Beale's Experimental Gears.
Fig. 88.

the tangent of the spiral angle. Thus, if e is 45°, the axial pitch is the same as the h, but the axial pitch of a 70° spiral tooth 64 of the true pitch.

### Shaping the Tool.

the spiral gear is cut in a milling-machine, d in a lathe, it is necessary to give the tool e of the normal section of the tooth to be this is most readily accomplished by shaping r the spur gear that most nearly coincides t normal section.

umber of teeth in the gear that is osculatory ormal spiral, and therefore most nearly with it, is found by dividing the actual of teeth in the gear by the third power of e of the spiral angle.

xample, if we are to cut a gear of 4in. , 6 pitch, and 24 teeth, at a spiral angle e central cutter should be shaped to cut a r of $\frac{24}{\cdot707^3} = \frac{24}{\cdot35} = 69$ teeth of $\frac{6}{\cdot707}$ ch. If the gear has 28 teeth of 4 pitch, ngle of 10°, the equivalent spur gear has

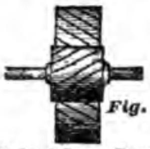


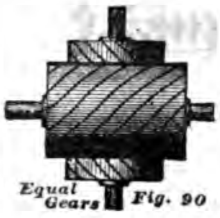
Fig. 89
Spiral Spur Gears

of 4·08 pitch, as the gear varies but little pur gear. If the gear is of 5 pitch, and 15 ith an angle of 80°, the equivalent spur 2,830 teeth of 28·7 pitch, and in general, gear has a great angle, and is a worm, n is practically that of a rack.

ust be taken, when the gear is a screw, rned in the lathe, that the tool should be its cutting edge normal to the thread of r, if it is shaped by the above rule. If the in the axial section of the screw, and it is, it should be shaped to the axial section rm, and have the axial pitch and addenut when the lead of the thread of the screw ompared with its diameter, the difference the normal and axial sections is not notice-

### elocity Ratio of Spiral Gears.

iral gear does not follow the well-known ur gears, that the velocities in revolutions n time are inversely proportional to the



Equal Gears Fig. 90

neters, but requires that ratio to be multihe ratio of the cosines of the spiral angles. formula

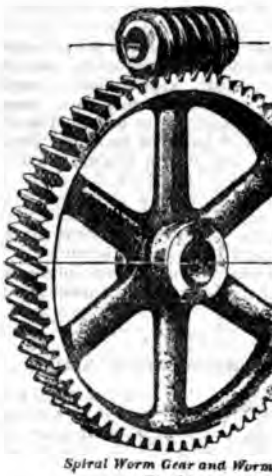
$$\frac{v}{V} = \frac{D}{d} \; \frac{\cos. A}{\cos. a}$$

re the diameters of the gears, A and $a$ are l angles, and V and $v$ are their velocities ions.

ngles are equal, the velocity ratio is the for spur gears of the same diameters. ows a pair of gears, B and C, that are of size and have the same angle in opposite , requiring the shafts to be parallel. See 9. The pair of gears A and B are exactly h equal angles in the same direction, the shafts to be at an angle equal to twice the spiral angle. See also Fig. 90. The statement that like spiral gears will not run together is founded on the Willis theory of spiral gear contact, and is wrong.

### Spiral Worm and Gear.

When the shafts are at right angles, and the angle on one is so great that it is a screw, the combination is known as a worm gear and worm, Figs. 91 and 92, and is much used for obtaining slow and powerful motions. It is also too much used for wasting power and wearing itself out, for its friction is very great, and consumes from one-quarter to two-thirds of the power received.



Spiral Worm Gear and Worm.
Fig. 91.

When the screw has a single thread, the velocity ratio is simply the number of teeth in the gear, and if there are two or three threads it must be notified accordingly. The spiral worm is adjustable in its gear both laterally and longitudinally, so that it will change its position as required by wearing the shaft bearings

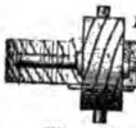


Fig. 92
Worm Gears

It is an excellent substitute for the hobbed worm and gear, and in most cases will serve practical purposes quite as well.

## CRYSTALLISED ORNAMENTS.

A BEAUTIFUL ornament, which is very easily made, consists of a wooden cross covered with Canton flannel, with the nap side out, and crystallised by immersion in a solution of alum. The nap retains the crystals so that they are not readily loosened or detached. The flannel should be attached to the wood by means of brass wire nails, and the cross should be suspended in a solution formed by dissolving 1lb. of alum in a gallon of warm water. The cross should be suspended in the solution while it is still warm and allowed to remain in until the solution cools, when it will be found covered with bright crystals.

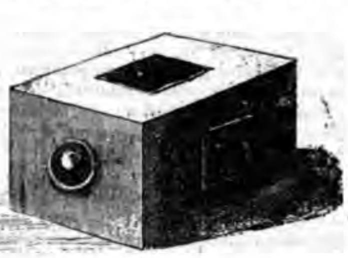


Fig. 1.—Grotto.

Fig. 1 is a perspective view, and Fig. 2 a longitudinal section of a grotto formed by crystallising alum in a box containing jagged points covered with Canton flannel, or wrapped about in various directions with coarse thread or twine. The box may be of wood or metal. It should have apertures in the top, ends, and sides. These apertures are stopped with corks while the box is filled with the solution. After the crystallisation the corks are removed, and the holes in the top, sides, and one end are covered with coloured glass, and over the front aperture is secured a convex spectacle lens, having a focus about equal to the length of the box. When the interior of the box is illuminated by a strong light passing through the coloured windows, the effect is fine.

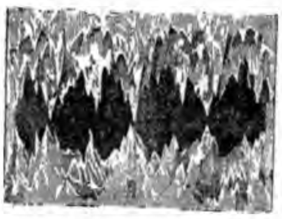


Fig. 2.—Interior of Grotto.

The solution used in this case is the same as that given for the cross. After the crystals are formed and the liquid is poured from the box, the interior should be allowed to dry thoroughly before closing the apertures.—*Scientific American.*

## USEFUL AND SCIENTIFIC NOTES.

**Painting.**—It is found that in painting wood one coat takes 20lb. of lead and 4gal. of oil per 100sq.yds.; the second coat, 40lb. lead and 4gal. oil, and the third the same as the second, say 100lb. of lead and 16gal. of oil per 100sq.yds. for the three coats. The number of square yards covered by one gallon of priming colour is found to be 50; of white zinc, 50; of white lead paint, 44; of lead colour, 50; of black paint, 50; of stone colour, 44; of yellow paint, 44; of blue colour, 45; of green paint, 45.

**Red Glass.**—In red glass coloured with copper, Messrs. C. Guignet and L. Magne say, in the *Monitor Céramique*, the colour is due to the presence of cuprous oxide, in opposition to the views of Ebell, who ascribes it to finely divided metallic copper. They found their contention on the fact that basic cupric chloride heated between two glass plates gives a red colour, holding that the soda in the glass reacts with the basic cupric chloride, giving cuprous oxide and sodium chloride. Even admitting that cuprous oxide may at a high temperature decompose, and the metallic copper dissolve in the glass with the formation of a red colour, yet this experiment must deal with a distinct phenomenon, inasmuch as it is completed at the softening point of the glass, provided air be excluded. The *Journal* of the Society of Chemical Industry says:—"By fusing together 100 parts of sodium carbonate, 50 of calcium carbonate, 260 of sand, and 10 of cupric oxide, a green-blue glass is obtained; the same mixture with 15 parts of forge scale substituted for the cupric oxide gives a yellow glass; if, now, these be fused together, they react upon each other, and yield a dark green glass streaked with purple-red veins."

**Steam Whalers.**—It is now a well-known fact that steamers have taken the place of sailing vessels in hunting whales, and that a cannon harpoon is used instead of the hand harpoon of former years. Hunting of whales by means of steamers is most actively pursued on the Norwegian coast, and the principal station for hunters is Hammerfest. Steamers of medium size and strongly built go out to sea from that station, and remain for days in search of whales. The moment a whale is sighted, everything on board is made ready for the attack. The cannon in use, from which the harpoon is shot into the whale, and which was constructed by Capt. Sven Foyn, is placed on the bow of the steamer over the forecastle. The harpoon consists of a long shaft, a ring to which is attached the towing line, and a sharp point. In this point is a grenade filled with powder, which explodes in the body of the whale by means of the striking together of the two barbs of the harpoon. The death of the whale is thereby quickened and rendered more certain. The line, which is made from the best quality of hemp, is fastened to the ring on the harpoon, and a sufficient quantity is coiled for shot range. The line lies on a platform directly under the cannon, and, by means of a guide-pulley, it is let out to follow the whale when he dives, for h seldom dies immediately. In his rage from pain h rushes in all directions, dragging the steamer after him in his dying agony. This is the dangerous time for vessel and crew. The engines are reversed and stoppers are placed on the sides of the steamer under the water, so as to offer more resistance to the whale's strength. The crew then wait until the whale is tired and dies. By means of a steam windlass the body of the whale is drawn to the surface, and attached by hawsers to the steamer's side, and thus towed into port.—*Illustrirte Zeitung.*

# SCIENTIFIC NEWS.

THE ephemeris for Denning's comet, published by Dr. Berberich, reads, on September 2, Berlin midnight, R.A. 15h. 38m. 45s., N. Dec. 23° 44·9′, the brightness being a little more than twice that at time of discovery. It will then be about at its greatest brightness, but it is moving so rapidly that it will pass into the Southern Hemisphere towards the end of September, moving towards Scorpio. The perihelion passage is, according to calculation, on Sept. 24.

Coggia's comet is of little interest except to possessors of powerful instruments, for on Sept. 2 its position for Berlin midnight is R.A. 11h. 55m. 41s., N. Dec. 8° 52·3′, the brightness being less than a fifth of what it was at the time of first observation.

The "Father Perry Memorial" has taken a decided shape, and, as hinted, it will be a fine telescope for Stonyhurst College Observatory. Mr. A. C. Thomas, of 30, North John-street, Liverpool, is the hon. sec. and treasurer (*pro tem.*), and an influential committee has been formed which includes some of the most distinguished astronomers. It has been decided that the best mode of perpetuating his name would be to aid the carrying on of the astronomical work in the observatory in which he so long laboured. It is well known that had any testimonial been offered to Father Perry during his lifetime, he would have devoted it to this purpose. To use his own words in a lecture at the Royal Institution, in May, 1889, shortly before his death: "For the last ten years I have been anxiously endeavouring to make Stonyhurst as efficient an observatory as the means at my disposal would admit." Astronomical work at Stonyhurst has long been hampered by the insufficiency of light supplied by the present 8in. object-glass for the equatorial telescope. It is proposed, therefore, either to erect a new telescope (which is much needed) with a 15in. object-glass, or to furnish the present equatorial stand with a 15in. objective. It would require £2,700 for the complete telescope and house, whilst £700 would suffice for the objective alone. It is hoped, however, to raise the more magnificent monument to his memory. Whichever be adopted, the telescope and the house in which it stands will bear the name of the "Father Perry Memorial," and the work done with it will be published under his name.

The staff at the Observatory on the top of Ben Nevis have adopted a young "blue hare," or mountain hare, that was picked up the other day near the loch on the side of Ben Nevis. It is already getting quite tame, and its only disadvantage as an indoor pet is that in the evening, when it is at its liveliest, it is apt to get in the way a little in the lamplight. The observers had a snow bunting as an outdoor pet last winter, which came to the window daily to be fed.

The meeting of the French Association for the Advancement of Science has been held at Limoges, and Prof. Cornu's address, which dealt mainly with improvements in physical instruments, was received with much satisfaction, especially his remarks in reference to spectrum analysis.

The Thursday excursion of the British Association (Sept. 11) is to Malham in Craven, where an escarpment can be seen along what is known as the South Craven Fault. The scenery is very picturesque, and includes Yoredale; but what is of more interest to the scientist, every branch of natural history can be studied. This advantage arises chiefly from the diversified character of the geological formations, which include Silurian rocks, mountain limestone, Yoredale shales, and millstone grits. It is hoped that as this will be an essentially working excursion, any field naturalists and geologists who may take part in the Leeds meeting of the British Association will attend the Malham excursion.

The American Meetings of the Iron and Steel Institute have been finally arranged, and about 300 members and a large number of their friends will leave this country for New York next month. The first contingent will start from Southampton in the Hamburg-American Packet Company's *Normannia* on the 12th of September, and later the *Servia* will take a considerable number. The week commencing on the 29th of September will be devoted to the reading of papers and discussions by members of the American Institute of Mining Engineers and the English Iron and Steel Institute; and again, on the 9th of October and two following days, these two bodies promote an international meeting at Pittsburg. Afterwards excursions will take place to the iron ore and copper regions of Lake Superior, and to the new iron-making district of Alabama. Altogether the American reception committee will provide sleeping and luncheon cars to take their visitors over 3,000 miles of the United States.

A French engineer, M. Decœur, proposes to supply electric power to Paris. He would generate the required electricity by utilising the tides. For this purpose he intends to construct, near Havre, two large basins joined to each other, into one of which the sea at flood-tide flows over a dam, while during ebb it flows out of the other into the sea again. At the inlet and outlet will be erected a number of powerful turbines for transmitting the energy of the water. The mechanical energy produced for transmission to Paris is estimated by M. Decœur at 42,000 horse-power. Perhaps the calculations have not been correctly made, as it costs something to build such works, and the result cannot be much.

The session of the Institute of Marine Engineers commences on Friday, Sept. 5th, at the Langthorne Rooms, Stratford. On Tuesday, September 16th, Mr. J. R. Ruthven is to read a paper on "Water Jet Propulsion."

The programme of the City and Guilds Technological Examinations has been issued, together with a circular explaining such alterations as have been made. The programme, &c., can be obtained at the offices, Gresham College, E.C., or at the Finsbury Technical College, Leonard-street, E.C.

The town council of Rochdale propose to make grants, under the powers conferred upon them by the Technical Instruction Act, 1889, to certain institutions in Rochdale for the promotion of technical instructien. At one of these institutions instruction is given in the following subjects, which are not included in the branches of science and art with respect to which grants are at present made by the Department of Science and Art, but for which sanction has been given, viz.: (1) Cotton spinning; (2) cotton weaving; (3) cloth weaving; (4) plumber's work.

According to Mr. C. W. Eves, chairman of the Jamaica Industrial and Manufacturing Exhibition to be held next year, there are a large number of fibrous plants to be found in Jamaica, comprising the aloe, pineapple, banana, and plaintain and nettle families. The ramie or rhea might be largely utilised. The committee wish to obtain an exhibit of some machines for fibre extracting to be shown at the Jamaica Exhibition in January next. Small and inexpensive machines would be most desired. The Jamaica Institute has offered £50, which the Government have supplemented by £150, making £200, as a prize for the best set of machines adapted to different fibres, provided that not less than three manufacturers compete. The subject is a very important one for the island, and it is hoped that the necessary number of exhibits will be obtained.

MM. Pappel and Richmond, of the Khedivial Laboratory, Cairo, say that the milk of the Egyptian buffalo or gamoose (*Bos bubalus*) presents several characteristics distinguishing it from that of the cow, which should be remembered in treating patients, especially infants, in Egypt or in other countries where this animal is common. The amount of fat was found to be a good deal larger than in cow's milk, the percentage in the specimens examined varying from 5·15 to 7·35. The sugar, which appeared to be a hitherto undescribed variety differing from milk-sugar, was also found to be of larger amount than that in cow's milk, the average percentage being 5·41. The fat, too, was found to differ from that of cow's milk, containing minute quantities of sulphur and phosphorus, and yielding four times as much caproic acid as butyric acid, whereas in cow's milk the quantity of caproic acid is only double that of butyric acid. The milk was also found to contain a small quantity of citric acid.

Sir Walter Buller has taken on himself the whole blame of the introduction of the sparrow into New Zealand. He told the Philosophical Society at Wellington the other day that in the year 1865 he had offered £100 for a hundred sparrows landed in the colony, and paid the money. He added that he took credit to himself for his conduct, being convinced that the sparrow is a much greater friend to the farmers than people are disposed to admit.

Prof. Renk, director of the Hygienic Institute in the University of Halle, had his attention drawn recently by his wife to the fact that milk, especially in Halle, always leaves a dirty sediment. Subsequently he examined the milk sold in Berlin, Munich, Leipsic, and Halle, and found that the Berlin milk is the cleanest, Leipsic is second, Munich third, and Halle fourth on the list. One litre of Halle milk contains on an average one gramme of dirt. It is not news that there is "dirt" in milk.

# LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

*All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

*All Cheques and Post-office Orders to be made payable to* J. Passmore Edwards.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

**"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."**
***—Montaigne's Essays.***

### THE PERSEID RADIANT.

[31498.]—I should have taken no notice of Mr. W. H. S. Monck's letter (31473), but fear that some misapprehension may exist if his remarks are not contradicted. It is very singular that though your correspondent has never, so far as I have heard, observed a meteor shower in his life, he yet assumes to criticise my deductions with all the airs of a man fully conscious of authority.

My purpose in writing this letter is simply to say that I regard the shifting radiant of the Perseids as fully and absolutely proved. Year after year I have observed it, and the character of the evidence is such that it admits of no question whatever. I have already published information as to the direction and rate of the displacement, with other particulars, and it is quite unnecessary for me to bring forward a lot of details here in support of my discovery. Mr. Monck appears to be curiously ignorant of the corroboration it received from some very accurate observation by Mr. D. Booth at Leeds in 1888 (see *Observatory*, Oct. 1888).

I would earnestly recommend your correspondent to gain a practical acquaintance with this subject from the open book of Nature, for at present he is simply groping in the dark. He will, by turning and twisting my figures and sorting my radiants in a way that is not permissible, derive some very anomalous results from my catalogue, and may lead others, as well as himself, astray. But I am fully consoled by the reflection that your correspondent cannot, try how he will, obliterate the shifting radiant of the Pereids from the sky. In time I feel certain my views will be confirmed. I sincerely regret, however, that Mr. Monck's misinterpretation as regards the Perseids will rather serve to obstruct the progress of our knowledge in this branch, and that his efforts, though professing to eliminate difficulties, will only increase them.

Bristol, Aug. 22. **W. F. Denning.**

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[31499.]—Mr. Monck's theory in respect to the shifting of the radiant of the August meteo appears to me to vary little from the observed facts. If the displacement of the radiant as observed rightly is but an "apparent shifting arising from the simultaneous action of different radiants whic attain their maximum in succession," as suggeste by Mr. Monck, the facts will remain the same; th is, from a combination of radiants which are active simultaneously, and which attain their maximu in succession, the probability is that there will be shifting of the radiant of the meteors as record rightly. That the radiant does shift is a fact th cannot be overlooked, if observations are to be reli upon. No doubt Mr. Denning could select from observed paths of meteors three or four short o that were close to the radiant for each date which the shifting was noticed. If so, and he wo kindly give a map or chart, with these short p only on it, the shifting would be obvious to every For my own part, I am persuaded of the displ ment of the Perseids from the results that I obtained in the year 1888, which were as follows:—

| Date 1888. | R.A. | Decl. | No. of Meteors. |
|---|---|---|---|
| August 8th | 42° | + 57½° | 25 |
| ,, 13th | 51½° | + 56° | 15 |
| ,, 14th | 55° | + 59½° | 5 |
| ,, 15th | 58½° | + 59½° | 6 |

This year the weather proved unfavourable, and though I was on the alert until dawn every day from the 5th inst. until after the 13th inst., I only got two fairly good nights, and these were not free from clouds. From these nights I secured two fairly good radiants:—

| Date 1890. | R.A. | Decl. | No. of Meteors. |
|---|---|---|---|
| August 5th | 37½° | + 54° | 5 |
| ,, 13th | 47° | + 55° | 8 |

It is noteworthy that on August 13th, 1887, I got a radiant at 47° + 53° from six meteors, which agrees very well with the radiant obtained in 1888 and 1890 for the same day of the month.

The brightest meteor recorded during the watch for the Perseids was on the 5th inst. at 11h. 10m., and I estimated its brightness as twice that of Venus when at her greatest brilliancy. It left a streak visible for about three minutes to the naked eye, and over five minutes as seen with field-glass. It was flaky, and assumed a serpentine form before becoming invisible to the naked eye.

If other observers saw this meteor, its path, as seen by them amongst the stars, will be valuable for determining its radiant more accurately. I classified it with the Perseids of this date (August 5th).

Leeds, Aug. 25th. **David Booth.**

### STATIONARY RADIANTS OF METEORS.

[31500.]—Mr. Denning's discovery of stationary radiants for meteors, and his discovery of shifting radiants, are both partly matter of fact and partly matter of inference. It is a matter of fact that he observed meteors coming from certain radiants on certain nights. It is a matter of inference that these meteors belonged to the same shower. In the case of the stationary radiants I regard this inference as conclusive, and I think every unprejudiced person who carefully studies Mr. Denning's recent Catalogue in the *Monthly Notices* will come to the same conclusion. As regards shifting radiants, my verdict at present is *Not Proven*, because I think the actual observations may be otherwise accounted for. In both cases I have no doubt that the observations are substantially correct. In fact, most of them have been repeated by other observers.

I transcribed Mr. Denning's Catalogue in order of Right Ascension, and the conclusion was immediately forced on me, not merely that stationary radiants existed, but that they were the ordinary rule. Indeed, the rule appeared to be so general as to suggest the question whether there were any exceptions. The two principal exceptions appeared to be—1. Shifting radiants. 2. Cometary radiants which were supposed to be only active when the comet was near the node. I mentioned some of my reasons for doubting the existence of shifting radiants in my last letter. I now give my reasons for doubting whether the (so-called) cometary showers really owe their existence—I do not say their intensity—to the comets in question. These reasons are in each case the same—viz., that the supposed cometary radiant is in fact a stationary radiant, which is active long before or long after the comet reaches the node.

Commencing with the Perseid radiants, Mr. Denning obtained meteors from a radiant at 40° + 56° on the 14th and 25th of June. On the 27th and 31st of July he obtained others from a radiant at 43° + 58°, and though he does not appear to have met with other meteors from this radiant until the 7th of August, Mr. Corder's observations cover a part of the interval. After the maximum period, August 9-11, Mr. Denning again obtained meteors from 40° + 59° on the 20th and 21st of August, and others (not in his last catalogue) from substantially the same radiant in the end of August and beginning of September. About the latter date they were also observed by Col. Tupman. Mr. Denning again saw them October 6, 14, and November 29 to December 10, so that the shower apparently continues from June to December.

A similar remark applies to the Andromedes of November. Mr. Denning's Catalogue contains radiants at approximately the same spot determined in August, September, and October. The Leonids and Lyrids are not identified with stationary radiants in Mr. Denning's Catalogue, but other observers supply the deficiency. Zezioli observed meteors from the Leonid radiant in February and April. Lyrids in May and June are catalogued by other observers, and Prof. A. S. Herschel traced fireballs to this radiant at other times of the year.

It is not the great multiplicity of radiants that give rise to these phenomena. I doubt if more than 250 really distinct radiants are known to exist, and though the great majority are in the northern hemisphere, they are not very thickly studded over it. There are many cases in Mr. Denning's Catalogue in which we pass over several degrees of R.A. without meeting a single radiant.

Dublin, August 23. **W. H. S. Monck.**

### METEORS.

[31501.]—"Heliostat's" letter (31474) recalls to my mind that I did see a remarkably fine meteor on the night of Sunday (August 10) about the time he states (9.20 p.m.). I was walking at Gorleston, Norfolk, but it appeared to start from a point about one-third of the distance from Eta Ursæ Maj., and Arcturus, and to run about at right angles to a line joining these stars. So large a difference in position could hardly be due to parallax? Where did "Heliostat" observe it? **Director R.R.L.**

### ASTRONOMICAL: B648—SELENOGRAPHICAL: ARISTILLUS, MAGINUS, AND CAPELLA.

[31502.]—May I call the attention of those who are interested in the question of reflectors and refractors to an interesting double star now visible during our evenings?—it is B648. It can easily be found without an equatorial, as it is the largest star in finder north and a little preceding γ Lyræ. It was discovered as double in 1877-78 with the 18½in. refractor of Chicago, and on account of the distance and the difference of magnitudes of its components, Mr. Burnham calls it "difficult." The *comes* has moved a good deal since the time of its discovery; but I shall not state now its present position in order not to influence the eyes of those who may feel inclined to try their instruments on it. With my 10¼in. mirror, by With, I can see it so very plainly that I am inclined to believe its distance has increased. On reducing gradually the aperture down to 6in., my smallest diaphragm, I can see it steadily. Perhaps "Darkness" will see by this that mirrors, when made by good makers, are not so bad after all. Will Mr. Tarrant kindly measure this double to see whether my suspicion of the increase of the distance of the *comes* is correct?"

In No. 1289, p. 301, of the "E. M.," Mr. C. P. Grey gave a chart of Aristillus. It is a pity that English selenographers have not given to it (if I judge by results) that attention it so truly deserves. I have had a few opportunities of observing this formation, but never in good atmospheric conditions. The result, so far, is so much like the representation of its floor by Schmidt, that to send it to the "E. M." would seem to be a mere copy of Schmidt's. I have not seen any depression on the top of any of the seven central peaks when they were casting a short shadow. The crater-like appearance of the central hills in full may be caused by reflection. No pass cut down to the floor was seen on the N.W. K and *h* were seen as excavations at the foot of a ridge, and partly in the shadow, *i* seen as a hillock, and *d* on the S. as a crater, with a hillock on the W. of it. I saw no trace of the clefts *a* and B. The small crater on the top of N.W. wall is very distinct on my sketch, but is absent on the chart.

A good sketch of the central mountains of Maginus, with the finest details around them, would be very useful. The large crater among these mountains given in all the maps seems to have no real existence.

On May 25, 1890, a small crater was seen for the first time on the top of the central mountain of Capella.

August 23. **C. M. Gaudibert.**

### RED SPOT ON JUPITER.

[31503.]—It will interest some of your readers to know that there is a red spot about twice as large as a shadow transit, with a faint reddish prolongation at each end, just north of the north equatorial belt of Jupiter, in a latitude corresponding with that of the great red spot in the other hemisphere. The spot is spindle-shaped, with the long axis parallel with the belts, and is of a uniform deep red colour, with well-defined edges, with the narrow faint streak at each extremity, apparently not connected anywhere with the north belt; but of that I am not quite certain at the preceding end of the streak. The spot was central about 10 p.m. on the 23rd inst., and follows the great red spot by about two-and-a-half hours, or a quarter of a rotation.

The north-equatorial belt has a marked coppery hue this season, and is in strong contrast to the greyish south belt, which three or four years ago was much the redder and stronger. I think this change in tint of the northern belt betokens increased activity in that hemisphere, and it is not impossible that this spot may be the commencement of another "great red spot." The instrument used was a 10in. Calver; power, 160.

**David Smart.**

Grange-road, S.E., Aug. 25.

### NEBULAR HYPOTHESIS.

[31504.]—Mr. Penny, usually so accurate, has, I think, not examined the Nebular Hypothesis from a correct standpoint.

In the first place, the contraction spoken of (letter 31462) is simply due to the cooling, or rather the residual cooling, due to difference between quantity of heat radiated from surface and that produced by contraction (the forces involved being molecular). The velocity of rotation of nebula is supposed to increase owing to this contraction, but to diminish owing to viscosity, which "dissipates" the energy of rotation in the form of heat.

Upon the whole, the rotation velocity increases until the rate of contraction diminishes so far, and the viscosity increases so much, that the rotation velocity (angular) ceases to increase, then diminishes, as is probably the case with the sun at present.

The history of the system divides, then, into two portions: during the first portion alone are planets evolved. The contraction at that period would probably be very much in the direction of polar axis, and the nebula might be disc-like in form.

If we consider the birth of Jupiter as (in the first instance probably) a ring of fragments which afterwards coalesced after innumerable collisions, falling in somewhat towards the sun (as will doubtless be the case with the Saturnian rings) we should look at the question by inverting Mr. Penny's method, as follows:—Find the limiting velocity of rotation which the nebula possessed at the time the Jupiter-embryo was produced, in order that the centrifugal force at that time might be greater than the attraction.

Mr. Penny would say that such a rotation velocity could not have existed, in view of the present rotation velocity of the sun; but Mr. Penny here omits to take account of the enormous diminution of velocity due to the viscosity of the nebula. In order to show that such an evolution of planets was not possible, it must be shown that the viscosity was not sufficient to produce the necessary diminution of velocity. Mr. G. Darwin has shown that tidal action of the sun may play an important part in the evolution of satellites, as also the approximate coincidence of tidal period with the proper period of the body.

This presents phenomena analogous to those of resonance and to those connected with the solution of the equation $\frac{d^2 v}{d f^2} \times c^2 v \times M \, sin. \, m\vartheta = o$, when $c$ is equal to $m$.

There have been of late a great many discussions anent the ether in the "E. M.," giving rise to Mr. Searle's interesting and excellent letters. It seems to me that it has been shown that the existence of a medium possessing certain properties will colligate certain observed facts; consequently the hypothesis of the medium must be considered as a good working hypothesis. No more can scarcely be said for the hypothesis of universal gravitation. New facts may indeed compel us to modify our hypotheses. I may here observe that some of your correspondents seem to have very strange ideas as to the function of the higher mathematics, which in physical inquiries is simply to demonstrate that a particular hypothesis will cover a certain group of facts.

Some mathematicians have considered the phenomena which would be experienced in four-dimensioned space, but merely as a mathematical exercise. If, however, certain phenomena should arise—which would, however, surprise me more than to wake up one morning and find the earth drowned by the fall of a water-comet, as in the time of Noah and family—then the "higher mathematics" might show that the hypothesis that we were living in four-dimensioned space was one not to be sneezed at.

If I put before a junior mathematician a problem in the lower mathematics, such as: If the Koh-i-nur cost twopence, how much will a diamond cost twice that size? Then the solution of that problem would not be considered as demonstrating that the Koh-i-nur could be bought for twopence. So the exercises in the "higher mathematics" in relation to four-dimensioned space are not considered as showing that such space is existing or ever will exist, even by persons reduced to the verge of idiotcy, by their knowledge of the "higher mathematics" in accordance with the dictum of our profound instructor, Mr. Audsley, who certainly has not weakened his intellect by knowing too much mathematics. **W. C. E.**

### ABSENCE OF "POLAR CAPS" ON THE MOON.

[31505.]—Probably, one of the first things to strike a new observer—accustomed to our earth and Mars only—would be the absence of distinct polar caps on our moon. We are all so used to the appearance of the full moon, from childhood up, that we fail to realise the case till pointed out. Properly speaking, "polar caps" are essentially an extraneous feature on any globe, and not always inherently a necessity in every one.

For instance, we have no reason to suppose that our sun—when it cools down—will exhibit the phenomena, for radiation is independent of latitude, and there would be no incident heat, as in our case and Mars, to retard the cooling and refrigeration at or near the solar equator. From what we can see, it is possible that our Earth and Mars are the only two planets in our Solar system which now have polar caps of snow and ice.

It is more than likely that Venus, being so much nearer to the sun than we are, and having a denser atmosphere, has none; and equally likely that our moon, so much smaller than our globe, and having no atmosphere (apparently), has passed through the polar-cap stage, and reached the one beyond, when (secular temperature having fallen very low) the equatorial belt of solar influence has become less and less, till the caps closed at the equator. The absence of distinct polar caps on our moon cannot be denied. We look in vain for any marked contrast between the polar and equatorial surfacing, in colour, texture, or character of the formation. To all appearance they are practically identical, and we are forced to the conclusion that whatever agencies surfaced the lunar poles, later on also surfaced the equatorial regions.

If the lunar axis were so greatly inclined that the sun's rays fell on the poles, the presence of distinct caps would not be so obviously demanded; but being only some 5° 9′, the incidence of solar heat would, as Neison points out in his "Moon," page 37, be practically *nil*. Hence if the globe ever had an atmosphere and water—which is more than likely—some form of glaciation on the poles seems a necessity as the globe cooled down. As secular temperature fell, these "polar caps" should, if anything, have slowly extended, and their total absence is anomalous, unless we assume that they have closed around the equator, and thus rendered distinction between polar and equatorial surfacing impossible. If this view is correct, it would at once explain, not only the general absence of colour on the moon, but the reason why "caps" are not now seen, and why the surface structure is practically identical all over the globe. Occasionally there seems to be some doubt as to the cause of the exact location and form of polar ice caps.

Webb, in his "Celestial Objects," page 147, tells us that Herschel found that the caps of "Mars" were not exactly opposite each other, and says himself that "one would expect that they might have been diametrically opposite." "Mädler and Secchi found the north zone (or cap) of Mars, concentric with the axis, but the south considerably eccentric," and "it has been suggested by Beer and Mädler that the poles of cold may not coincide with the poles of rotation." Later on, at page 148, Webb says that "Secchi found the appearance at the poles irreconcilable with the idea of circular caps, and was forced to adopt the supposition of complicated and lobate forms; Schiaparelli alludes to the possibility of a mass of floating ice."

Apparently it was taken for granted that the snow caps of Mars should not only be truly circular in form, but placed truly over the axis of rotation, like the cloud caps of Jupiter and Saturn.

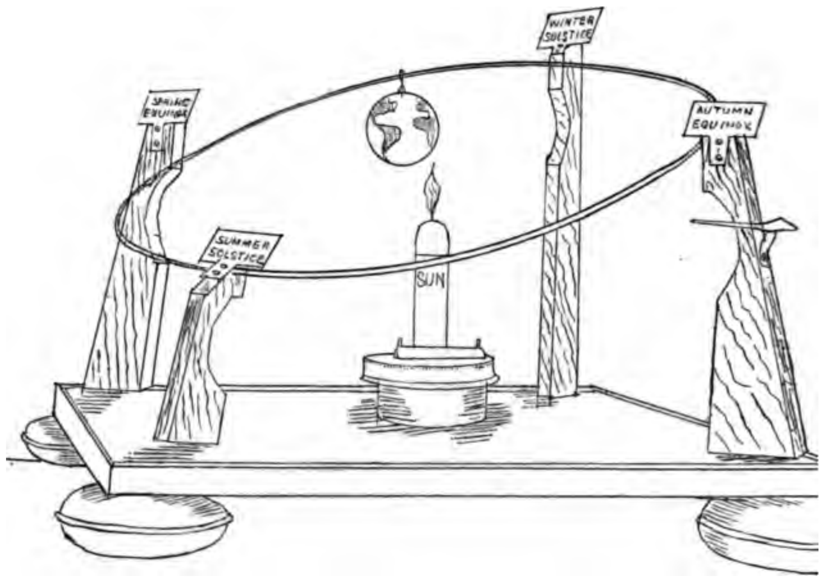
It seems to me that Dr. Nansen's late journey across Greenland goes a long way to prove that *it* is our north polar cap.

On our south pole we have one—placed centrally over the axis of rotation, and it certainly does not float about—having two large volcanoes on it, Mts. Erebus and Terror, and it corresponds exactly to the north polar cap of Mars. But on our north pole, as far as we can see, there is no large permanent ice cap, but in its place an irregular polar basin. The character of the Arctic and Antarctic ice bears this view out. In the south we see the immense flat-topped bergs of 2,000ft. thickness and several miles long, which are evidently portions of the southern ice cap broken adrift. In the north we see a preponderance of floe, or field ice, a few flat-topped bergs near Franz Joseph Land (Young), and the angular bergs of the Atlantic, mainly from Western Greenland (Greely).

Apparently our Arctic basin has no continent or islands in it, whereby a permanent ice cap could become anchored as the southern cap is, and thus the floe of each season—about 7ft. thick (Greely)—is perpetually broken up by tides and storms, and removed by the polar currents. The presence of a large island, or islands, even if somewhat eccentrically placed, like Greenland, seems to be essential for the developement of an "ice cap." The necessity also for a symmetrical figure is not apparent, or that the cap should be necessarily at the pole, or position of "greatest cold." The above would indicate the solution for the anomalous position of the south polar cap on Mars, and the lobate forms seen by Secchi in 1858.

The site of the south pole on Mars is probably, like our north pole, a sea basin, and the cap has formed naturally, as in our Greenland, on the nearest adjoining land. We may dismiss the idea of a "floating" cap as untenable, and also M. Fizeau's solutions of canals, as lanes of water in a "pack," inasmuch as such canals would necessarily alter their forms and positions daily.

As before stated, "polar caps" are an extraneous, and not a necessary, feature in all cases. It is a moot point whether they would ever be formed on a planet so far removed from the solar influence as Neptune. In the case of planets nearer the sun, on the other hand, "polar caps," divided by an equatorial belt of solar influence, would in certain stages of cooling appear to be inevitable.



Whether our moon has been surfaced by volcanic rocks alone, or by sedimentary rocks also (as in our case), it is equally difficult to see how the globe can have passed from a heated stage (with atmosphere) to its present airless condition, without having had polar caps at one time or other.

The "caps" (aided by the radiation from the dark side) would be the "refrigerators," against the influence of which solar heat would have to contend for mastery.

The position assumed here, is, that the lunar surfacing affords us fairly good proof that refrigeration has gained the day, and that the globe is encased in ice and snow from pole to pole.

**S. E. Peal.**

Sibsagar, Asam, India, July 15.

## JOSHUA'S COMMAND.

[31506.]—REFERRING to "E. L. G.'s" letter (31497), many of us would greatly rejoice if the stumbling-block of Joshua x. 12, 13, could be so easily removed as he asserts; but a reference to the Hebrew text at once dispels the illusion. In the first place, the prepositions prefixed to the nouns "Gibeon" and "valley" in Joshua's command have a dative, and not a genitive, force. Again, although there may be doubt as to the exact meaning of the verb in the same clause when separated from the context, yet when that verb is repeated in the next sentence in describing what happened to the sun, and is taken in connection with the verb which states the result of the command upon the moon, there is room for very little doubt as to the meaning of the whole passage. There is no ambiguity about this last verb; it comes from a root meaning to stand, set firmly, sustain. So that whatever happened to the sun, whether it "stood still" or "was silenced," the text is clear and definite in saying that "the moon stood," or "was stayed." There is no foundation for Bryant's "permanently silenced."

Will "E. L. G.," who is so satisfied with Bryant's explanation, kindly show by analysis how the signification he gives can be evolved from the text? Also, as "E. L. G." says that the passage is well known to be mistranslated in all modern versions, will he refer us to any ancient version which supports his view? The oldest that I am acquainted with—the Septuagint—is distinctly opposed to him.

**Tyler.**

## A MODEL TO ILLUSTRATE THE ALTERNATION OF THE SEASONS.

[31507.]—THE accompanying sketch is from a photograph of a model which I have constructed to illustrate the variation of the seasons caused by the revolution of the earth around the sun. It also shows the duration of day and night at any time of the year at any spot on the earth's surface.

As it can be made by anyone with very little trouble, or expense, and a model being more easily understood than a diagram, I venture to hope that the design may be of some use to mamy of the readers of the "E.M."

The principle of construction is as follows:—A spirit or oil-lamp at the centre of the baseboard to represent the sun. A circle of iron or brass wire about 14in. diameter fixed on four wooden supports at an angle of 23½° to the horizontal, so as to bring the centre of it about 3in. above the flame of the lamp—the earth's orbit. A wooden globe about 2in. diameter, with the lines of latitude and longitude, and mapped out as the Earth. a hole bored through its centre from pol and through it is inserted a small about which the ball may be rotated. end of the spindle is attached by a loose to a bent wire hook, which slides along circle. The hook and its connections sh just sufficient length, so that when the m is at the spring and autumn equinoxes ( on the sketch), the centres of the ball an the lamp should be exactly level.

With these few words, I think the explain itself; but I may add that the light and shade on the earth in the drawi from the candle, but are due to the p being taken outdoors. **Walter H**

## THE NEW ASTRONOMICAL S

[31508.]—I HAVE read with great in numerous letters in the "E. M." upon th I notice, however, that most of the writer London as the headquarters of the ne Why so? This, if carried out, would exclude the bulk of country members fr ing the meetings, where they would not the papers read and discussions thereon, have the pleasure and advantage of m other members. To these members th would constitute *their* new society. W the place of meeting more central?—say M where North-country members could meetings, but who would be debarred b cost from travelling some 250 or 300 mi centralise everything in London?

**An Old Member of**

[31509.]—As Mr. Maunder, to whose formation of the new astronomical society owing, is at present on a vacation trip, say that the programme issued is not, o complete one. It does not define, for in future officers of the society or the mode Questions of this kind may, I think, very for the first general meeting, and befor the provisional committee will no dou some recommendations to lay before it.

It was thought desirable to issue a list visional committee at once, and conseq names of several gentlemen who were join had to be omitted, because no answe received from them. Among these were M Sadler, to whom one of your corresponde also Sir Howard Grubb, who has since his willingness to join the committee. of Mr. Davies in your last number, I th that he is not hostile to the project. society, however, will seek to keep c quarrels as to the L.A.S.

Aug. 23. **W. H. S.**

## BRITISH ASTRONOMICAL SO

[31510.]—As one of your many corre *re* B.A.S., seems to object to the small fee to be paid by all subscribers, voted for an initiation fee of 10s., pe will permit me briefly to state my r doing so.

1. The council will require more mone the extra expenses of starting the s advertising, circulars, forms, and printi possibly some few office expenses, sta incidentals for secretarial use, which w required when the society is fairly sta which expenses should not be charge

funds to be raised by subscription, such
resources being fully required for secretary's
itor's honorarium, &c. The provisional
tee are quite alive to the danger of having a
*ll* financial margin—a rock on which the
has been well-nigh wrecked—a danger that
nted out some two years since by thoughtful
and which the council has partially recti-
raising the subscription 50 per cent.
ie B.A.S. will take rank with other minor
c societies, such as the Geologists' Associa-
id I believe I am correct in saying they
all charge an entrance fee. The society
l to charges 10s. entrance fee and 10s. sub-
n. We think the experience of such suc-
scientific societies is a pretty safe guide to
the proceedings of the B. A. S.
e venture to think that all *real* and earnest
s of astronomy, however humble their
in life, will not begrudge the little sacrifice
ntrance fee for all the advantages that must
by association with fellow students, and by
with the sectional arrangements of the

es and subscriptions to a scientific society *do*
keeping up the status of such association.
y recognise this fact without fully endorsing
it is desirable to make our new society as
ble as possible in the public eye, to at
ie level of kindred institutions. It is no
onour to be associated with many of the
io have already given in their adherence to
..S., and the credit should not be too cheap.
entrance fee of 5s. and a subscription of
l help to keep out some of those who would
thout serious intention to engage in astro-
work, and they mainly form the class
inpunctuality in paying subscriptions are a
of weakness rather than strength. Those
uld give 10s. as an entrance fee to a society
likely to belong to that class. I do not find
ith the long list of names in the L.A.S., but
e it largely to the superabounding energy of
cials of that once flourishing association.
ccess of the B.A.S. will depend on the
of real workers and ardent students, rather
iumerical flourish.
y apprehension the success of the B.A.S. is
by the position and ability of adherents in
l stage, and *not less* by the commercial
ss of its financial arrangements, or, as a
aïvely said, "They do not intend to give
ng for nothing." **W. R. Waugh.**

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## RPOOL ASTRONOMICAL SOCIETY.

l.]—At the last ordinary meeting of the
a committee, of which we the undersigned,
with a third (with whom we are at present
to communicate), were elected members,
thority to call in the assistance of a pro-
l accountant, to investigate certain charges
against the treasurer. If the society had
tive in withholding the report, such surely
ses to exist, since Mr. W. H. Davies himself
s to be wishful that an examination of the
accounts be made by distant members.
willing that such a course be adopted, and
t the separate results of the two committees
ted in the pages of the "E. M.," the *Journal*
.A.S., or other medium.

**Chas. A. Defieux.**
**George Higgs.**

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## E REFLECTING TELESCOPE.

.]—There were one or two slips in my
letter; but as they only partly obscured
ral meaning, I will not waste space cor-
hem.
specially glad to see Mr. Tarrant's reply,
luable measures, made with his reflector,
tly prove what can be done in this way by
nd perseverance.
ing to "Heliostat" (31479), I may say
a few of us observing in the suburbs of a
-sized town, and our conditions vary suffi-
o insure a pretty fair average opinion as to
ties of reflector-using. Only one of us com-
an observatory—a very perfect one; but
he feels windless, his advantage is more
unterbalanced by other difficulties. Our
clude wood, zinc, and iron, and the latter
seems to be the best all round, as wood
p a mirror too much on some nights, neces-
ventilation.
m total of our experience seems to be that
rfect night a really fine mirror will do
nything; but the rarity of such occasions
that life is too short to do much useful
h this form of telescope. If a speculum
how a faint companion near to a large star
night, would it not miss delicate points in
tiguity to brighter ones on the moon or
This matter deserves careful considera-
the mere cheapness of reflectors cannot
ate for unreliability.
spent a few hours with a clever friend who
great deal about telescopes and adjustments, and who uses a moderate-sized reflector. The night was still and promising; but his instrument simply transformed sober stars into objects that reminded one of the "corkscrews" seen on a "children's night" at the Crystal Palace! The mirror was said to be of marvellous definition, and I should not like to judge it on *one* night; but the owner said "It never did show stars well," and yet he is one who disputes with high authorities on delicate planetary detail!

Jupiter, Venus, and Mars are not well placed; but there are many reasons for keeping an eye on them even now. Will a reflector define them fairly? A refractor does. I have no interest in either instrument beyond that of an impecunious amateur who would like to go in for a bigger reflector if only he could feel sure they were not failing to fulfil their great promise. What sort of definition does that apostle of reflection, Mr. Common, get? Perhaps he would tell us? **Tenebris.**

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[31513.]—There are several reasons why the letter of "Tenebris" hardly needs a reply. First, the question was discussed not very long ago, and as to numbers, ended greatly in favour of the reflector. Secondly, it contains its own reply, and, I may say, its own refutation of much he says. Thirdly, his remarks would not have so much the appearance of bias if he had given us his real name. He has "no wish to open the question," yet requests "all who can to join in it."

"Tenebris" says we ought to get "one or two solid estimates of the capabilities of the reflector," as though there were no such instances! Yet goes on to instance a number of such desired cases where "splendid work is being done."

If "Tenebris" has been a reader of this paper he knows perfectly well that very many more instances of splendid work could be added to those he names.

If the object of "Tenebris" is to advise observers to avoid the reflector, his letter shows too much of either bias or want of knowledge about them to be reliable. For instance, he states, without giving any particulars, that his refractor gives "splendid definition when the reflector refuses to define *at all*" (italics are mine). This reads, like other parts of his letter, as coming from one with other motives than seeking the experience of others; it may be the success of the reflector disturbs him. Does "Tenebris" think the reason for the "numerous reflectors used" is owing to their failure or their success?

Some of the names he quotes against reflectors are really in its favour. He instances Mr. Lancaster, who said: "I cling to the refractor." Mr. Lancaster was completely answered in that debate, and showed a want of acquaintance with the reflector very common with the ordinary optician.

To me the remark, "I cling to the reflector," had a clear reason. Mr. Lancaster just previous to the debate (in which I took, I think, no part), wrote to me to go into arrangements for supplying him with my reflecting telescopes for sale. I should have been perfectly justified in stating this at the time; but I knew the reflector could take care of itself without it. Mr. Burnham's experience with reflectors was not such as to enable him to say much as to their merits, and his remarks about stops are certainly not correct, as all users of the reflector know perfectly well.

Why should not a small aperture of a reflector perform better on stars in bad air as well as a refractor?

As to doubles measured with a reflector—supposing that was the only work of a telescope—Mr. Sadler's work is one of the greatest testimonies to their capabilities. I suppose few men have seen so great a number of difficult doubles—and that with reflectors. *Seeing* difficult doubles and *measuring* them are different things—that is, different pursuits. Mr. Sadler did not take up the measuring.

It has been shown again and again that for general use the reflector has the advantage of the refractor, and that the refractor is best for *measuring* doubles, and that a moderate size is better than a large one, on account of our climate. The reflector is less suited for measuring doubles, more from a mechanical point than an optical; but for merely seeing doubles there is little to choose. As to seeing the stars, &c., in their true colours, the reflector is decidedly the best.

There is another important consideration I may point out to "Tenebris,"—that, not only the men he points out as doing "splendid work with reflectors" have been users of refractors, but nearly every other observer who could be named as using reflectors has also given up the former for the latter. So the supposition of "Tenebris" that they would have probably done more with a smaller refractor is singularly out of tune.

As to Mr. Davies, that gentleman thinks sufficiently well of reflectors to send his friends to me, which is another "solid estimate of their capabilities" "Tenebris" is anxious to obtain.

Such is the nature of our climate that "friends must pop in to see fireworks with big" refractors as well as big reflectors, and I fail to see, as he supposes, that perseverance can make any telescope act well on a bad night. **G. Calver.**

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[31514.]—The letter of "Tenebris" (31445) on the above subject will doubtless be read with great interest by very many of your subscribers, and they will look forward with not a little curiosity to the answers which may be forthcoming on behalf of the silvered-glass reflector.

Everyone will acknowledge that the severest test which can be applied to the defining power of a telescope, of whichever kind it may be, is its ability to deal with close double stars. The more unequal the components, and the closer they are, especially in the case of a rapid binary system, the more severe is the test. A telescope which can give a good account of itself in this department of observational astronomy will be acknowledged to be of first-rate excellence.

And it is here that the silvered glass reflector is often said to fail. "Tenebris" is evidently of this opinion, and challenges proof to the contrary. He quotes Mr. H. Sadler (in 1885), that, so far as he is aware, "there are no measures of double stars extant, made with a reflector of any aperture, which can be compared with the measures of Dawes, Dembowski, Engelmann, or Schiaparilli, made with the aid of refractors of from 6¼in. to 8½in. aperture."

Now, it was with a view specially to test this point—viz., whether the silvered-glass reflector is capable of competing with the best work of the refractor in this particular field—that in 1880 I purchased the telescope, observatory, and entire apparatus of the late Rev. Henry Cooper Key. The instrument was an equatoreally mounted 18¼in. silvered-glass reflector. There were two mirrors: one by the celebrated With, of Hereford, of superb excellence, and the other unfinished. The "flat" was by Browning, and left nothing to be desired. I gave the two mirrors to Mr. Calver, of Chelmsford, with instructions, if possible, to make the unfinished mirror superior to the one by With. When he returned them to me I subjected both to a severe course of testing upon close doubles, with the result that I found the "Calver" fully equal to the "With," to say the least. I thereupon sold the "With" and retained the "Calver," and with Mr. Calver's handiwork I have made all my measures of double stars. I believe that he furnished me with an 18¼in. mirror unsurpassed by any of its size in the world.

From 1882 to 1884 I published the measurements I made of double and binary stars in the *Observatory* and English Mechanic. Whether a really first-class silvered-glass reflector is capable of doing first-class work in this department may be gathered from the following extract, published in your journal on the 1st September, 1882, by Mr. S. W. Burnham, who is acknowledged to be the greatest living authority on double-star work. He says:—"I have read with great interest Mr. Perry's valuable letters relating to double stars. Whatever may be the performance of reflecting telescopes generally, there can be no doubt that he has a most excellent instrument, and one capable of doing, in his hands, the very best work in this field. The class of stars observed, and the excellence of the measures, furnish satisfactory evidence on this point. Mr. Perry, however, will agree it has rarely happened that a large reflector has been so severely tested in any tangible way. We have had plenty of descriptions of how planets, nebulæ, &c., have looked, which, however satisfactory to the observer, could be no evidence to anyone else. Fortunately with he micrometer, no description is needed, and the correctness of the observation can be verified at any time."

It would occupy a great deal too much of your valuable space to quote the measures upon which these remarks were founded, and those of your readers who possess the back numbers of the journals named can see them for themselves. I think, however, that I may claim Mr. Burnham's testimony as decisive in favour of what such a mirror as Mr. Calver has furnished me with is capable of doing in the most difficult and delicate department of observational astronomy. "Tenebris" raises an interesting point as to whether a reflector and refractor when placed side by side, and tested by the same observer upon the same objects, would perform equally well on all occasions. He says, "I am using a first-class speculum, and sometimes it gives me a treat by showing what it can do; but only about one starlight night in twenty seems to suit it at all. My refractor behaves splendidly when its catoptric rival, though well adjusted, steadily refuses to define at all, and friends of mine find similar difficulties." I must say I cannot understand why this should be so. The atmospheric conditions are alike for both. If a layer of heated air is trying to mix with a colder stratum above it, no telescope can define properly. The open tube of the reflector may be a disadvantage; but bad atmospheric conditions for one form of telescope are equally bad for the other, and the refractor is as powerless as the reflector to remedy them. And I cannot understand why, if the reflector gives "Tenebris" a "treat" on some occasions, it should not do so always when the exterior conditions are good, if, as he says, the adjustments are all right, and proper precautions are taken as to opening doors, windows, shutters, &c., a sufficiently long time before-hand. Piazzi Smyth found the definition on the top of the Peak of Teneriffe to be superb; when at Edinburgh stars appeared in the telescope as "an agitated mass of luminous hair;"—and he always used refractors. I think the difference is more in the atmospheric conditions than in the form of instrument, always premising that the instrument is the best of its kind, and that proper precautions to secure good performance be taken. But I have never used anything larger in the shape of a refractor than a splendid 2¼in. Dollond, and therefore I have never had the advantage of comparing the doings of a large refractor with those of my instrument under precisely similar conditions. But I remember showing a close double star to Prof. Piazzi Smyth on one occasion, and he told me I could not expect any instrument, refractor or reflector, to perform better. And I have ventured to express my opinion in your columns that were Mr. Calver's reflector placed side by side with the Chicago refractor (which is of the same aperture, and I believe by Alvan Clark), the performance of the two telescopes would not be found so very diverse.

**Jevon J. Muschamp Perry.**

St. Paul's Vicarage, Alnwick, Aug. 19.

[31515.]—In reply to the request of "Heliostat" (p. 554), for the experience of others with regard to reflectors, I may say that although I do not, as a rule, attempt the observation of close double stars or other difficult objects, I am, for general purposes, fully satisfied with my 6¼in. Calver reflector.

I have a small, lightly built Berthon Observatory sufficiently pervious to the air to render any exposure of the mirrors at night previous to use unnecessary. The mounting is equatorial, and the base composed of concrete, with a stone pillar 9in. in thickness.

It is liable to slight derangement as regards the declination circle, but can be easily adjusted by means of the screws at the foot of the supporting iron pillar.

There is only one particular in which it disappoints me, and that is in the observation of sunspots by projection. With a low-power eyepiece they are fairly well defined; but when I attempt to use a higher one, they become misty.

Can any of your correspondents kindly suggest any different form of eyepiece, or would a Barlow lens be likely to obviate this? **E. Brown.**

## REFLECTORS.

[31516.]—It is to be regretted that "Tenebris" (letter 31445) has not stated the aperture of the reflector and refractor whose performances he compares so much to the disadvantage of the catoptric instrument. If his O.G. is 4in. and mirror 9¼in., his results are easy to understand. A small instrument of either kind will perform well upon a night when a large one seems unsatisfactory, simply because the smaller lacks power and light to bring into view the atmospheric disturbances which annoy with the larger. If I were going to compare performances, I should stop my reflector down to same aperture as refractor, and put down all deficiencies, either of light or definition, to its discredit, or I should desire to get a refractor of same size as reflector to compare together. I regard any other manner of comparison as calculated to mislead, for I find that there are very few nights indeed when a 4in. aperture will not give me good star discs, and stand 80 to 100 to the inch, while very few nights give absolutely steady discs with 9in. aperture and about 60 to the inch.

I fully endorse Mr. Burnham's opinion about the use of stops, and have never yet used a stop to improve performance. I can always see better with whole aperture than any reduced one, and often fail at a close double star with 6¼in. when 9in. will show it with ease.

I am in the worst possible situation in London, surrounded by tall houses which reduce my open sky to a very small space. My reflector is mounted in a very rough and ready way, and I myself, in all probability, not nearly so sharp-sighted as thirty years ago, and I formerly was as much prejudiced against a reflector as anyone could be. My opinion has been expressed in the English Mechanic very strongly in favour of refractors, and I only became converted by the logic of facts and experience.

As regards light-gathering power, I have seen the comes to Polaris with 1¼in. stop, and to Vega with 2in. (I never tried a smaller on this). Enceladus with ease with whole aperture. I also discovered three minute *comites* to 39 Draconis and two to 72 Cassiopeiæ, and one to B A C 6468. This last has not been published, and I will now only say it is nearer the close pair than Webb's star making the triple. I might give many instances, but prefer to mention defining powers. Delta Cygni is usually easy. "Dunér, with a very fine 9 $\frac{6}{10}$in. achro., could rarely see this pair after sunset" is Webb's comment *re* this star, which I do not regard as difficult at all. Zeta Boötis, Lambda Cassiopeiæ, and Lambda Cygni I cannot now divide, but see as discs either in contact or squeezed up. $\beta$ 137 is easily divided with 275 and a small comes seen about 12″ away. Mu$^2$ Boötis shows like shot-holes not very close together now, and Eta Coronæ is no trouble at all.

Could a refractor do more? It seems to me we hear as little of the doings of the giant refractors as giant reflectors. The new discoveries are not numerous and many of them only guesses—very unreliable indeed.

It must be remembered that it is not only the possessors of reflectors who are gifted with perseverance; and, further, the professional astronomer uses the refractor only, and especially for measuring close doubles, while the reflector owner is usually an amateur rather seeking acquaintance with the glories of the heavens than exact measures and only devoting spare moments to study—mostly in a bad situation and coming to his work already tired instead of fresh.

I should like to see the two telescopes of "Tenebris," and thus get a better idea of the result of his comparisons. Perhaps he will inform us of the aperture of each and the powers used.

**H. E.**

## THE ETHER.

[31517.]—Having been away from home for several weeks, and not seeing the "E. M.," I have had to defer what I had to say, and leave the "ether" to others, and as it still excites interest and correspondence, I will resume my position in the discussion by some needed remarks on recent letters.

Mr. Searle (31365, p. 464) replies to my question by endorsing Mr. Quinn's definition, and finds it "very good as a rough explanation"; well, I can readily conceive how he would have treated it if he had found it during his glancing over my book. "A current is a unit," is it? A *static* unit can be properly described as *flowing*, can it? And all this in the course of hypercriticisms on other modes of expression. I will only object to Mr. Searle's own amended definition, that, in common with many of the mathematical electrician's statements, it requires us to do or to conceive as being done, things which no ingenuity could really accomplish, and which are absolutely opposed to the nature of electricity and all our knowledge about it. "If a circular ring be charged with one electrostatic unit per centimètre of its length." Here is the common mathematical error: *that charge is an impossible thing*; it ignores the equal opposite charges, which in the region of real facts must co-exist. If that were outside the ring, the charge would have no magnetic effects at all; if within, I am pretty sure there would be none. Has not Mr. Searle misapplied the effect of a charge rotated round a magnetisable body—a localised charge which involves changing lines of force as it moves—to a circular ring which would give no change of lines?

Next, as to removal of ether, the etherialists, as they invent any kind of action or property which will answer their purpose, have some advantage in discussion with those who have to employ only the facts which nature supplies. They tell us that the ether is the real agent in electrical actions; but they fall back upon any convenient variation of its functions by the presence of various kinds of matter. The doubter (really the experimentalist as against the speculator) finds that the presence of matter is *the* essential. Air, for instance, under ordinary pressure is a very complete insulator, and has a faculty known as inductive capacity, which enables it to endure "electric stress" under clearly discovered laws. When it is exhausted to a certain extent, its inductive capacity is only slightly varied; but its power of conduction is so increased that our "vacuum tubes" transmit "current," also under fairly-known laws. We push the exhaustion still further, and the air undergoes a change of powers—not of degree, but of character. It passes into the so-called "fourth state of matter," in which the mechanism of conduction is quite different. Well, now comes in the theoretical action of the ether, which has no demonstrable existence in fact. The action of the molecules of air in that vacuum can be traced, just as it can in the radiometer; but the action of the ether can only be traced out in mathematical formulæ based upon data invented by the imagination. Do my readers demand evidence of this? I will give them plenty before long; meanwhile I will call my first witness in Mr. Searle himself.

Now, Mr. Searle, you say (middle col. p. 461): "The most obvious way of explaining the existence of transverse vibrations is to say that the medium has the properties of an elastic solid." Dear! dear! I always understood that the first principle of science was to discover what is, and then to learn why it is. This discussion began in an incidental remark of mine that there was, after all, no great difference between the systems of the old scholastics, who first devised à priori theories, and then fitted facts to them, and that of the modern philosophers who would invent any attribute of the ether which would seem to enable it to account for anything. Well, here we have Mr. Searle describing with approval that identical process. He actually calls it *explaining* nature, when he *says* that a hypothetical substance, of which neither he nor any human being really *knows* a single property, *has* such and such a property.

Let us illustrate this system. An ingenuous inquirer comes to ask "why a stone falls to the ground?" We reply that examination of universal facts shows that it does not do so; that all matter exerts an attraction upon all other matter in a certain degree; that the matter in the earth and in the stone mutually draws them together, and the resultant motion is produced in the smaller and easily-moved mass; it does not *fall*, it simply approaches the larger mass. Now this is real knowledge imparted; and it is a real *explanation*, because it changes an isolated fact into an instance of universal fact, and it carries our understanding back one stage in the line of causation. But our ingenuous inquirer "wants to know, you know"; so he asks "Why or how does matter exert this mutual attraction"? "Ah!" the man of true science says, "I do not know, and as I have no possible means of learning, I will not *pretend to explain*." But suppose our inquirer goes to someone who thinks he can *explain by saying* something. What can he say? He may explain by asserting that each particle of matter is occupied by an angel with as many pairs of hands as a Hindoo god, and these angels are all busy trying to pull each other closer. Or he may say that space is filled with "Ether," which has the properties of an elastic solid, together with several hundred other properties to be discovered (that is imagined) whenever wanted. Will anyone tell me where is the difference in validity of these two "explanations"? They are equally imaginary; but the second puts on an air of make-believe knowledge —*more mischievous really than the other.*

In Mr. Searle's *explanation* he illustrates the very process which I have been blamed for describing as drawing fictitious cheques upon nature; but we must not blame him personally, as he is merely practising what is becoming a regular procedure among men of high name in science. The process is to imagine a set of conditions under which facts to be explained might occur, and then to treat those conditions as though they actually existed and really resulted in the facts.

Thus Mr. S. tells us we are able to *explain* things by *saying* that a medium has the necessary properties, and coolly tells us "the medium has now been endowed with rigidity and incompressibility [to say nothing of incomprehensibility], it can undergo distortion, but not change of volume." Now, Mr. Searle, please divest yourself for a moment of the harness which cramps the minds of all who submit them to scholastics, ancient or modern, and tell us, as a man of sense, *is it possible to explain anything in nature by inventing facts and existences?* What is all this but make-believe knowledge? Is it anything better because it is wrapped up in formulæ and wrought with all the machinery of mathematics? The true scientific humility which clearly recognises the limit of knowledge and honestly says: "I do not know—I wait for knowledge," is worth more to the real student of nature than volumes of the cabalistic spells with which the speculators disguise their ignorance and issue it as knowledge.

Mr. Searle may be quite sure "that 'Sigma' will not be deterred by his critics from bringing forward his reasons for calling the various statements as to the part alleged to be played by the ether in electric induction and conduction 'nonsense' as soon as possible." But I wish my critics would stick to the point and give me what I have so often asked for—facts—not imaginary endowments, and above all, just a small sample of that "jelly" which they describe as so valuable.

I must also object to a statement of Mr. Searle's treated by Dr. Edmunds (31393, p. 489). When circumstances are wholly inconsistent with some hypothetical or suggested term in the chain [illegible] causation, of course we must conclude that the term does not exist. But the agreement of the circumstances and the term does not in the least degree *prove* the existence of the term. I pointed this [illegible] early in this discussion. It might be possible [illegible] substitute any one out of a hundred different terms, all of which might agree with the circumstances. Dr. Edmunds clearly points out several other [illegible] points in Mr. Searle's logic.

Mr. Job, 31466, p. 533, treats of some of the di
culties of the fundamental ether hypothes
related to light; but that I have always set on
side: it is the application of the ether to elect
that I object to, and the arrogance of those
take up that notion in setting up for dog
truths notions which are mere guesses, with
or less of probability to support them. But I t
Mr. Job rather mixes up two wholly diffe
matters—the interference of light-rays, and
absorption of the energy of light-rays by ma
atoms, or rather molecules, upon which that e
does work.

Mr. Calver (31476, p. 533) fails to see how
title of "Nonsense" has been made out. As I

for the phrase, I will ask him if he does
r it "nonsense" when people talk of
lly beyond their knowledge, as if they
ority"? Is it not nonsense for scientific
ts to leave the ground of experiment
on for those of the fancy? Is it not
attribute to the imaginary actions of a
l agent, phenomena known only as
by the changes taking place among the
known matter? The first of these I
proved; indeed, the etherialists do not
ey only justify their guesses as agreeing
They well may, as they are invented
to do so. The others I will deal with in
ter. **Sigma.**

### THE BANANA.

–In your issue of Aug. 1st you quote an
article from the *Liverpool Mercury*, by
on the Banana; but there is a statement
beginning that I must take exception to
ras the fruit forbidden in Paradise. I
writer was so enamoured with his sub-
gave it this place of honour.

for the interest of your readers, state a
ct known but to comparatively few. In
of Philæ on the Nile there is a tablet on
ulptured a tree, with a man and woman
de, the fruit of the tree in their hands,
ent. The carved hieroglyphics when
state this in effect to be Adam and Eve
forbidden fruit of the *pomegranate* tree,
a its internal formation highly typical of
uences of the Fall of Man. This was
rved some 4,000 years ago, and may rank
authority. This interesting subject is to
Forster's "One Primeval Language,"
194, &c. **F. B.**

### MOTOR FOR CYCLE.

–I am surprised that "Nun. Dor.,"
or any other mighty critic did not
the poor "Petrotryke" last week, and
s litter of pistons and rods.

ould it be utterly impracticable to
s on a cycle? I can tell "Cycloid" that
nuch easier to accomplish that than it
mprove the mechanism so that a cycle
pelled at 20 miles an hour with ease.
" will require to start with improvements
s first.

Dor.," "Nig.," "Petrotryke," and
agreed as to the inutility of steam. The
ikely motor is petroleum. A few years
ras great hope as to what could be done
eum or gas. Those interested looked at
lumps of metal which were made into
s, and turned away sadder, but not
. Not so with "Petrotryke." All the
him was gammon. What he set him-
, in the first place, was to perfect the
elf. Working beside one of the latest
Otto engines, and knowing that there
power escaped through the exhaust-pipe
turned into work, the first thing to do
rect this. With our two pistons and
ks, we will turn three-quarters of the
ver in the Otto engine into useful work.
e time, with our "Petrotryke" engine we
shock of both explosion and exhaust
t is the exhausting of the engine and the
k which causes the jumping of gas-
d with high-speed steam-engines. The
l be greatly improved when steam is
between "Petrotryke's" pistons.

ention that I had a letter signed "P. W."
says: "I presume no criticism of the
(by "Petrotryke") is required." Now, if
and "Nun. Dor." are the same person,
own himself beat? However, he goes
hat "no cycle has yet been built capable
d the strains and jerks of any efficient
Cycles have been built to be driven by
muscles," using his own words. I can
. Dor." that, when the efficient engine is
g, that the cycle which will be built for
more efficient for the engine than the
for the muscles. I do not see "P. W.'s"
ference to how "real power should be
We showed how in our design of the
. The cycle for our engine ought to
wheels, and, as we have power to spare,
attach another two-wheeled carriage

correspondent "Inexperience" (p. 555)
d his cycle with one ton of steel springs
same up very tight, he will have a store
o lift his machine up-hill equal to about
or about ten minutes. He will get about
sults with half that weight of indiarubber.
.H.," 31489.—"Petrotryke's" motor was
ed to develop a slight amount of power.
that it was equal to 1H.P. Smaller and
otors will be made. It is anything but
and it will form a rigid back-bone for the
ou do not know much about gas-engines,
uld know that there are hundreds of gas-engines which have no water jacket. Suppose that the driving wheels of the Petrotryke were 8ft. in. circumference, and that a speed of five miles was wanted, the engine would require to run at 60 revolutions. Now I ran my 2H.P. Otto engine at that speed to-day. For 15 miles the engine would run at 180, for 20 miles 240 revolutions. My 2H.P. Otto can do any of those speeds, and why not the Petrotryke. I weighed a length of steel tube 3in. dia., 19in. long, ⅛in. thick, weight 6$\frac{1}{16}$lb. This tube will stand a pressure of 3,000lb. The pressure in the cyclinder of the Petrotryke would never exceed 125lb.: there is surely a good margin of safety. My estimate of the weight of an engine to develop ¾H.P. is very near correct. "J. H. H." says: "For lightness, economy, and cheapness in first cost, I do not think that a high-pressure steam-engine can be beaten." Can he make a 1H.P. steam-engine and boiler which will not weigh 80lb.?—and what about the question of water? Does he reckon that it should not be counted—not to speak of coals? The Petrotryke will run 100 miles on a gallon of oil. There is nothing of the nature of rubbish in the design of the Petrotryke, but a good deal in what "J. H. H." has said. He has not given the matter much attention, and should not write about things he does not know. "The idea also of trying to drive a cycle by means of a gas-engine working direct on the cranks"! is a good one—at least, it has proved so with the locomotive. This is not the only good idea: for instance, there are no strains between the cylinders and cranks; another one is that the gases will be expanded to a very low pressure. We have made some points. Has "J. H. H." not one? Kinematics are not in your line. You know somewhat, "Nun. Dor." Where is your thinking cap? I should like to have the opinion of "T. C., Bristol," and some others who know what they are speaking about. **Petrotryke.**

### THE GASSNER DRY BATTERY FOR ELECTRIC LIGHTING.

[31520.]—In letter 31306, published in the English Mechanic of July 4th, 1890, I gave a short account of some experiments performed by me with the Gassner dry battery, with a view to testing its constancy in ringing electric bells. At that time I thought it might be put to some other uses beside those of furnishing current to ring bells and work telegraph instruments. If the Leclanché battery could be used for furnishing current to small electric lamps used as night-lights, then I could see no reason why the Gassner should not be employed for the same purpose, seeing that in point of constancy it is superior to the Leclanché. Through the courtesy of Mr. P. C. Brewster, 12, Addle-street, London, E.C., the English agent of Dr. Gassner, I have been able to fully test the capabilities of the Gassner for lighting small electric lights of 2½c.p. One of these small 6-volt lamps fixed to a watch-stand by the bedside and connected to four cells of the Gassner battery, will furnish enough light to see the time by a watch hung on the stand close under the lamp. As the E.M.F. of a Gassner cell is 1·60 volt, four cells in series proved to be just enough to light up a 6-volt lamp, but five cells gave a better light, and more cells would be required to properly light up a lamp of higher resistance; say seven cells in series for an 8-volt lamp, and nine cells in series for a 10-volt lamp. The advantages of using this battery for such a purpose are: 1. It is perfectly dry, and consequently there can be no spilling of battery liquid on the cárpet. 2. It is closely sealed, so there are no fumes or odour of any kind to taint the air of a bedroom. 3. It does not need attention, but is ready at any time, without the trouble of cleaning and recharging. 4. When run down there is no mess made in recharging the cells, as they are simply connected to a primary battery, such as a Bunsen, or to a dynamo, and recharged in a manner similar to that employed in charging accumulators. The battery may, therefore, be placed in a box by the bedside, or in a cupboard in the bedroom. A braided double-line cord, containing two No. 18 wires, should be run from the battery to a pressel near the bed, and two wires from this to the lamp-stand on a table by the bedside. At any period of the night, when it is desired to know the time, it is only necessary to press the button of the pressel, and a sufficient light is shed on the watch dial to see the time. The lamp may be used to light up the room whilst the gas or lamp is being lighted; but I do not recommend the battery for other than intermittent lighting, as the volume of current rapidly diminishes through low resistances. Should any of "Ours" have had any experience with this battery for a similar purpose, I shall be glad to see an account of it in these pages. **G. E. Bonney.**

### THE THERMODYNAMICS OF THE AUTOMATIC VACUUM BRAKE.

[31521.]—As you have published several letters in which an entirely misleading account is given of a paper of ours, with the above title, which recently appeared in *The Engineer* (June 27th and July 11th, 1890), we shall be glad if you will allow us space in which to give your readers our own account of the objects and scope of our paper.

The failure of the Automatic Vacuum Brake to act, upon certain occasions, owing to the presence of ice, and the fact that upon other occasions water has been found in the pipes and other parts of the apparatus, has led to the publication of numerous letters and newspaper articles, in which this water and ice have been traced to the atmosphere. It has been admitted by some writers that water may sometimes gain access to the brake pipes from preventible sources; but the condensation of atmospheric moisture has been regarded as an entirely unpreventible occurrence, and an attempt has been made to discredit the brake on the ground that it is therefore defective in principle, and always liable to freezing in winter.

Now, as we stated in our paper, any water which gains access to the interior of the brake apparatus "can only be condensed steam which has leaked from the ejectors used to create vacuum, or it has been introduced from carelessness or malice." All that is necessary to prevent the entrance of steam, is a proper arrangement of stop-back valve between the ejector and the main train pipe of the brake; so that the condition necessary for the disappearance from the Automatic Vacuum Brake Returns of all cases of failure caused by water or ice getting into the pipes, cylinders, and valves, resolves itself into a simple question of mechanical construction. Such being the case, we consider it desirable, in the public interest, that the fallacy of the atmospheric condensation hypothesis should be exposed, and the fact made clear that it is impossible for atmospheric moisture to be deposited and accumulated in the automatic vaccuum brake apparatus under any circumstances whatever. This we have done in our paper. We have considered fully and minutely the thermodynamic conditions and changes of condition which occur in the operation of the brake, and we have proved by arguments, based upon the researches of some of the most distinguished scientific investigators, that the accumulation of atmospheric moisture is impossible; we have supported our arguments, and tried to make the facts more evident, by carefully-conducted experiments made in the laboratory, and described in our own paper in minute detail; and we have finally proved the correctness of our conclusions by experiments on a larger scale made with complete actual trains, one of the train experiments being described in our second article, and the other in a letter which appeared in *The Engineer* on August 8th, 1890.

We have shown that the expansion or rarefaction of air in the automatic vacuum brake apparatus takes place in two distinct ways. When the apparatus is exhausted to release the brake, the air expands adiabatically, and frequently becomes cooled below the dew-point; with the result that the invisible aqueous vapour is condensed in the form of a cloud, which remains suspended within the air, and cut off from contact with the surfaces of the brake apparatus by a layer of cloudless air; this cloud almost immediately re-evaporates, because the mass of air within the pipes is so small relatively to the mass of metal composing the pipe, that the temperature of the pipes is not appreciably affected by the expansion of the air, conquently the air remaining in the pipes becomes quickly warmed again by heat diffused from the pipes, and having been dried by the process of expansion, it is able to dissolve far more moisture than exists in the cloud.

On the other hand, the air which leaks into the brake apparatus through the piston rod glands and faulty joints, and which has to be withdrawn at the same rate to maintain the vacuum constant, expands freely, without performing external work, and therefore without falling appreciably in temperature; consequently none of its aqueous vapour is condensed. We found in an experiment with an actual train that the temperature of this current of rarefied air is a fraction of a degree *higher* than that of the surrounding atmosphere, and we explained the reason for this. We also showed that this current of rarefied and dried air has a great evaporative power, and by connecting up a bottle of water between the coupling pipes of two carriages of an ordinary train we evaporate 2¾ fluid ounces of water in 15 minutes.

Those of your readers who wish to verify our arguments or check our results will, we hope, refer to our original articles; but as certain interested writers are making it their business to misrepresent us, we think it advisable to state:—

Firstly, that we do not dispute, and never have disputed, the facts shown by the Board of Trade returns; that water and ice have been found in the Automatic Vacuum Brake Apparatus, and that failures have been caused by ice.

Secondly, that our paper was written solely to prove that this water and ice *cannot have been condensed from the atmosphere.*

Thirdly, that we have accounted for the water and ice, and have shown that the sources whence they have come are preventible ones. Either the water has come from the ejector, in consequence of the leakage of steam through the stop-back valve which has been badly designed; or the steam has leaked through a carelessly made and improperly located joint; or the water has been maliciously introduced. Undoubtedly water which has got into the brake apparatus will freeze if the temperature be low enough; and nothing we have said can be construed into a statement to the contrary.

**L. Archbutt, F.I.C., F.C.S.**
**R. M. Deeley M.I.Mech.E., F.G.S.**
Charnwood-street, Derby, August 19.

### VACUUM CONDENSERS.

[31522.]—The experiments by "M. A. R." (letter 31451, p. 530) are very important. Before writing about them, I am waiting to see if he will give his own explanation of them. I made experiments with what he calls vacuum condensers forty years ago; but mine had metal rods between the electrode and the inside tinfoil coating, and therefore I did not witness the phenomenon he has seen.

**James Johnstone.**
8, Merchiston Park, Edinburgh, Aug. 22.

### THE FREEZING OF VACUUM BRAKES.

[31523.]—The letter of your correspondent "An Engineer," No. 34393, p. 556, containing a copy of the important regulation which Mr. Webb considers it necessary to issue in order to overcome the dangers of the automatic vacuum brake becoming frozen up upon the London and North-Western Railway in winter time, is sufficient to prove to every impartial person that the vacuum brake is very liable to, and actually does, become frozen and useless, and every railway man is perfectly well aware that many instances occur every winter. The two gentlemen, Messrs. Archbutt and Deeley, to whom your correspondent refers as writing to the *Engineer*, state that the vacuum is a "dry brake," and that the idea of moisture being drawn into the pipes is a "fallacy." So much for theory, but let us turn to actual facts and practice. In the first place, let us turn to the official returns issued by the the Railway Department of the Board of Trade, and it will be found that no less than 214 faults or failures of the vacuum brake are therein recorded during the past four winters. It may also be added that I have had occasion to examine the wrecks of two collisions at Carlisle, both caused by ice having formed in the vacuum pipe between the engine and tender. Further, I have been a passenger in trains when they have overshot the platforms from the came cause, and at various times I have seen every part of the vacuum brake frozen up, or blocked with ice.

Your readers are well aware that I have for years pointed out this danger of freezing in the vacuum system, and also that I consider that when the brake freezes up it is not just to commit the engine-driver for trial for manslaughter. Now the real object of Messrs. Archbutt and Deeley's articles appears to be to remove the blame from the vacuum brake, and place all the responsibility for accidents due to ice forming in the apparatus solely upon the unfortunate engine-drivers.

Of course I can quite understand that Messrs. Archbutt and Deeley and the other advocates of the vacuum brake are most anxious to shift all blame from their system; but in so doing is it not a gross injustice to place it upon an innocent engine-driver?

It is certainly necessary that the absurd and incorrect theories of Messrs. Archbutt and Deeley should be exposed, as possibly they may succeed in causing some driver being unjustly committed for manslaughter. **Clement E. Stretton.**
Blackpool, August 23.

### MODEL PUMPS AND INJECTORS.

[31524.]—With all due regard to Mr. Haughton's opinion of model injectors, I must say I should be sorry to have to trust entirely to them for feeding a boiler. They frequently cease working from getting too hot, and are often difficult to start. I have tried different patterns, and find that Giffard's is the most difficult to make, and the least reliable, while a modification of Koenig's will work pretty well; but even that is liable to stop if it gets overheated. I am afraid also that the majority of amateurs would find the work beyond them on account of the fineness of the work required. For a loco. 24in. long, the injector should not exceed 2in. in length; larger than this it becomes unsightly. For steamboats, nothing equals a donkey pump, and one that has no flywheel will start at a moment's notice, and will make from 20 to 150 strokes per minute without giving any trouble. They can also be made self-starting, so as to maintain the water in the boiler at the same level. This cannot be done with an injector.

**A. F. Shakespear.**
72, Lambeth-road, S.E.

### COLLIERY FAN WORK.

[31525.]—In No. 1303 of the English Mechanic I gave some particulars of the performance of a centrifugal ventilator, and have in the mean time obtained some further data with respect to a similar but larger fan, which may be of interest to many of our readers. The instance now referred to is especially interesting, from the magnitude of the work performed. It was required, under otherwise unchanged conditions of the main airways of the mine, to pass a volume of air amounting to 116,500 cubic feet per minute, where hitherto, with a "Guibal" fan of 39ft. 6in. diameter, and 8ft. 2½in. wide, making usually 52 revolutions per minute, and with a depression of 3·15in. of water, only 59,300 cubic feet had been passed.

As it is assumed that the water gauge increases as the squares of the volumes, it follows that the work to be done was perhaps unprecedented in the sphere of mine ventilation,—both as to dynamical force represented in the air moved, and as to the w.g., which latter would amount, by calculation, to no less than 12·15in. for:—

$$59300^2 : 116{,}500^2 :: 3{\cdot}15 : 12{\cdot}15,$$

and the horse-power in the air moved, to 223, for:—

$$\frac{116{,}500 \times 12{\cdot}15 \times 5{\cdot}2}{33{,}000} = 223.$$

The problem was unquestionably a difficult one; but it has been successfully solved by a fan, of the new type, 12ft. 4in. diameter and 6ft. 6⅝in. wide, revolving at 350 per minute, and passing, as determined by very careful and exact measurements, 127,080c.ft. of air per minute under a depression of 10·63in. of water—i.e., a larger quantity than was required, and at a lower depression. The work in the air is—

$$\frac{127{,}080 \times 10{\cdot}63 \times 5{\cdot}2}{33{,}000} = 213\text{H.P.}$$

or 10H.P. below the estimated for the smaller volume.

The actual quantity required was passed at 320 revolutions of the fan, and under a w.g. of only 8·780in., the H.P. being only 161·2, or 28 per cent. below the estimated, showing, therefore, the very remarkable fact that the guaranteed quantity was obtained with a very much lower w.g. than that due to the squares of volumes, and consequently, also, with very much less power developed in the driving engine.

The body capacity of the new form is, as will be observed, only about $\frac{1}{13}$th that of the Guibal which it replaces, while the work actually done is 7¼ times the amount. The relative circumferential speed was as 1032 : 490. The measurements were all taken with the utmost care (it being a question of fulfilling the guarantees) as well with anemometers as with Pitôt tubes.

At other speeds of rotation the measured results were as follows:

216 rev. 80,000c.ft., and 4·527in. w.g.
288 rev. 105,194c.ft., and 7·323in. w.g.

The revolutions of fan were calculated from the engine speed, the ratio being 4 : 1, and no allowance made for slip; but it is probable that the actual speed of the fan, considering the great power carried by the belt, was considerably less. At 216 revs. (54 of the engine), the slip was just 1 per cent., but the power transmitted was in this case only about one-fourth of the maximum, or at 350 revolutions.

I am of opinion that there is no other instance on record of a fan doing this amount of work, but am, of course, open to conviction, and shall be glad of particulars. The great (Guibal) fan at the Hilda colliery (50ft. by 12ft.) making 41 revolutions per minute, only passes 128,500c.ft. at a depression of 3·3in. of w.g., whilst its body capacity is nearly 30 times that of the fan above described.

I may remark that the drift area in place of measurement is 58·86sq.ft., so that the air velocity was 2,160ft. per minute. Measurements were also taken at a depth in the mine of about 250 yards, the area at this point being 50·63sq.ft., and it was found that the volume passing at this point was 23·6 per cent. less than above in the drift, showing considerable in-leakages in the upper parts of the mine. The equivalent orifice of this mine is, under the conditions given, 15·078sq.ft.

**Marienberg.**

### PHOTO-MICROGRAPHY.

[31526.]—In answer to the request of "Pathologist," I do not think that I can, in any communication of such a length as you are likely to be able to find room for, give him much advice which would be helpful. The arrangements used are really the same in principle throughout, and I have no doubt that "Pathologist" is perfectly adequate to perform all he may require. Given a good microscope, a steady base-board, and an absolutely light-tight connection between the microscope and the sensitive plate, together with a good extended-focussing arrangement, the results from objectives of good quality, with or without eyepieces, are likely to be satisfactory, *provided the objects are suitable*. The suitability consists in two features, of which thickness is by far the most important: difficulties of colour may always be overcome; but thick sections, owing to the number of planes of which they are made up, yield no good results with high powers, though with low ones fairly satisfactory negatives may be obtained from moderately thick preparations. Thin, well-stained sections will always give good negatives when the optical parts are such as they should be.

If "Pathologist" is anywhere near me, I shall be happy to give him any assistance I can. It has often occurred to me that with so many photo-micrographers as there now are, it would not be difficult to form a society, which might be very useful and helpful to those who, like myself, are cut off from attending meetings in the evening, and have few opportunities of direct intercourse with their fellow-workers.

As to the letter of "Coarse Adjustment," I have to say that, so far as I know, Dr. Dallinger, and certainly Mr. Mayall, jun., took part in Mr. Nelson's experiments, and therefore his supposition that errors of manipulation passed unnoticed at the first trial will require more than his opinion to back it. The opinion, however, of those who do not hesitate to promulgate (anonymously) charges of incompetence, or failing that, of deception, against three of our leading English microscopists—all men of high scientific rank—will not weigh very heavily in the balance against the careful and deliberately expressed conclusions of the latter. I choose to suppose, and with far more ground, that Dr. Czapski's letter referred to the lens as it left his hands before the second experiment.

As to the safety of the trunnions of my own microscope I am not concerned, since I do not intend to risk my collimation by hanging a brass box full of shot on my fine-adjustment head. I leave that to "Coarse Adjustment," since such adjustment evidently suits him. He and "F.R.M.S." gave totally different descriptions of the same thing: he described it as it existed in his imagination, "F.R.M.S." in his second letter describes it as it actually exists; of the similarity of the descriptions I leave others to judge. Finding my own arrangement perfectly satisfactory, I see nothing to gain by changing it.

The question of the use of eyepieces, other than projection, is a matter of opinion, not of dogma. Some of my most successful negatives have been done when using Huyghenian eyepieces, and as objectives are constructed for use with eyepieces, and no sensible worker would trouble to connect up his microscope and camera, for high-power work at any rate, until he had first secured as perfect an image as possible, this fact, coupled with the convenience of a shorter camera, must, as I said (which was not all what "Coarse Adjustment" represents me as having said), be allowed due weight in the decision. It will be quite plain to answer the latter's "plain question" when he produces his photographically perfect lens: there is none such yet. Zeiss's *aa* is the nearest thing to it that I know, and I employ it with or without an eyepiece, guided only by the magnification required, and considerations of general convenience. The only objective at present made for projection only is the Zeiss 70mm. apochromatic, a very fine lens indeed, but with a good deal of spherical aberration toward the margin, or, more strictly speaking, with a rather round field. It works excellently with a Huyghenian eyepiece for direct observation.

I objected to "F.R.M.S.'s" closing quotation from my book, because he chose to represent that a phrase which refers only to one strictly-defined step in photo-micrography, alluded to my position towards the subject in general. "Coarse Adjustment" must have a very coarse mental adjustment indeed if he thinks my remark susceptible of such an absurd interpretation as he puts upon it. I incline, from this and other similarities of style, to think that "Coarse Adjustment" and "F.R.M.S." know each other pretty well—in fact I am not sure that they have not a precisely similar style of caligraphy.

However this may be, I am always willing to meet, fairly and above board, antagonists who can argue courteously, even under assumed names, scientific questions of general interest. When, however, anonymity is simply intended to conceal the insignificance of those who venture to attack secretly such men as those whose position I have herein endeavoured to defend, I see no use in prolonging discussion, and this is, therefore, my final contribution to the "Dallinger, Nelson and Mayall v. Czapski" question. **Edward C. Bousfield.**

### SMOOTH SHAVING.

[31527.]—In my wanderings about the worl
being of the Esau type, a hunter and a hairy m
I have tested the barbers of many nations, a
bought their facial implements, too. The razor
India, though a clumsy-looking semi-disc of s
on a straight handle, does its work in native ha
on scalps (as a religious rite) and on rough fa
very neatly and comfortably by merely moisten
the epidermis with cold water, soap being p
hibited. Many a time has that primitive ins
ment crossed my chin without making a scra
At the courts of Oriental tyrants drawing a dro

ng the operation of shaving was a capital
, precautionary edict, no doubt. Mussel-
re, till lately, used by savages for the
f hair, till the important discovery that a
of broken bottle is far more effective.
e case with those fierce islanders of the
s, who operated in this rough fashion on
ped Indian convicts whose lives were
they were considered desirable "young
for a tribal alliance by marriage. When
s rescued these foolish truants described
rings under the ceremonial installation as
nd of long duration. Prehistoric man
ke of flint to remove his locks and eye-
lisfiguring his countenance" on occasions
ng. The modern Hindoo shows his grief
ber's hands in the same fashion, as did
r-land, old Egypt. I have nice specimens
gian cutlery, but not until a few days ago,
ow that the inventive Norseman had
before us in razors. A friend who has
elling hard for two whole years, came to
me, and exhibited the most beautiful pair
oilet tools I ever saw, of very highly-
essemer steel, simple and scientific, being
n, flat blades of metal, inserted in grooves
stuff. The agent warrants their edge to
e months, when the razors must be sent
ismounted, and sharpened, having to be
rom the grooved back to do so. Chantrey
or made one of hard bronze with a keen
ve edge, and there are relics of Pompeii,
ured in that alloy. **Eos.**

### )THER BED BUG HUNTER.

—A LONG time ago I described in these
t estimable insect, the lesser *Blatta*, and
evouring proclivities. I learned his good
uring a voyage in a French sailing-ship,
the captain desired me not to injure his
es, though they did attack my shoe-leather
k hours. **Eos.**

### BEE-STINGS.

—WHEN wounded, remove the sting with
squeeze the wound, and suck it; then
h a camel-hair brush a drop of liquor
his alkali neutralises the venom. Liquor
also found beneficial. A bee-keeping
mine has tried the German remedy of
gs on any member troubled with rheumatic
**Eos.**

·The smallest filaments of flax readily
rom each other when delicately washed
ater or alkaline lye, or when a thread of
sected with a needle point. They have
e diameter of 1-2500 of an inch. Different
of flax separate into these minute fibrils
ent degrees of facility, and thereby create
rades of value for the fine spinner. Good
l be long, fine, glistening, and soft like
ilver grey, neither greenish nor blackish.

**age of Castings.**—In locomotive cylin-
enth of an inch in a foot; pipes, one-third
in a foot; girders, beams, &c., one-third
a in fifteen inches; engine beams, con-
ds, &c., one-third of an inch in sixteen
ge cylinders, say seventy inches diameter,
roke, the contraction of diameter, three-
an inch at top; ditto, one-half inch at
itto, in length, one-third of an inch in
hes; thin brass, one-third of an inch in
s; thick brass, one-third of an inch in ten
ac, five-sixteenths of an inch in a foot;
ame; copper, three-sixteenths of an inch
bismuth, five-thirty-seconds of an inch in
, one-quarter of an inch in a foot.

**Pathology.**—There is a disease in Japan
*kakké*, a disorder of the kidneys commu-
bacilli, and closely related to the more
*ri-beri*. From the distribution of *kakké*,
has recently drawn conclusions as to the
aposition of the present population of
he fact that Chinese always escape the
en in localities where it is very prevalent,
n his opinion, that the Chinese or Mon-
ent is not the dominant one. He finds
ituents in the population: (1) descendants
(2) of Negritos; and (3) a Malayan ele-
h is the most prominent. Wherever the
goes, he brings with him the *beri-beri*
sease; his liability to this being probably
Hindu blood in him. From India we
*eri* spread, like the Malays, to Mada-
the one side, and to Japan on the other;
rith it also in Java, Sumatra, &c. Ac-
the proportion of Malay blood in the
Japan is the frequency of the malady,
rs in various forms and under different
s to the Negrito element in Japan, M.
d an interesting proof of it in the island
a the form of a small statuette of Buddha,
characteristic nose and hair of the

# REPLIES TO QUERIES.

◆

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[71289.]—**Double Circular Saw (U.Q.)**—I do not think spur gearing would stand the work, unless very heavy and fitted with extraordinary accuracy, and it would be certain to be very noisy. The saw to the left is in a bad position for cutting, and unless a guide is brought close down to the teeth it would either split the wood or throw it up. If both saws were hammered to run true when warm, the difficulty due to difference of temperature would be small, and only at ends of the cut. A band saw, or one of the jigger saws made by Ransome and other makers of wood-working machinery, would be better. I have not the figure at hand, but I am under the impression that you can saw a greater thickness with these than with a circular saw using the same power.
GLATTON.

[71290.]—**Carriage and Waggon Springs (U.Q.)**—Let L be the distance from end of spring to strap at centre; $t$ be thickness of each plate in inches; W the working weight carried by spring in tons; $d$ the distance the spring will deflect under the load W. W should not be more than—

$$\frac{13 \cdot \dot{3}\, t^2}{L} \times b\, n.$$

Where $b$ = width of plate in inches, $n$ = number of plates of which the spring is composed. With this load the deflection will be—

$$\frac{1}{300}\,\frac{L^2}{t} = d.$$

With any less load $w$ it will be—

$$\frac{w\, L^3}{4{,}000\, b\, t^3\, n}.$$

The stress on the fibres of the steel under a maximum steady load = W will be about 90,000lb. per square inch. I should be glad if some correspondent can explain to me how it is that the steel can (as it does) stand a bending moment giving nearly double this stress. If a straight strip of steel is bent round a cylinder having a radius 200 times the thickness of the steel, the stress will be 90,000lb. Hence Molesworth gives 200 radii as the proper number. I think it will be found, however, that the radius of the spring when free should be less than this, or the working load will deflect the spring more than is required to straighten it. In the above figures the modulus of elasticity is taken as 36,000,000lb. See also Molesworth, p. 230, twenty-second edition. GLATTON.

[71295.]—**Dynamics (U.Q.)**—I am afraid the textbook is wrong if it makes the statement exactly as you have put it. GLATTON.

[71328.]—**Slugs for Air-gun (U.Q.)**—I do not know how they are made, but from their appearance I should imagine they are punched. Suppose a fixed vertical plate with a hole in it in which two punches—one on each side—fit exactly. The one on the right to have a conical depression, that on the left a conical point. If that on the left is brought flush with side of plate, a sheet of lead held on the other side, and the hollow punch driven through, a bullet would be the result. It is easy to imagine the rest of the cycle of the operation. The hollow punch and the lead plate would be withdrawn, the latter being "wiped" off the punch by a fixed stop. The other punch would then move forward and push the bullet out, so that it fell into a receptacle, and so on. The mechanism to give the motions would be either by cams or by an arrangement like Atkinson's gas-engine.
GLATTON.

[71331.]—**Clock Dial (U.Q.)**—Could not you do this with a suitably shaped punch? Before going over with the punch, bed the brass down on some warm pitch and let it get cold. GLATTON.

[71395.]—**Vortex and Annular Blast Pipes (U.Q.)**—In some locomotives the exhaust pipes join a foot or more from the top of the blast pipe, and are continued upwards as a single pipe from the point of junction. In others one is carried up inside the other, so that the central one is a plain jet; the other is an annular one. I do not know to what form this word "Vortex" is specially applied—it seems about equally applicable to all. GLATTON.

[71439.]—**Aniline Colours (U.Q.)**—I have not time to experiment; but you might make a weak solution by wetting the sweets with a paintbrush, and colouring very faintly a piece of white paper with the pigment. Expose to the sun for a day. I think I am right in saying aniline would fade; but perhaps a chemical correspondent will kindly say if vegetable colours will do the same. GLATTON.

[71550.]—**Annealing (U.Q.)**—I don't think this question a very useful one; it is, however, obvious that the querist's idea is correct. The writer of the article merely quoted the glassmaker's expression without dealing with the correctness.
GLATTON.

[71475.]—**Centrifugal Force (U.Q.)**—The stress = $\frac{w\,v^2}{g}$ lb. per square inch (Unwin) where $w$ = weight of 12c.in. of the material, $v$ = speed of rim in feet per second, and $g$ = 32·2. If material = cast iron, $w$ = 3·36lb., and the expression becomes—

$$\text{Stress} = \frac{3{\cdot}36}{32{\cdot}2}\,v^2 = {\cdot}0958\,v^2.$$

GLATTON.

[71559.]—**Teeth on Cogwheel, &c. (U.Q.)**—Write Britannia Co., Colchester, about teeth. They supply a special tool, I believe. Mode of cutting worm must depend on what appliances you have. If axis of worm is to be at right angles to that of wheel, teeth of latter will have to be cut "on the skew"—i.e., slanting. About 5 or 6 parts copper to 1 of tin, makes a good metal. A mixture recommended by the Admiralty is copper 44 parts, tin 4 parts, zinc 1 part. As to melting, &c., half an hour spent watching the operation in a foundry will teach more than pages of writing. Have the metal just hot enough to make a sharp casting; the heat depends on size of casting. GLATTON.

[71576.]—**Cantilever (U.Q.)**—Yes, if you refer to the stress at the point where it is greatest—i.e., close to the joined end. GLATTON.

[71596.]—**Battery (U.Q.)**—Would not a chloride-of-silver cell be just what you want? Described in back numbers. GLATTON.

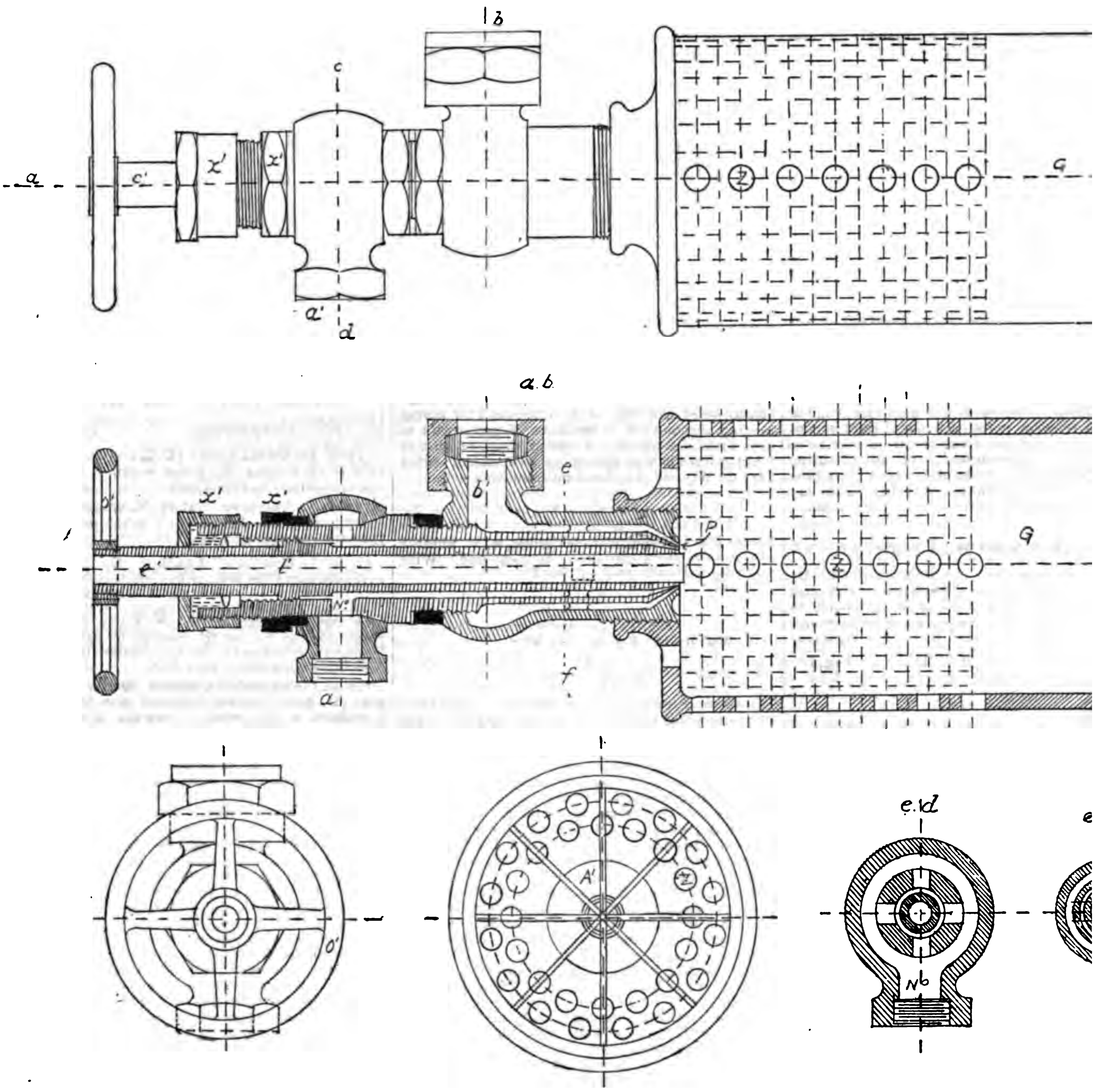
[71600.]—**Russian Leather Spots (U.Q.)**—Would oiling the leather be objectionable?
GLATTON.

[71612.]—**Walrus Tusks (U.Q.)**—Ivory dealers expose ivory hair-brushes, &c., which, when freshly made are yellowish, to the sun behind plate glass. This bleaches them —*Verb. Sap.* GLATTON.

[71632.]—**Obelisk on North Western Railway (U.Q.)**—The obelisk noticed by correspondent is probably the one which marks the Metropolitan Police area in that district. There is a similar one on the Brighton Railway, about 17 miles from London Bridge, on the up side between Merstham tunnel and Starbridge signal-box, and most likely there are others on the various main lines, where the metropolitan boundary is crossed.
P. NEALE.

[71802.]—**Claude Lorraine Black Reflecting Mirror for Sketching.**—If not too late, I give the following, which I made (copied) from one I saw. Take a sheet of paper the size you wish to give to your mirror, say like a small slate. You may get a slate first, and be guided by its frame, which you may use to frame your mirror. Rule your paper to form regular squares of 1in., larger or smaller; lay this paper under the clean glass, and copy the squares on the glass with a thickish ink of vermilion and water, and a drawing pen. Take care you make the squares equal. Let it dry. In a small clean saucepan melt gently some common yellow wax; when melted, stir in well enough of lampblack to make a cream-like fluid; now warm the glass, let the wax cool a little, and pour it uniformly over the lines and glass, covering every bit. When cold, frame it, cover the back with a bit of thin wood (taking in the frame), hinge a lid to the front. To use it, get a common walking stick, fit an iron point to the end, remove the handle; get a long gas-screw, cut off the head and plain part, screw the thick end into the stick, and leave out about an inch of the thin end of the screw. In the middle of the edge of a long side of frame make a hole for the screw. When not required, screw the handle in its place. The above was made about forty years ago on the Continent. If more explanation is required about its use, I shall be glad to give it. SUTARG.

[71839.]—**Cyanide.**—I fail to see the drift of "More Light's" question relative to my former reply to this query and query 71846. If he merely wishes to test my knowledge of matters relating to the Patent Office, I may be able to satisfy him by pleading ignorance. I do not know of any patent which will debar any reader of the ENGLISH MECHANIC from making a double cyanide of gold and potassium, or of silver and potassium. I have read that the Messrs. Elkington took out a patent in 1840 for the electro-deposition of gold and silver from their cyanide solutions, and that similar patents were taken out by Mr. G. T. Bousfield in 1861, and Mr. T. Moore, in 1864. But the processes of making gold and silver cyanides, and dissolving them in solutions of cyanide of potassium, were known to chemists and published to the world long before the Messrs. Elkington appropriated them and incorporated them in their patent. See Gore's "Electro-Metallurgy," pp. 19—22. If "More Light" wishes to warn me or my readers against infringement of patents, let me advise him to read Mr. Gore's list of patents, pp. 371—385, in the above-mentioned book, and he will then see how inventors have sought to protect themselves and monopolise the art



of electro-deposition. I shall be glad to know how many of these are now in operation.

G. E. Bonney.

[71554.] — **Petroleum Fuel.** — Having read "A. M. H.'s" reply in "E. M." of July 4, *re* petroleum burner, and, thinking it may perhaps interest your readers to know something of these instruments in use in Russia, I select the best burner in the market that I am acquainted with. The burner of which I shall speak, of which a copy of drawing I inclose, which is about half natural size, is the invention of Mr. S. Bray, and which is the only burner doing good work in Russia in all sizes and systems of boilers. In referring to the drawing, (*e'*) is the central tube, which is the means of regulating the flow of hydrocarbon to be consumed. By regulating same by hand wheel (*o'*) – (*b'*) is steam entrance; (*a'*) is inlet for hydrocarbons. On end of pulveriser is a cup (G'), drilled with holes (Z'), at end of which is a netting (A). It will be seen that in the Bray burner the steam flows round outside of oil, instead of *vice versâ*, as in the Holden burner. In all burners that I am acquainted with, and also by what I can see of the Holden burner, all give a blowpipe flame, which, playing on one particular part of the boiler, in a very short space of time causes leaky seams. The Bray burner, I think I may say, is the only burner that does not do that, as the flame from this burner is long and similar to the flame from a coal furnace, the wires at end of cup breaking up the gases, which causes the air drawn through holes in cup to intermingle with them before combustion takes place, and the flame commences about 1in. from these wires, and in large boilers, where a deal of steam is required, the flame will reach nearly to end of return flue of a Lancashire boiler 30ft. long; whereas other systems of burners under the same conditions, and burning the same quantity of hydrocarbons, the flame cannot be made to reach beyond 15ft. Bray's burner has stood a great many trials against some 20 different systems, and in every case it has proved itself to be the best, both in economy, easy working, and non-injurious to steam boilers. In no one trial has other systems evaporated more than 11·50lb. of water per 1lb. of hydrocarbon, whereas the Bray burner evaporated 15·25 under the same conditions. The hydrocarbons in these trials had a specific gravity of 0·905 at 50° Cel., feed-water 50° Cel. Of course, these trials were made in Mr. Bray's presence, and he worked the burner himself; but, taking ordinary working, the burner gives 14·50lb. evaporation for 1lb. of fuel. Another great thing for the Bray burner is, that, they are made only in one size, and this one size is equally economical both for a small vertical boiler consuming, say, 9lb. hydrocarbons per hour, and for a large Cornish boiler consuming, say, 800lb. of hydrocarbons per hour, and in both cases giving the same economical results. The burner never leaks, as it is made with glands, and the fixing to any boiler is not so expensive by half of other systems in general use. If this should interest any of your readers I shall be very pleased to answer any questions through your columns concerning petroleum burning, and I believe there exists an agent in England for this burner who perhaps would supply any information to those interested.

Moscow. H. B.

[71858.] — **Mathematics.** — "Very advanced mathematicians" do not trouble themselves much with any system of units, being but little concerned with numerical calculation; but I should say that
in experimental science, from the little I
that line, the C.G.S. system is universally

W. R. C

[71874.]—**Cupric Sulphate.** — Mr. W
Grey, F.C.S., Analytical Chemist, says (p.
vol.): "This salt crystallises with fine mol
water, to which, *in some way*, its colour is
it be heated to 100° for some time four mol
water are expelled, and on raising the tem
to 240° the remaining molecule of water
off, leaving only anhydrous sulphate of co
*white* substance. This body . . . . instan
blue or *bluish-green, on obtaining water.*
italics are mine). The above involves ma
esting questions. Mr. W. John Grey is
and solely a first-rate analytical chemist;
a prominent physicist. The above-mentio
nomena are both chemical and physical.
the learned gentleman kindly explain
according to chemico-physical laws? He
the salt's colour, in some way, is due to
molecules of water. In what way?
colourless; how, and according to what c
genic law, can it cause the salt's colour?
with? Why is that colour a bluish gree
than any other colour? Is there any rel
tween the colour and the number of wat
cules? If so, what relation? One easil
stands that heat can vaporise and elim
water; but when four molecules are thus d
is the salt still bluish green? If not, w
colour, if any?—by what produced? V
salt is anhydrous, and has become a wh
stance, what has become of the bluish
Were the vaporised, eliminated, driven-
cules of water thus coloured?—and b
Cupric sulphate is a combination of co

acid. Copper is of a yellowish red; sul-
id is colourless. It is formed by the com-
of sulphur, which is a solid crystallised
llow body, with oxygen, which is invisible,
ıtly colourless, gaseous, insipid, &c. What
ıe of the solidity of the crystals and of the
the sulphur? What causes the acidity?
s the colour of the sulphur caused by? In
l state its crystals are of the 4th system.
ıny relation between its colour, the form
stals, and the number and arrangement of
co-chemical constituent elements, and
; to what law? The cupric sulphate being
of yellowish-red copper and colourless
acid, what becomes of the copper colour?
is formed the bluish-green colour of the
Which are the chromatogenic elements
olours? Sulphur, when cold, is smell-less,
heated it is very odorous. Heat has no
here from comes the odour?—of what
? In a molten state sulphur is colourless
lucid. Why? If then poured into cold
becomes ductile, its crystals are of the 5th
ınd its colour is brownish red. It loses
s chemical properties, and if re-melted and
re-takes its natural colour. How is all
ined? White is not a spectrum colour.
to Newton's principle, it results from a
ixture of the seven spectrum colours. If
an the white aspect of the anhydrous sul-
explained? "Ex nihilo nihil: in nihilum
reverti." An old chivalric motto says,
e oblige." So does science, Mr. Grey.

A FOREIGNER.

]—**Tire Cement.**—I suppose readers are
red of giving the recipe for this cement,
ı be found in many back numbers. Melt
say equal parts of guttapercha and pitch:
rtions do not make much difference, but
n excess of guttapercha is better than an
pitch. CYCLIST.

]—**Mine, or Bull Dog, or Pig-Iron
r Slag—Mill Furnace Cinders or
re.**—"Mine" is another term for ore.
ion, of course, varies with source; but
he ores smelted in Britain contain the iron
oxide, hydrate, or carbonate. In addition
lica or clayey material. The ore is burnt
rtain proportion of fuel (coal, coke) in
ps in the open air. It is thus deprived of
ioxide, water, and other volatile con-
leaving a red to black cindery mass,
"burnt ore." The burnt ore is mixed
ighed proportion of flux, and treated in
ace for production of metal or "slag," or
dross, the former being known as "mine
he slag consists essentially of silicate of
and lime, with traces of iron, magnesia,
es, alkalies, and sulphur. It floats above
n metal, and is drawn off first. Per cent.
ies from 30 to 50. Many attempts have
e to employ slags for industrial purposes;
esent the general plan is to run the slag
ngular tubs, allow it to cool, and convey
ot about half a mile off, where it is tipped
ft as waste. Where stone is scarce, in
ountries slags are used as road-metal.
l, produced by blowing steam through
ag, has been used for coating boilers; but
t slags are little used for economical pur-
ap-cinder, or slag of the puddling furnace,
s contains such quantities of iron (as silic-
; it is added to the blast-furnace charge,
o obtain the metal (then called "cinder-
r it is broken up into lumps and roasted in
ich causes a very fusible slag to run off,
residue of "bull dog," mainly ferrous
nd used for fettling the bed of the puddling
Mill-furnace cinders are used for the
pose. They are quite distinct from burnt

S. S. R.

]—**Dolomite—Limestone.**—Owing to
nesia which it contains, dolomite is of
alue for forge-iron production, and also
ganiferous-iron; but iron smelted with
n flux is unsuited to foundry purposes;
agnesian limestone is therefore avoided,
bundant in the locality. Magnesian lime-
ot burnt for lime, the product being poor.
sed in ironworks as a flux. Limestone is
en employed; but the oxide has special
es. S. S. R.

]—**Dolomite, Slag.**—CHEMICAL, MEDI-
nderford, so-called on account (I conclude)
ad or ford being made with the cinder of
the ironfounders, has a most singular
ce in this—i.e., the blue tint of the road
due to the blue colour of the slag of the
rd Ironworks being in excess of all other
t seen by me. Can metallurgic chemists
for the said blue appearance present, more
a most slags? When fluor spar is present
estone flux (magnesian limestone prevails
istrict), what chemical change takes place,
e fluoride, in the furnace? What is the
of the magnesium, sodium, and potassium,
under the head alkali in the slag analysis?

"The 12 Tissue Remedies of Schussler," Boerick, 921, Arch-street, Philadelphia, relates to the waste products of the ironworks slag (in so far as relates to its elementary chemical constituents) to such a degree as to lead me to ask for information from those metallurgists whose attention to the subject of slag, &c., has, owing to the basic-hearth and other modern steel-making processes, &c., of late years been specially directed. Some six years ago accident led to my testing the action of slag as a possible and probable medicinal agent on the human body. Schussler's investigations (then unknown to me) had anticipated mine, but in a different sphere, Schussler having experimented (separately and solely with each salt) with calcium as fluoride, phosphate, sulphate; magnesium, as phosphate; silicon as $SiO_2$; sodium as phosphate, sulphate; ferrum as phosphate, &c.; while I dealt with slag itself. Experimental chemists in search of some medicinal novelty as a means for obtaining scientific fame and pecuniary gain, have in this waste product a means leading to a profitable end; but it must be on the Hahnemannian lines. Much has already been done in turning to profitable use the otherwise waste product of the steel-works, called basic cinder, as a fertiliser of the soil, or as a means of supplying certain agricultural crops of vegetation with food, or with a stimulus for assimilating more food. Agriculture in this respect backs up homœopathy; for the doses of the stimulant (ammonia especially) must be atomic in quantity, soluble, and attenuated in form; otherwise death to the plant follows. Now is not this fact an encouraging one towards casting aside blind unreasoning scepticism in favour of unprejudiced investigation? No. 23 of the League Tracts, "Homœopathy in the Old School," is calculated to this end. So thinks

THE LYDNEY DISPENSER.

[71986.]—**Hydraulic Ram, and the Flow of Water in Pipes.**—(1) Allow me to draw "G. L. E.'s" attention to the extract from Montaigne's "Essays," under the Editor's Notes, p. 527. (2) "G. L. E." writes very illogically. How can he presume to indite thus: "Theoretical engineers will tell you 1½ and 2in. pipe." Afterwards, "As the back-pressure is not so great on the ram as in a larger pipe." (3) How is it possible for "G. L. E." to express an opinion upon the undelivered views on this particular subject of theoretical engineers? (4) I take the liberty of informing "G. L. E." that the static pressure remains the same, whatever the bore of the pipe may be, the water being quiescent, whether it be an inch, a foot, a yard, or a mile; the vertical height being always constant. This is one of the first principles of hydrostatics. (5) In this particular case, the vertical height being 20ft., the pressure would be 8·64lb. per sq.in. (6) When water is in motion it is properly governed by the laws of hydraulics. In that case the effect is the very opposite of that false law which "G. L. E." propounds. (7) The flow of water being constant in time and quantity, the larger the bore of the conducting-pipe from the apparatus which is forcing it onward to its exit, so will the friction flowing through the pipe be lessened, and thereby the force or pressure upon the delivery-valve of the apparatus at its base be also lessened, in strict conformity to the *n*th increase of sectional area and $\sqrt{v}$ of its velocity, following a natural and not an empirical law. (8) I have checked off the relative heads which would accrue, if 1½ and 2in. bore pipes were used, taking the quantity, time, and length as before. With 1½in. pipe it would be ·03605ft.; with 2in. pipe, ·00733ft. (9) By good practice as well as sound theory, it will result thus, the normal head being 20ft. the quantity and time as before. Supposing any of the following bore of pipes be used, the heads will be increased in this manner:—With ⅜in. to 66·75ft.; ½in. to 30·38ft.; ¾in. to 21·293ft.; 1in. to 20·2933ft.; 1½in. to 20·0365ft.; 2in. to 20·00733ft. (10) The ultimate sentence of "G. L. E.'s" is a very fallacious idea; very similar in value to those held by the "flat-earth" and "perpetual-motion" faddists. (11) "G. L. E." sneers at theorists. Let me inform him some theory is based upon well-grounded practice, combined with well noted and observed experience, and not upon such a vague and unsound notion as that given by him in his concluding sentence in "Ours" of August 15th. (12) I will venture to assert that no theoretical engineer of sound judgment would lay, or attempt to lay, either 1½ or 2in. bore pipes for this purpose under conditions given by "Aqua-Thruster."

TUBAL-KAIN.

[71987.]—**Telephones.**—To MR. ALLSOP.—Having been away for a time, I was unable to answer this query before. The illustration of the E.M. receiver in article I. is full size, so you can get the size of the different parts by measurement. You will be able to use a ferrotype plate after December next, when Bell's patent expires. You cannot lawfully use any carbon transmitter until Edison's patent expires (which it does in July, 1891) unless for experimental purposes only.

F. C. ALLSOP.

165, Queen Victoria-street, E.C.

[71997.]—**Nickel-Plating.**—If the current employed to deposit nickel is too strong, or its E.M.F. is too high, or the solution is out of working condition, bubbles of hydrogen will form on the article being plated, and these will be bridged by a thin deposit of nickel, which will strip under the least pressure, because it does not adhere to the surface of the article on which it is deposited. Sometimes, however, a loose deposit is caused by want of care in preparing the article to receive a deposit. A mere trace of dirt will prevent perfect adherence.

G. E. BONNEY.

[72003.]—**Alleged Brake Failure at Liverpool L. and Y.**—I think "An Engineer" must have been misinformed of the cause of the above. There was no failure in any way of the brake, nor was there any water found in the pipes. The cause was a miscalculation of speed on the part of the driver, who, like a great many more drivers who run into Exchange Station, are rather too bold. The rails are always in bad condition through oil and water, caused by carriage-examiners and washers being always fully occupied attending to the trains. The first failure of the automatic vacuum brake has yet to come on the L. and Y.

JACK FROST.

[72012.]—**Telephones.**—It is very probable that you have not wound your magnets to suit the battery or circuit, or it may be only want of adjustment. You must adjust them on the actual circuit on which they are required to work, and not on the secondary of an induction coil where the current is very powerful. As regards the expiration of the patents, see my reply to query 71987.

F. C. ALLSOP.

[72026.]—**Prurigo.**—The best advice I can give "Frances" is *Tolle causam*, or to be more explicit in his description of his symptoms. With regard to the curious jargon of the "Lydney Dispenser," who goes so far as to presume to call upon the readers of "Ours" for a verdict, could it be seriously entertained by anyone but an ignoramus that all the advances of medical science, the labours of our great medical centres, that the brilliant intellects so fitly gathered recently in Berlin have all worked in vain, and that obscure quacks claiming to have received the sacred fire of knowledge are to impart to ignorant persons the power of healing themselves with sugar pilules? I have often wondered why otherwise sane individuals, when they have to deal with diseases in their own body, or in those dependent on them, abandon reason, and fly to superstition and quackery. Nevertheless it is a fact, and one is afraid to say how many lives have been lost or ruined in consequence. I hope the readers of "Ours" will believe that the knowledge of disease is only bought by years of patient drudgery, and it is a subject of such immense proportions that most of the best minds engaged in its study and practice only regret that life cuts short their incomplete and arduous work. Those are the people, and those taught by them, that are enabled to treat and understand disease. I hope none of my readers will ever regret for a lifetime, or find it too late to regret, sending for proper medical advice. I have known of many, and it's only the consciousness of it that induces me to reply to such obvious rubbish as you have seen in our previous issue. In perusing the "Lydney Dispenser's" advertisement, among many similar statements I notice "cataracts absorbed." I can assure the readers of the ENGLISH MECHANIC that it is the indication of the most hopeless ignorance to make so utterly absurd and false a statement. No one can say that he has been able to influence similar pathological changes, as those taking place in cataract, in any part of the body, by internal treatment. It would be on a par with endeavouring to reproduce an amputated limb by "Bry., Calc., Merc., &c.," whatever they may be.

INNOMINATE.

[72036.]—**Guessing the Number Thought of.**—As somewhat analogous to this, the following for finding the age of a person may be of interest: Let the person multiply month of birth (number) by two, add to product the number five, multiply the result by 50 and add to the product his or her age in years, deduct 365 and add to the remainder 115; let the person tell you the final sum thus arrived at. If you then cast off the two right-hand figures you have the age in years, and the remaining left-hand number, or numbers, gives the month of birth.

X.

[72039.]—**Electric Lighting.**—Run the wires along the wall and arrange a sloping cover of zinc or wood above them, so that all wet will drain off. As regards switches, read articles III. and IV. of "Practical Electric-Light Fitting," which appeared in the ENGLISH MECHANIC of May 2 and 30; the most usual form of switches are illustrated there. The continuation of these articles will appear shortly. F. C. ALLSOP.

[72051.]—**Universal Telephones.**—These telephones are very similar to the E.M. receiver shown in Fig. 2 of "Telephones: their Constructio and Fitting," the first article of which appeare the "E.M." of May 16th. The diaphragm is of celluloid, and the results given by these telephones are really surprising, considering there is no microphone. Anyone can make an "E.M." receiver if he can make a diaphragm that will resist the atmospheric changes, which is where the difficulty comes in. F. C. ALLSOP.

165, Queen Victoria-street, E.C.

[72062.]—**"Lady of the Lake" Engines.**—If "North Western" will kindly write to me with the particulars asked for, I shall be much obliged. My address was advertised in No. 1276.

P. NEALE ("Hascombe.")

[72068.] — **Electro-Coppering Zinc.** — You have failed to get an adherent coat of copper on zinc because you have attempted to deposit copper on zinc from a solution of copper sulphate. As zinc will freely dissolve in sulphuric acid, and is electro-positive to copper in this acid, it becomes coated with copper by simple immersion in a sulphate solution of this metal. To deposit copper on zinc, you must employ an alkaline solution of copper, easily made up in the following manner: Dissolve 4oz. of copper sulphate in one gallon of rain-water, and add to it enough liquid ammonia to first precipitate all the copper as a green powder, and then dissolve this to form a beautiful blue liquid. This will take about 4oz. of strong liquid ammonia. Next add a solution of cyanide of potassium, until all the blue colour disappears, and the solution assumes the tint of old ale. This should be well stirred, and allowed to rest for 12 hours before being used. Employ three quart Bunsen cells in series, and an anode of pure electrotype copper. Gas should be freely given off from the article during deposition. If the anode does not dissolve freely, but gets coated with a blue or green crust, add a little more ammonia and cyanide. This solution will give an adhesive coat of copper on iron and steel, as well as on zinc; but the articles must be cleaned and properly prepared.

G. E. BONNEY.

[72069.]—**Beef.**—"Butcher" has been misled. Beef slaughtered in the cool of evening will keep sweet longer than that slaughtered in the afternoon; the reason being that the animal heat can get out quicker in proportion to the coolness of the atmosphere. In really hot weather (no matter what part of day) beef will go bad within twelve hours of slaughtering through the animal heat being condensed in the middle of the thickest parts, unless quickly slaughtered and "fats opened out" (a term well known in the trade). BINDON.

[72071.] — **Wasps.** — Put some cyanide of potassium (poison) into the place, and keep as air-tight as possible, so that the air will become saturated with it. This is certain to kill them and cannot do any harm. G. B.

[72071.] — **Wasps.** — Spirits of turpentine or paraffin oil will do. If you have anything to cover the nest up with, it will be better; but I think it will be sufficient to pour the turps or paraffin into the nest. They won't trouble much about getting away (I do not mean burn them out of it; simply pour a little in the nest). G. BATTER.

[72071.]—**Wasps.**—It may be useful for readers of the "E.M." to know of a good fuse, which will settle any wasps' nest in half a minute. An old gun cartridge case is a good size to be filled. Take saltpetre, 12 parts; sulphur, 7 parts; and orpiment, 4 parts; mix well together through a sieve, and press into a case. If this, when lighted, is put into the hole of nest and tamped up, the whole nest may be dug out immediately the fuse has burnt out, even when (as is often the case) the nest is 2ft. or more from its entrance hole. I have taken more than 100 nests without a sting.

F. B.

[72071.]—**Wasps.**—When you have located a wasps' nest, take a stout stick, some pieces of rag, some kerosene, a spade, and some matches, and advance against it. An assistant is also useful. The correct time for the performance is after sunset, when all the wasps are in; that will be about 8 p.m. If there is more than one entrance to the hole, stop all except one. Wrap some rag round the end of the stick, saturate the rag with kerosene, and set fire to it. Hold the burning rag at the mouth of the hole, and enlarge the entrance to the nest. All wasps that come out must be burnt; a little kerosene thrown into the hole and set fire to will materially assist. When you get to the comb, throw some kerosene on it, and set it on fire; stir it about until the whole show is entirely destroyed. The great secret of success is to keep the hole filled with flame, so that no wasp can get out. During the last three weeks I have taken thirteen large nests in this manner, and I can safely say that it is the cheapest and most effective plan I have ever tried. H. P.

[72071.] —**Destroying Wasps' Nests.** —The very simple and scientific mode of annihilating these ests of the garden is this:—Saturate a bundle of t rags with bisulphide of carbon, fastened to of stick; having cleared the mouth of their entrance hole, stuff the rags into the same, and put a bit of turf over it, to exclude air. Avoid inhaling the fumes of the dreadful vapour, and take good care that you do not bring a candle near, as it is highly explosive and inflammable. This recipe has been adopted for years in the North of England, and is the least dangerous of any I know in the hands of prudent people. The smoke of puff-balls is a powerful anæsthetic, and was long used to stupefy bees and wasps by village people. Boiling water is required to kill a swarm of winged wasps after this operation, as the insects soon revive by exposure to the air. The combs are very saleable to anglers, being scarce, and in great demand, but they must be slightly baked, or the brood will be hatched; besides, this heating process renders the grubs firm for the hook. Eos.

[72083.]—**Demagnetisation of Watch.**—You must not operate on the watch *en masse*. Treat each affected piece singly. See Mr. Britten's "Handbook." If the hairspring and mainspring show any signs, you had better replace them. Also examine the case-springs. A. J. W.

[72084.]—**Music for the Deaf.**—Some years ago I remember reading in the invention column of *Cassell's Monthly Magazine* a description of how to make an instrument called an Audiphone. It is in the shape of a fan, the top of which is touched or bitten by the teeth, the handle being held in the hand. It was claimed for this instrument that people deaf, in the degree that "Afflicted One" describes, were enabled to hear a concert or music quite distinctly. I hope these meagre data may be of use to "Afflicted One." INNOMINATE.

[72098.]—**Immediate Life Annuity.**—I find that the "Germania" Life Office makes no difference between male and female annuitants, and grants annuities under the condition of *returning one-half of paid-in capital* at death. The rates of annuity are as follows:—

Age last birthday, 50, annuity, yearly, 5·84 per cent.
" " 56, " " 6.50 "
" " 60, " " 7·10 "

If without returns, the per centages for the ages mentioned, are, respectively, 7·68, 9, and 10·20. The offices of this Company is at Stettin, in Prussia.

M.

[72098.] — **Immediate Life Annuity.** — Another German society, the "Allgemeine Rentenanstalt," of Stuttgard, based throughout on mutual principles, grants a fixed annuity of £6 2s. 2½d., *plus dividends*, per £100 at 50 years age of entry (£6 11s. 5d. at 55, £7 3s. 0d. at 60, and so on), irrespective of sex, and returns at death the capital, less annuities and dividends paid. The dividend commences in the second year, and amounts for 1890 to five per cent. of the annuity, which would bring the latter up to £6 8s. 3d. per £100. This supposes the annuity paid *yearly*. If half-yearly, the capital paid in must be increased by 0·5 per cent.—i.e., by 10s. per £100, as entry fee. It is evident from this that in £100 ÷ £6 8s. 3d. = 15·6 years, the capital would be exhausted, and that no return of capital at death would be made; but as the life expectancy at 65·6 is still 10·5 years, the society would pay in all, including dividends, up to that time, 26·1 × £6 8s. 3d. = £160 18s. 7d. for each £100 received, and for as much longer, at the rate of £6 2s. 2½d. per year, plus dividends, as the annuitant might still live. This form insures a high rate of interest, and the society's risk is the possibility of a long life on the part of the annuitant; whereas in case of early death (within about 15 years), a proportional part of the capital, decreasing at the rate of £6 8s. 3d. per cent. per year, is returned. There is no loss of importance in conveying money to and from Germany, as the exchange is duly regulated. £1, at present, is equal to marks 20·40, and vice versâ; cheques on London cost marks 20·95 per £1, so that the difference is only about ¼ per cent. I do not know if the society grants annuities to persons outside of Germany, or if it has an agency in London; but this could be easily learned by applying to the above address.

M.

[72104.]—**Camera Lucida.**—In using a camera lucida, the edge of the prism divides the pupil of the eye into two parts: with one part you see the image of a distant object in the prism; with the other part you see the pencil point near to you. The round convex lens underneath the prism adjusts the focus to the eye, sufficiently near for ordinary use; the concave lens, in front, acts in the same way for short-sighted persons, but in the reverse direction. In a properly constructed camera, these two lenses cannot both be used at the same time. A well-known artist of great merit frequently told me of the benefit he derived in his younger days from the use of the camera lucida, in giving him correct ideas of perspective, and for this purpose he strongly recommended its use to young artists. ROBT. J. LECKY.

[72116.] — **Locomotive Colours.**—N.B.R., black, with a narrow red line on each side. I think that the L.C. and D.R. are picked out with two red lines. G.N.S.R. are picked out with bla lines. R. S. BRUCE.

[72123.] — **Compound Marine Engine.** — I should be much obliged to "T. C., Bristol" if I would kindly inform me what size and descripti of boiler would suit the engine, and how thick would be: for material I prefer copper. T cylinders have no jackets and no drain cocks, ther fore, I presume, they and the receiver will becon choked with water on starting. How is this to avoided? The receiver is jacketed.

A. F. SHAKESPEAR.

[72127.]—**Dyeing Ivory.**—Black may be o tained by boiling the ivory in a strained decocti of logwood, and then steeping it in a solution red sulphate, or red acetate of iron. Blue: Ivo kept immersed for a longer or shorter time in dilute solution of sulphate of indigo, partly sat rated with potash, will assume a blue tint greater or less intensity. Green: This is given dipping blued ivory for a little while in a soluti of nitro-muriate of tin, and then in a hot decocti of fustic. Yellow and Orange: This is given impregnating the ivory, first with the above mordant, then plunging it in a hot decoction fustic. The colour passes into orange, if so Brazil wood has been mixed with the fustic. very fine unchangeable yellow may be commun cated to ivory by steeping it 18 or 24 hours a strong solution of the neutral chromate of potas and then plunging it for some time in a boili solution of acetate of lead. Scarlet and red: T may be given by imbuing the ivory, first with t tin mordant, then plunging it in a bath of Bra wood or cochineal, or a mixture of the two. La dye may be used with still more advantage produce a scarlet tint. If the scarlet ivory plunged for a little while in a solution of potash, will become cherry red. Violet, lilac, and purpl These are given in a logwood bath to ivory, pr viously mordanted for a short time with soluti of tin; when the bath becomes exhausted, imparts a lilac hue. Violet ivory is changed purple red by steeping it a little while in wat containing a few drops of nitro-muriatic aci With regard to dyeing ivory, it may be in gener observed that the colours penetrate better befo the surface is polished, than afterwards. Shoul any dark spots appear, they may be cleared up rubbing them with chalk; after which the ivo should be dyed once more to produce perfect un formity of shade. On taking it out of the boilin hot dye-bath, it ought to be immediately plunge into cold water, to prevent the chance of fissur being caused by the heat.

New Hampton. N. A.

[72130.]—**Photography.**—Your queries lead m to suppose that you are a beginner in photograph as you do not seem to be at all familiar with th appearance of a negative. If I am right in m supposition, I would advise you to obtain som elementary work on photography, and well read up. Do not be discouraged at your non-success every spoiled plate will teach you a lesson if yo will profit by it. The absence of detail and boldne in your negatives may be due to various causes, bu most likely, I suspect, to under-exposure or unde development, or perhaps your developer is n sufficiently strong. Do not remove your develop too soon, but wait for the proper density, an nothing but experience will teach you the rig moment. It is quite right for the face and han to appear black in the negative. There is nothi unusual in having to hold the negative to the lig after fixing; in order to see the image, it is necessa to do so, and the image should appear well mark and not too thin. SHUTTER.

[72134.] —**Homœopathy and Poisons.**—Th ancient Roman workings amongst the iron o mines, still visible to-day in the outskirts of Lydne Park as freshly as 1,000 years ago, afford, among other strongholds, an impregnable sanctuary for th foxes of the Forest of Dean, which are, I believ unequalled in Great Britain for their size, cunning craft, and daring. Alike as is portrayed in Landseer's great picture of the fox "Not Caught Yet," the old forest fox, "The Lydney Dispenser," is no to be caught in the trap laid for him by "A.W.S." in p. 542. Part V. of Ruddock's "Vade Mecum" is devoted to poisons and their antidotes; whi "Spillan's Homœopathic Prescriber's Parmacopœi (Leath, St. Paul's Churchyard, London, E.C. contains (p. 144—171) the information asked for so far as relates to what are poisons, and the usu means for endeavouring to antidote an otherwise fa dose, so far as was known up to date of issue, 18 As to cattle and poisonous herbage generally, w get them to eat *in situ* if you can. I am ope afford you or anyone else every facility for the t Domestic herbivorous quadrupeds have probab sense in addition to touch (situated in the muz smell, and vision, and of which man has nei knowledge nor conception; alike also as to what that instructs the cat to eat an emetic in order t its stomach of the skin and the fat of the field-mo one of its natural foods;—the aspect of phy distress, during the action of the emetic, on

ıften affords me much subject-matter
ɔn, &c. The collection of the League
to be necessary, notably the last issued,
, "How the Powers of Drugs were
' for remodelling the querist's rather
tions *in re* Hahnemann's therapeutic
f toxic agents.

THE LYDNEY DISPENSER.

**Gunpowder.**—Two formulæ are given

$$O_3 + S + C_3 = K_2S + N_2 + 3CO_2.$$
$$O_3 + S + C_6 = K_2S + N_2 + 6CO.$$

is, however, much more complicated
ıve.

SM.

**American Organ and Concert**
ıould advise the querist to let his Bell
n as it is; but, if he must have the pitch
ter employ a practical tuner—one used
g of American organs. Reeds are raised
craping at the free end; but as that is
f the reed which is voiced, he had better
ıe.

G. FRYER.

**Tapering Tubes.**—Hammer the out-
nd you want larger on a mandrel.

T. C.

**Leclanche No. 1 Cells.**—Replacing
ds by circular plates will reduce the
the cells a little.

F. C. ALLSOP.

**Leclanche No. 1 Cells.**—None what-
liminish slightly the internal resistance;
ıot an advantage for constant work.

S. BOTTONE.

**Leclanche No. 1 Cells.**—No,
ıt. The battery is not constructed for
a constant current is required, only for
ıl one; because, after the battery has
some time, the manganese becomes ex-
ɔxygen, and the force of the electrical
reatly diminished. But if you let it rest
period the manganese will obtain for it-
supply from the atmosphere, and is
for use. Therefore you can see how
ɔuld be for you or anyone else to try and
anganese a constant supply of oxygen
g the positive element.

J. PAWSEY.

**H.P. of Bicyclist.**—About $\frac{1}{6}$H.P.

S. BOTTONE.

**Cog-Wheels.**—If G has twelve teeth
seven turns to one of C, and if you
wheels of 68 teeth and 14 teeth, the
un correct speed. You must suit the
f wheels to the pitch of teeth you use.

T. C.

**Cog-Wheels.**—If you must use bevel
best arrangement will perhaps be
(p. 562) a pinion of seven leaves.
l-wheels will then be 51 and 18 teeth
, and 2in. and $\frac{3}{4}$in. outside diameter.
pinion must be only $\frac{1}{4}$in. diameter this
weak, as your other dimensions sug-
erable force, and I do not think this
d run well at high speeds. I should
ıt you substitute a contrate wheel and
he bevel-wheels; you can then make G
er with 21 teeth, and the contrate
. diameter with 68 teeth, and gearing
ion of eight leaves $\frac{5}{16}$in. diameter on
. This train ought to be amply strong
l if carefully depthed will run very well.
ıst carry the worm-shaft beyond the
ɔntrate wheel you must make that wheel
gh to allow a bridge over the shaft to
ivot of F; it will, however, be best (if
ch power) to pivot the worm-shaft as
ɔinion as possible. I have not time to
lrawing this week; but perhaps some
r will. If you still want one, let me
I will send one later on if Mr. Editor
ɔm for it. But if you make the bevel-
must be careful that they are properly
ur sketch is wrong in this respect, as
ɔe parts of two cones having their points
nt where the central lines of the two
ld intersect if produced.

A. J. W.

**Pennyworth of Gas.**—Automatic
ɔr supplying gas by the pennyworth are
Liverpool at the Corporation Artisans'
Marsh and Thorp's automatic arrange-
sts of a money-box, placed in connection
ıtlet of the gas-meter. This money-box
valve which closes off the gas supply and
ɔened by means of a penny. The mode
ɔn is as follows:—The gas consumer,
s, places a penny in the slot; he then
ne with a plunger until it drops into the
. The penny, when pushed, actuates a
ich opens the valve a certain distance
s the gas varies in price). The valve is
with the measuring-chamber of meter,
dually worked down on to its seating by
n of this chamber. As the valve nears
, the size of the light or lights diminish,
he consumer that another payment is
If this is not made, the valve closes, and the lights are put out, and cannot be relighted until a penny has been placed in the box.

T. G. M.

[72156.]—**Kauri Gum.**—I am not acquainted with this, but the only solvent of a true gum is water. If it is a resin instead of a gum, it will be insoluble in water, but probably soluble in alcohol and other organic liquids.

SM.

[72156.]—**Kauri Gum.**—You will never make a good job out of it by melting and casting; but you can cut it quite easily if you cautiously saw it with a fine fret saw, kept moist with olive oil. The saw must be stretched quite tight, and not allowed to wobble, otherwise you will split your kauri.

S. BOTTONE.

[72160.]—**Troublesome Feet.**—Try washing them every night in salt and water. I have found this admirable in many cases.

R. G.

[72160.]—**Troublesome Feet.**—"H. W." will probably find great relief by douching his feet with cold water and then giving them a vigorous friction with a rough towel; after this to massage or rub the soles of the feet, himself, with such a lubricant as neat's-foot oil every morning for as long as he can, not longer than half an hour. It will also be an advantage to wear valgus pads, that he can obtain from any surgical-instrument makers.

INNOMINATE.

[72161.]—**Light.**—The room requires ventilating. Arrange over the burner a tin funnel having an exit into the flue.

SM.

[72161.]—**Light.**—I should recommend for oil-light a Wanzer lamp, as they are clean and cheap, give no smell or smoke, and require no chimney. Or would a small electric light suit you better?—If so, look through the advertisements.

J. PAWSEY.

[72163.]—**Sepia.—Anemone.**—Sepia consists of black pigment 78 per cent. $CaCO_3$ 10·4, $MgCO_3$ 7, alkaline sulphates and chlorides 2·16, mucus 0·84. There is no chemical formulæ for a mixture like this. Anemonin, $C_{30}H_{12}O_6$ (?), is the active principle of several species of anemone—A. pulsatilla, A. pratensis, A. nemorosa. It is poisonous.

SM.

[72165.]—**A Defective Dynamo.**—The causes of failure may be any of the following:—1. The insulation is defective. 2. You are driving wrong way. 3. The winding being correct, the ends of the field magnet wires are not connected rightly. They should be so connected that on coupling up the two free ends with a battery one pole-piece is distinctly and decided N., and the other as distinctly S. 4. The field magnets have not been sufficiently magnetised. 5. The connection of field-magnet wires to brushes or pillars are not right. If in shunt, one F.M. wire from each limb goes to each separate brush. If series wound, one F.M. wire goes to a free terminal, the other F.M. wire goes to a brush, while the other brush and free terminal are connected by a short independent wire. 6. The slits of the commutator are in the wrong position as regards the brushes. The slits should be under the brushes when the iron cheeks of the armature face the field-magnet pole-pieces.

S. BOTTONE.

[72166.]—**Gas Compression.**—Taking the atmospheric pressure at 14·7lb., the pressure at 1$\frac{1}{2}$in., 2in., and 2$\frac{1}{2}$in. water will be 14·754lb., 14·772lb., and 14·79lb., and if the heat is absorbed during compression, the cubic feet at 120lb. gauge pressure will be 9·13, 9·12, and 9·11 per cubic feet of space.

Bristol. T. C.

[72166.]—**Gas Compression.**—Gas, under a pressure of 1$\frac{1}{2}$, 2, and 2$\frac{1}{2}$in. of water is, in other words, under a pressure of 0·047, 0·072, and 0·09lb. per square inch (1 atmos, or 14·7lb., being equal to 406·8in. of water), or, including the atmosphere, 14·747, 14·772, and 14·79lb. per square inch. To compress to 120 + 14·7 = 134·7 per square inch; divide 134·7 by the last-named figures and you obtain the number of cubic feet to compress into 1 cubic foot for each cylinder at *initial* temperature, viz. 9·134, 9·119, and 9·108 cubic feet. But practically, no such a quantity could be got into the cylinders at this pressure, owing to the heat generated, and consequent expansion and pressure reaction of the gas. If uncooled, and assuming an initial temperature of the gas of 20deg. Celsius, the temperature at the final pressure of about nine atmospheres absolute would be 282deg., and its volume, from the rise of temperature in compressing, would increase (282—20) × (·00368 + 1) = 1·964 times.

MARIENBERG.

[72168.]—**Electric Bell.**—It does not matter if you use a double wire. If the earth is used, it is customary to connect it with the zinc. The cells are harmless in a bedroom.

SM.

[72168.]—**Electric Bell and Battery.**—If "Bene" will note the fact that there are six connections and three wires to do them with, surely he can solve the difficulty. If he has 50 cells in his room, he won't kill himself.

SIMPLE.

[72168.]—**Electric Bell and Battery.**—It does not matter to which terminal of the bell the line or battery wire is attached, unless the bell is a continuous-ringing one. Having the cells in your bedroom will not matter.

F. C. ALLSOP.

[72168.]—**Electric Bell and Battery.**—It is absolutely indifferent to which terminal the wire is connected. The Leclanché cell gives off no injurious fumes. A little ammonia is liberated, but very trifling in quantity—so little indeed as to be unrecognisable except by bringing the nose quite over the cell.

S. BOTTONE.

[72168.]—**Electric Bell and Battery.**—Connect the anode with one terminal of the bell, connect the other terminal to one terminal of the push, and the last terminal of the push to the cathode of the battery. I should not advise you to keep your batteries in a bedroom, above all places. Leclanché batteries should be kept in a cool place—such as a cellar, where the temperature is always about the same.

J. PAWSEY.

[72171.]—**Chemical Rancidity.**—According to Dubrunfaut (*Comptes Rendus*, 72, 37) the rancid odour is due to volatile fatty acids. Tidy, in his handbook, says that these result from the action of decomposition-products of the albuminous matter which is always present as membrane, &c., in animal fats, upon the glycerides, setting free the acids. However, the matter is by no means thoroughly understood.

DIRECTOR R.R.L.

[72171.]—**Chemical.**—Fats are the glycerides of fatty acids, or glyceryl ethers. The combination of glycerol with a fatty acid and the elimination of water. Thus—

$$\underset{\text{Glycerol}}{C_3H_5(OH_3)} + \underset{\text{Palmitic acid}}{3C_{15}H_{31}COOH} - 3H_2O$$
$$= \underset{\text{Palmitin.}}{C_3H_5\,3C_{15}H_{31}CO_2.}$$

The thickening of fixed oils is purely an effect of oxidation; but rancidity appears to depend upon the presence of azotised substances, which putrefy on exposure to air and act as ferments. Animal oils are peculiarly subject to rancidity.

SM.

[72173.]—**Portrait Lens.**—The Petzval form of portrait lens certainly gives the most pleasing picture for portraits. There is more rotundity in the image, and a more artistic concentration of best focus on the principal figure, which makes the result preferable to that obtained with a view lens or rectilinear, in which the background is painfully and obtrusively sharp and distinct.

S. BOTTONE.

[72174.]—**Tattoo Marks.**—Nothing but removal of the skin can have any effect on these marks, which are permanent.

INNOMINATE.

[72175.]—**Gramme Dynamo.**—To MR. BOTTONE.—I presume your dynamo is series wound? If so, you would get cooler running if you were to put 12lb. No. 20 on the fields, and connect up in shunt, removing altogether the No. 18 now on. Or, to avoid removing the existing No. 18, you could add on about 4lb. No. 22, and then connect in shunt with the brushes.

S. BOTTONE.

[72176.]—**Integral Calculus.**—Let $a = nt$ be the radius of the sphere, and suppose the figures to be generated by the revolution of a semicircular plane round a diameter. Take the centre for the origin, the diameter for the axis of $x$, and divide the semi-axis $a$ into $n$ parts, each equal to $t$. Planes perpendicular to the axis passing through the points of division, will cut the hemisphere into $n$ circular slices. The equation to the generating semicircle being—

$$y^2 = a^2 - x^2,$$

we have, for the volume of the $m^{th}$ slice, the expression—

$$\pi\,(a^2 - m^2t^2)\,t + d_m,$$

in which the quantity on the left is the volume of the cylinder contained in the slice, and $d_m$ that of the remaining portion which encircles the cylinder. It will be seen, by drawing a figure, that the proportion of $d_m$ to the cylinder may be made as small as we like by decreasing $t$. Let $V$ denote the volume of the hemisphere, and $D$ the sum of the $d$'s, obtained by giving all integral values to $m$, from $m = 1$ to $m = n$. Then, adding together the volumes of all the cylinders, we have—

$$\begin{aligned} V - D &= \pi\,[a^2 - t^2 + a^2 - 4t^2 + a^2 - 9t^2 \\ &\qquad + \&c + a^2 - n^2t^2]\,t \\ &= \pi\,[n\,t\,a^2 - (1 + 2^2 + 3^2 \ldots + n^2)\,t^3] \\ &= \pi\left\{n\,t\,a^2 - \left(\frac{n}{6} + \frac{n^2}{2} + \frac{n^3}{3}\right)t^3\right\} \\ &= \pi\left\{a^3 - \left(\frac{a\,t^2}{6} + \frac{a^2\,t}{2} = \frac{a^3}{3}\right)\right\} \end{aligned}$$

Make $t = 0$. Then $D$ and the terms containing $t$ all vanish, and we finally obtain—

$$V = \pi\left(a^3 - \frac{a^3}{3}\right) = \frac{2}{3}\,\pi\,a^3$$

I should like to know if any mathematical author gives this analysis.

Charing. J. R. C.

[72177.]—**Agglomerate Leclanche.**—Since the blocks alone contain the depolariser, it is evident that the real work of depolarisation can only take place in them. S. Bottone.

[72178.]—**Telephone Diaphragm.**—These diaphragms were, I believe, made of celluloid. F. C. Allsop.

[72181.]—**American Organ.**—This fault is known as ciphering, the cause of which is evidently something preventing the pallet of that particular note from closing. Take off the sound board and examine the pallets, and you will have no difficulty in rectifying it. G. Fryer.

[72182.]—**Fitting-Up Electric Bells.**—To Mr. Bottone.—I should advise you to use No. 18 wire. Wooden casing or cleats would be preferable to lead. The cause of your two gate bells acting erratically is just because they are coupled in series. You should either connect the two bells in parallel, and use more battery power, or use a device for shunting the current, as described and figured at p. 163 of my "Electric Bells." S. Bottone.

[72183.]—**Sugar-coated Pills.**—A revolving pan is required, heated either by steam coil or blast of hot air; it is also necessary to have a cold-air blast for quickly chilling the contents of pan. The pills are first coated with starch, which is allowed to get quite hard. This is only necessary when any colouring matter might dissolve and tint the sugar. They are next coated with syrup, and rotated till dry. Polish is given by friction and a little wax. Manipulative details can only be learnt by experience or personal tuition. A written description is of no use whatever. It is not every sugar boiler who can sugar-coat properly. Sm.

[72184.]—**Expansion Engines.**—You appear to imagine that the total back-pressure on one piston equals the forward pressure on the other piston, but that is not so. If areas are as 1 to 3, the forward pressure would be as 3, and back as 1, leaving 2 as a forward pressure gained by expansion. There is a part of this lost, however, by loss of pressure of steam in passing from one cylinder to the other.

Bristol. T. C.

[72186.]—**Electro-Coppering Steel Jack Chain.**—The steel chain could be cheaply coppered by the process described in reply No. 72068 in last week's issue of the English Mechanic. But coppering does not preserve from rust so effectually as nickelling. S. Bottone.

[72187.]—**Hydrostatics.**—11¼lb. per square inch.

Bristol. T. C.

[72187.]—**Hydrostatics.**—The pressure (on the keel) due to the water will be about 11¼lb. per sq.in., diminishing regularly with the vertical depth to nothing at the surface. A. J. W.

[72188.]—**Razors.**—The way to keep razors sharp is never to strop them unless they are blunt. Some people are always using the strop, and so they are always rubbing the edge off the razor. Sm.

[72188.]—**Razors.**—I got my shoemaker to give me a strip of leather about 1½in. wide, 18in. long. I then poured some salad oil on it, and then put a little emery powder on it, and then rubbed it with a table-knife, again adding a little oil and powder, this time using an old razor, and "stropping" it. I never wish to have a better strop. Of course the more it is used the better "edge" it will give. G. A. Batter.

[72189.]—**Razors.**—I cannot tell A. Bean how to sharpen razors; but I can tell him how to keep them in good order. After using, strop on your hand only till quite dry. I have used two on alternate days for close on 12 months, and they are as good as ever. Simple.

[72191.]—**Collodion.**—Provided your methylated alcohol be really good, and your ether likewise, you will get very good results from the following formula:—Ether 300 parts, alcohol 180 parts, iodide of cadmium 5 parts, Pyroxiline 3 parts (by weight). Dissolve the iodide of cadmium in the alcohol, then mix with the ether. Lastly add the pyroxiline, shake up and allow to stand 24 hours in long closely-stoppered bottle. If the pyroxiline is of such a nature to give too viscid a collodion, add 3 parts, by weight, of chloroform. Note that the alcohol must be "absolute." S. Bottone.

[72192.]—**Clock-Mending.**—State exact length of pendulum the clock formerly had, and I will put you right. F. J. Garrood.

[72192.]—**Clock-Mending.**—You must do away with the existing escape-arbor and replace the next wheel. The old escape-wheel rotated about 3¼ times in a minute; the new one will have to go 10. If you cannot calculate the numbers from the above, count all the wheels and pinions in the train backwards as far as the centre wheel, and let us know them; I will then send you the numbers. I regret I have not one of these clocks by me, or would have done the counting myself. A. J. W.

# UNANSWERED QUERIES.

*The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.*

Since our last "Glatton" has replied to 71289, 71290, 71295, 71328, 71331, 71395, 71439, 71475, 71550, 71559, 71576, 71600, 71612; P. Neale, 71632.

| | |
|---|---|
| 71666. | Hydraulic Lock, p. 363. |
| 71684. | Binocular Telescope, 364. |
| 71700. | Scrapers, 364. |
| 71701. | Test for Gold, 364. |
| 71704. | Organ Pipes, 364. |
| 71705. | Cycle Gold Transfers, 364. |
| 71712. | Copper, Brass, and Zinc Signs, 364. |
| 71721. | Sea Chest, 364. |
| 71722. | Cement Kiln, 364. |

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|---|---|
| 71884. | Weighing Machine, p. 451. |
| 71890. | To "Sigma," 451. |
| 71900. | To Prevent Bleaching, 452. |
| 71902. | Centrifugal Pumps, 452. |
| 71908. | Chamber Organ, 452. |
| 71917. | Bad Colour in Gilding, 452. |

# QUERIES.

[72193.]—**Oboe for Chamber Music.**—Will Mr. Tahourdin or some other qualified reader kindly say if the oboe is suitable for amateur chamber music?—either alone or with the pianoforte, &c. Also whether any special difficulties are attached to this instrument, and if it can be well continued by players of advanced age, in the same way that Mr. Lazarus continues with the clarionet?—H. W. Dobby.

[72194.]—**Arc Lamps.**—Can any of your readers tell me if Brush, Pilsen, Siemens, Brockie-Pell, arc lamps can be worked with continuous and also alternate currents?—A. B.

[72195.]—**Magic-Lantern.**—I have a 4in. compound condenser, and 2½in. single lens, also ¼in. portrait double combination. I wish to convert same into use in magic-lantern. I should feel grateful if any reader would give me size with rough sketch to make body of charcoal iron? What would be a safe distance from condenser to lime? Could I alter focus by cutting ¼in. lens in half, and fixing them in sliding tube, so has to get the picture the same size with lantern close or at a distance off the screen?—Smithy.

[72196.]—**To Mr. Bottone.**—Would you be so kind as to tell me which is the best way to test a lightning conductor? And also how far to put the copper-plate into the earth?—A. Robson.

[72197.]—**Joining Malleable Iron to Steel.**—Probably some reader can inform me how a piece of steel can be backed by malleable iron? Is it done by the ordinary process of welding, or is there any solution used and applied between the two metals when hot? I know two pieces of cast-iron can be joined by a process known as burning it together. I don't think that malleable iron and steel is done this way, but it is done very extensively by the Americans.—W. Glass.

[72198.]—**Weymersch Battery.**—Will some reader of the "E. M." kindly say with what substance the inside of the Weymersch battery is coated?—Battery.

[72199.]—**Solder for Indian Silver Jewelry.**—What kind of solder should I use to repair Indian silver jewelry?—Alloy.

[72200.]—**Cutting Brass Discs.**—For cutting a few thousand discs of brass 2in. diameter by ⅛in. or 3-16in. thick, what kind and weight of press should I use? Can I do this neatly with toggle-joint press?—No Power.

[72201.]—**Storage in Flywheel.**—Will a practical engineer put us in the right groove? Myself and friend differ in the following: He argues that it takes more power to drive an engine than the work you can get out of it. For instance, supposing the pressure on piston equalled 2H.P. driving a flywheel of suitable weight, would not that drive, say, a corn-mill of 3 or 4H.P. or more? Should like to know what it would do, not driving off flywheel, but a pulley on end of crank-shaft.—Fly-wheel.

[72202.]—**Coil.**—I have 6lb. of 22 c.c. copper wire; please say what should be thickness and height of the field-magnets and yokes? Also diameter of channel for this amount of wire? Also size of armature, cores, and the amount of gauge wire? Which would be best—cast-iron or malleable?—Old Subscriber.

[72203.]—**Harmless Smoking.**—Can anyone give further particulars of the above, by means of pyrogallic acid? 1. How do you make a 10 per cent. solution from the solid acid? 2. Should the solution be made with water or spirit? 3. Should the cotton wool be steeped in solution, and then allowed to dry before using?—W. E. Smith.

[72204.]—**Star Maps.**—Would "F.R.A.S." or any amateur astronomer be kind enough to advise me a good star map? I have been lent an old "S.D.U.K." map, dated 1840; but it has very few stars or nebulæ marked on it. I have also had the use of Proctor's star atlas for a few evenings, but find it very inconvenient to work out a constellation in the whole of which is not in one map, for the maps are circular, and not easy to piece together. Piazzi's stars are often given in Webb's book in Roman numerals without right ascension or declination. How is it possible to locate these?—Harris Tothill.

[72205.]—**Astronomical.**—Would any astronomical amateur who has mastered the difficulties of R.A. and Declination, tell me of the best book for learning about the subject? Also how to make use of it in using an equatorial? I have read Guillemin, and Smythe's "Cycle," but it is assumed by each writer that the reader is conversant with the subject.—Harris Tothill.

[72206.]—**Drawing and Making Boilers.**—Can any of your readers give me information about a practical handbook on drawing and making steam-boilers?—No Sig.

[72207.]—**Arc Lamps.**—What arc lamp can be worked with continuous current? What with alternate current, also what with both systems?—W. H. B.

[72208.]—**G.W.R. No. 16 Broad Gauge 7ft. Coupled Loco.**—Would any reader kindly give sketch, dimensions, and weight of the above?—R. P.

[72209.]—**Marking Dust Sheets.**—What would be the best material with which to mark a number of dust sheets used by painters, in such a manner that the mark cannot be washed out? Marking-ink is too expensive to use for it.—B. H.

[72210.]—**Noise in Telephone.**—Will Mr. Bottone or some friend tell me the cause of the frying noise in telephone? It comes on at times, and lasts for some considerable time. I have six cells at each end, and, with this exception, it answers fairly well?—Telephone Noisy.

[72211.]—**Skin Perforations.**—Would "Constance" who wrote to you a year ago about piercing the nipples for rings, favour us with an account of her subsequent experience in wearing them?—R. M.

[72212.]—**American Scroll Chucks.**—I should like to have the opinion of some fellow-readers on the subject of these chucks. I wish to have one for my lathe, if they are to be relied on for accuracy and holding power. On referring to a back volume (six years ago), I find some correspondence on this subject; but there seems to be a great difference of opinion as to their accuracy and holding power. I should, therefore, be glad to know if any of the self-centring scroll chucks, now in the market, can be recommended? I wish to use it for model and general amateur work. Would a chuck of, say, 2½in. or 3in. diameter hold a model cylinder sufficiently well to bore up to 1½in.? In the correspondence referred to, the key-chucks are mentioned as holding better than the lever chucks, and that the small ones are often more accurate than the large ones—is this still so? Any information will be esteemed.—Scroll Chuck.

[72213.]—**H.P. of Flow of Water.**—If a cistern 50yds. long, 50yds. broad, and 50yds. deep, were filled with water, and a pressure of 2,240lb. per square inch were applied, what H.P. should I get from a flow of water from one outlet of 1c.ft. per minute, from 5 outlets of 1c.ft. each per minute, and from 10 outlets of 1c.ft. each? Could I obtain 1,000H.P. per 10 hours? Or what size of a tank of water do I require to obtain 1,000H.P. per 10 hours, with a pressure of 1 ton to the square inch?—B.

[72214.]—**Preserving Decoctions of Herbs.**—Can anyone tell me what to put with herbs after boiling (non-intoxicating) to keep them sweet?—Paralysed One.

[72215.]—**Coloured Gold.**—I am making an instrument in gold 22 carat; but finding it a little too heavy, I have dissolved some of the gold off with a mixture of nitric and sulphuric acid, which has left it a light brown colour. How am I to get this off without filing or scraping it? Can it not be done by immersing in some solution? And what is the cause of it turning that colour?—F. E. S.

[72216.]—**Lubricating Pistons: Cornet.**—What is the best lubricant for the pistons?—C. D.

[72217.]—**Publishing Mechanical Drawings.**—Would any reader help me in the following? I have a large collection of mechanical drawings which I intend having published. Would it be cheapest to etch them on metal, or draw them on wood, which I could do myself? The size of plate or block is 12in. by 6½in., and I should require over 350. Information as to best and cheapest way to set about it would oblige.—Giovi.

[72218.]—**Camera Lucida.**—I find a haze surrounding every object, so, therefore, there's no distinct line to follow; and also should like a little further instructions on the two round glasses which I speak of on page 541, query 72104. Mine has one plain, and the other plano-concave. Thanks to "F.R.A.S." for his kind reply.—Reno.

[72219.]—**The Birth of the Moon.**—I do not thoroughly understand Proctor's reasoning in "Mysteries of Time and Space," as regards the birth of the moon from the bands formed by the tidal waves. What was the process of the transformation? And how could such a change have been gradual? I quite understand the ring system, but nothing beyond their formation. A detailed answer would greatly oblige.—F. C. V.

[72220.]—**Eyesight.**—Can any of your readers tell [illegible] what importance to attribute to an affection of one eye which sees a flame, say, of a distant gaslight, as [illegible] luminous ring? Said eye being so short-sighted [illegible] scarcely at all to aid the other in reading, while its [illegible] seems displaced, for the image of an object, say, on the other side of the way—of course dimly seen by said eye—does not quite coincide with that seen by the sound eye, thus blurring the object. Very irksome this. Yet, strange to say at an advanced age, I can read and write without my glasses, though not for long at a time, without inconvenience. A recent inquirer as to eyesight in the "E.M."—not the present writer—was urged to go prompt to [illegible] oculist. This I have done at some cost; but got merely the focal length of a lens for sound eye, to which the other must accommodate itself. No explanation [illegible] given of the eye-affection or of what it may portend. had hoped to get glasses of different focal length should enable both eyes to act together in read E. M.

[72221.]—**Specks Before the Eyes.**—I can times see a small speck in front of my right eye. watch-jobber and feel anxious. What can this mean?—Bad Sight.

[72222.]—**L.B.S.C.R.**—Can any correspondent give a sketch of the three-coupled tanks in use railway, commonly known as "Terriers"; a singles of the "Grosvenor" class?—A. C. Hall.

[72223.]—**Solution for Cleaning Brass.**—some of your readers kindly inform me of a soluti cleaning brass-fittings of engine?—Engine-driver.

[72224.]—**Printing Press.**—Could any reader by giving me an idea and dimensions for making rinting press, with drawers for keeping type, J. M., Brighton.

]—**Trisecting an Angle.**—Will some reader ie best way of trisecting an angle? I believe it been done by pure geometry. Is there a back can refer to on this subject?—W. E. H.

]—**Working Time Tables.**—I wish to rking time books of the English lines, for the f making some calculations of speed. As there lty in obtaining them from headquarters, could ur readers oblige me with a recent spare copy? ss was advertised in No. 1276.—P. N.

]—**Imitation Rock or Coral.**—Can any orm me if there is a substance or mixture that to wood, to make imitation of rock or coral for pots?—J. Lemon.

]—**Logarithms.**—Would some practical man ll me how to use a table of six-figure logarithms vantage in making calculations of any dimen- or instance, suppose I have to find the 8th power rule says: "The logarithm of any power of a equal to the product of the logarithm of the and the index denoting the power"; so, pro- ius:—

$$\begin{array}{r} \text{Log. } 88 = 1{\cdot}944483 \\ 8 \\ \hline 15{\cdot}555864 \end{array}$$

he logarithm of 35963636 +; but this is not the equired, since, by ordinary multiplication, the r of 88 is found to be 3,596,345,248,055,296. tical hints will be acceptable.—W. F. Webb,

—**Enamelling Slate.**—Can any reader tell o enamel slate? Also the proper degree of heat or baking, and the method of polishing after- I have a large iron oven, which I think will do g the slate.—Enamel.

— **Cataract — Eserin Lotion.** — An ic specialist states that my wife has cataract in and signs of it in the other, and has ordered two "G. Eserin" to be applied to each eye nightly. ny medical or chemical friend kindly tell me the ended thereby, as my wife is very weak and and would almost sooner let the disease take its an be operated upon.—Anxious.

]—**Erecting Machinery.**—I have to erect a mmer (3 tons) upon a foundation already built; ace two boilers on their setting upon top of heat- ce. Diameter of boilers, 6ft. 6in.; length, 12ft. ike some hints how to remove boilers from as there is no tackle about the place, it being a new branch railway. Should I use sheer-legs, up an incline with beams to side of waggon? l I fasten on block to boiler when moving? w shall I raise them into position on top of fur- ut 6ft. high? Any hints will be of great value g fitter. This is my first experience of outside . C.

—**Balloons.**—Can any reader oblige with a ore for a balloon to be made of calico, at least 10ft. ter? The method of cutting is principally re- W. T.

]—**Tisane.**—Could any French chemist tell me ients of what the French call: "Tisane aux erbes"? Is it an infusion or a decoction?—

]—**Electro-Motor.**—I have constructed the scribed in a previous number. The magnets are from the coils; but when I remove one of the ie current still passes. Could anyone kindly ome hint as to what is wrong?—A. C. Hall.

]—**Boiler.**—Will any of "our" readers kindly with the size, shape, metal, and all dimensions g a boiler to work an engine 1¼in. bore, by 2½in. Should it be a tubular boiler?—and if so, how es, and what dia. should they be? I should like lenty of steam. What would be probable cost of nplete with gauge, &c.?—Tubes.

]—**Locomotive Speed.**—On a railroad with e rising gradient throughout of 1 in 110, an engine d of 18 vehicles maintains an average speed of 45 hour. What average speed should the same aintain with the same load on a rising gradient 1 in 236, reckoning in each case that a 50-mile be made without a stop?—Speed.

]—**Water Supply.**—A company obtaining its om the Lower London Tertiaries finds the water lually lowering. What is the best way of in- the supply? Supposing a second boring to be n the existing shaft, will there be a larger inflow ven time, or will the apparent advantage be neu- y a reduction of velocity?—E. Kent.

]—**Cleaning Daniell Batteries.**—What is way to clean a few copper cylinders belonging to Daniell battery, telegraph form? They are nside with a kind of green dirt. When clean charged what voltage would the battery give, candle-power lamp would it light?—A Puzzled

]—**Shearing Strains.**—Required; a simple finding the shearing strains on a wrought-iron in. diameter, with two rows of flat arms, 10 on —in all, 20 arms—1¾in. by ⅜in., at 100 revolutions te. Rule for finding strength and number of pokes in a pulley, the diameter of pulley and ing given. Is there any book published on iron pulleys?—A. B. C.

]—**Writing with the Foot.**—A man with- is desirous of using his toes as a means of but experiences an insurmountable difficulty in he pen. Information as to how to hold the pen, ion of the writer, with other helpful hints, would sed by—Handless.

]—**Magnolia Metal.**—What is Magnolia dvertised as a "self-lubricating, non-heating Has any correspondent of "E. M." tried this found? Would it answer for carriage brakes? ry of the wear and tear, and consequent expense, attending indiarubber or ebonite blocks. Am now using pieces of old leather traces—economical, but requiring constant removal over very steep and stony roads.—Eos.

[72242.]—**Photographs on Tin.**—Can anyone explain the process? I am acquainted with dry-plate photography; but, like others, find it very expensive. The photos. I mean are taken on coated tin, taken and finished in about five minutes. Any hints as to coating the tin, exposure, and finishing will be thankfully received; or whether materials are best bought ready for use?—Dry-Plate.

[72243.]—**Candle-Power.**—What is the best way to find the candle-power of a gas burner and an incandescent light? I have tried equalising the shadows thrown by a vertical rod; but find this a very difficult matter, owing to the difference in colour of the shadows. I have made a frame, holding tissue paper with a grease stain in the centre; but am not sure whether I get correct results or not. Have the distances of light to be adjusted until the grease spot disappears? How must this spot be viewed? At right angles through the lights, or at an acute angle between the light and paper? What candle-power should an ordinary fish-tail gas-burner give? In my opinion, a candle gives a more concentrated light than gas—i.e., more light for a given volume of flame. Is this correct? Can anyone explain the probable reason why gaslight is so injurious to the eyes? My eyes are all right in the summer, but feel the effects of gaslight about the end of winter. I find, however, that the electric incandescent light does not hurt my eyes. Yet I hear others complaining about the evil effects of electric light. Is this mere prejudice?—Electro-Optical.

[72244.]—**L. and S.W. Locos.**—What was the distinctive number and class of the L. and S.W.R. loco. which broke down so badly at Surbiton on the afternoon of August 11th, while taking down the 3.40 train from Waterloo to Guildford? Have the L. and S.W.R. no spare locos. at Clapham or Coombe and Malden, or even Surbiton itself (all three stations are junctions) in case of any breakdown occurring? Is it true that No. 61 (front-coupled) class are going to be removed from the line, because their internal gear gets dangerously over-heated? —Reinders.

[72245.]—**L. and N W. Locomotives.**—Travelling on this line a short time ago, I saw some locomotives with very small funnels and domes. Can some correspondent say what they are used for, and, if not asking too much, a sketch with principal dimensions?—Locomotive.

[72246.]—**Solenoid.**—Will anyone kindly inform me the best way to make a selenoid coil to lift 2lb. to 4lb. weight, and the best and cheapest battery, with as few cells as possible, required? I want it to hold the weight for a period of from 6 to 10 hours at a time. I want it to pull the piston or plunger into the coil about 3in.—Concentric.

[72247.]—**Ivory Card-Case.**—Could any reader give me any idea how to make an ivory card-case? I should prefer one that has some fretwork in it. Also whether I should require any more tools than are used for wood?—E. B.

[72248.]—**Prehistoric Man.**—Will "Geologist" please explain how geology proves that human remains found in stalagmites are those of prehistoric man?—G. B.

[72249.]—**Coil.**—I want to make a spark coil to give ¼in. spark. How long ought the bobbin to be, and how much and what gauge wire should I require?—Coil.

[72250.]—**Old Batteries.** — I have bought some second-hand batteries. The carbon and zinc plates are very much corroded with mineral deposit. Will some reader inform me how and what to clean them with so as to make them fit for working.—G. B.

[72251.]—**Noisy Water-Tap.**—Will some reader say what is the cause? At times there is a loud musical note, sometimes changing to a series of strokes or beats. There is no steady-pin on valve of tap. Kindly explain cause and remedy.—D. W. B.

[72252.]—**Dip.**—I thank "F.R.A.S." for his reply to query 72087 about moonrise. I do not understand how the dip is so large. Young, in his "General Astronomy," page 59, gives approximate formula as dip in minutes of arc = $\sqrt{\text{height in feet}}$, which would, for 3571ft. make it less than 1°. Will "F.R.A.S." kindly say how the dip 1° 22′ 51″ is obtained?—Ch. Grant.

[72253.]—**Chemical Action in Battery.**—Will any reader kindly inform me of the precise chemical action which takes place in a battery composed of metallic zinc, graphite, and ordinary sea-water?—J. S. Brown, Penang Foundry.

[72254.]—**Springs of Yellow Metal.**—Can any reader inform me of any alloy of copper or other metals closely resembling spring steel for elasticity? I wish to make some springs of yellow metal.—J. S. Brown, Penang Foundry.

[72255.]—**Zinc in Powder.**—Will any reader inform me of the easiest method of obtaining metallic zinc as an impalpable powder by the precipitation method?—J. S. Brown, Penang Foundry.

[72256.]—**Small Dynamo.**—To Mr. Bottone.—I wish to construct a small dynamo, having an armature precisely the same form and size as the one described by you for a magneto in your book on "Electrical Instrument-making," p. 99, § 65; but I want to substitute electro-magnets for the permanent steel magnet, as directed by you in your book. Please tell the best type of fields, with dimensions and quantity of wire to wind the same? I want it to light 1 or 2 small incandescent lamps. Should the magnet coils be connected in shunt with the brushes, and what E.M.F. am I likely to get from so small a machine? What advantage do I get by using electro-magnets? I wish to avoid a casting if possible. A rough sketch would oblige.—Constant Reader.

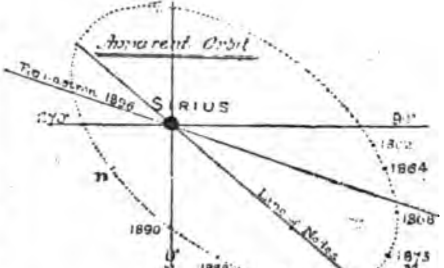
[72257.]—**Astronomical.**—I should be much obliged to "F.R.A.S." if he would answer me the following questions:—1. Which of the following satellites require the largest telescope and the highest power to render them visible: Saturn's two faintest satellites, Mimas and Hyperion, the satellites of Uranus, and the satellite of Neptune, and I should like them to be named in their respective order of difficulty? 2. Is Hyperion more difficult to see than Mimas? 3. Is a 4in. refractor powerful enough to show a very small disc to Neptune—i.e., so that it could be detected from a star? 4. What are the highest powers that can be applied to the great Lick refractor and Lord Rosse's great (6ft.) reflector respectively under the most favourable circumstances?—A. C.

[72258.]—**Steam Coil.**—Can any of our readers assist me with the following? I have a coil to make for exhaust steam to pass through, to be made of 3½in. wrought tube, 12 tubes 4ft. 6in. long, the ends of which are to be brazed in. Ends are made of flat iron, ½in. thick, turned on the edges, and driven tight into the tube and burred over so they cannot drop out by the expansion of the tube when heated. What I want to know is the best way to braze them in, what sort of brass, what kind of fire, and whether they should be dipped into water or left to cool?—Anti-Brazer.

[72259.]—**Viol d'Amour.**—Can any of our friends give a description of the Viol d'Amour? I have seen a few words about it as "having six gut strings, below which are six steel strings in unison, which are played with a bow after the fashion of the viola, and the beautiful tones which are produced." I should be very glad to have more information about this instrument, and possibly it may be interesting to others; at all events it will prove a diversion to some of the matters we have had under discussion in our paper lately.—E. G. P.

[72260.]—**Hydrostatic Problem.**—As my query with regard to solidity of sphere has been so thoroughly answered by kind correspondents, I should like to ask another that has been puzzling me, viz.: What physical interpretation is to be put upon the two values for $x$ in questions relating to height of fluid column in a tube with partial vacuum at the top, $x$ being height of the column? I refer to questions as to pumps and imperfect barometers, &c. Sometimes both values of $x$ are +, sometimes one value is −, while in all cases one value alone is needed and the other is superfluous apparently. If it were worked out by an example, it would greatly oblige.—Ch. Robinson.

[72261.]—**Rectification of Elliptic Orbits.**—In *Knowledge* for this month, Mr. Gore has given some interesting diagrams of orbits of binary systems. He explains very clearly the difference between the real and apparent elliptic orbits. "In the apparent orbit, the primary star, which is supposed to be situate in one of the foci of the real ellipse, does not lie in the focus of the apparent ellipse; and from its position in the latter ellipse we can deduce mathematically the particular angle at which the oblique section must be made, to agree with the observed place of the primary star, and other details respecting the real ellipse." This is quite intelligible; but can any of our readers give the method of rectification. I have selected the apparent orbit of the *comes* of Sirius as being a notable example. By the way, a point in this puzzles me. The nearest approach of the *comes* to its primary is at *n*, the farthest recession at 1873 M. I should have expected these to have been in the same right line. Is this occasioned by the synodic motion of the couple?—W. S., Liverpool.



A floating saw-mill is in use in Florence, Wis. The boat is 40ft. by 80ft. in size, and draws 17in. of water. The mill hands live aboard, and the boat is moved along the river to wherever there is a fine lot of timber near the banks.

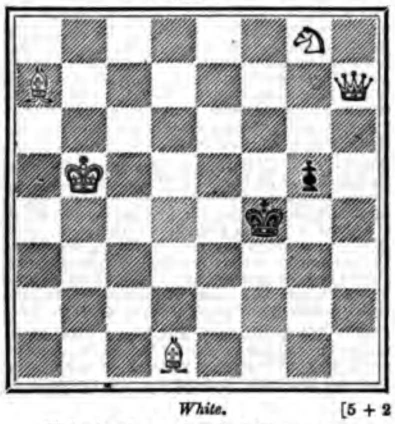
**Electric Cooking.**—State Chemist Dr. Charles W. Drew and Edward R. Francis gave an interesting exhibition of heating and cooking by electricity in Minneapolis last week, which was attended by quite a number of local electricians. The methods of heating water for stewing and boiling were particularly noticed by the spectators, as well as the oven for heating purposes alone. Dr. Drew placed a piece of cardboard over the aperture at the top of the oven, and by applying the thermometer, the temperature was found to reach over 400°, while that of the toasting apparatus, which is the latest invented article of the outfit, forced the mercury to 320°. The workings were practically illustrated with the ordinary kitchen supplies and proved very satisfactory, the heating oven, however, seeming to be the best perfected arrangement. Some further additions are to be made to several portions of the apparatus, which will make them of especial use for the general purposes intended. Patents have been issued to Messrs. Drew and Francis for their appliances.—*Electrical Review* (N.Y.)

## CHESS.

All communications for this department must be addressed to "J. Pierce, Knollside, Yawl, Lyme Regis, Dorset."

### PROBLEM MCCXVII.—By W. T. Pierce.

*Black.*



*White.* [5 + 2

**White to play and mate in three moves.**

### Solution to 1214.

| *White.* | *Black.* |
|---|---|
| 1. Kt-B 5. | 1. Q-Q R 8 (*a*). |
| 2. Kt-Q 4. | 2. Q takes Kt, &c. |
| 3. B mates. | |
| 2. P-Q 3 (ch), &c. | (*a*) 1. Q-K R 8, &c. (*b*). |
| 2. Kt-Q 4 (ch), &c. | (*b*) 1. K moves. |

### Solution to 1215.

| *White.* | *Black.* |
|---|---|
| 1. Kt-K B 3. | 1. Q-R sq &c. (*a*). |
| 2. Kt-K 5 (ch). | 2. Q takes Kt. |
| 3. B mates. | |
| 2. B takes Kt, &c. | (*a*) 1. Kt takes P (*b*). |
| 2. Kt. takes P (ch), &c. | (*b*) 1. P-K 4 (*c*). |
| 2. B takes Q, &c. | (*c*) 1. Q-K 7 (*d*). |
| 2. B-K 7 &c. | (*d*) 1. K-K 6 (*e*). |
| 2. Q-K 4 (ch), &c. | (*e*) 1. K-K 4, or B 4, or B 5. |

### NOTICES TO CORRESPONDENTS.

Correct solutions to 1214 by F. A. E., Sheffield, and J. Kistruck; to 1213 by F. A. E.

J. P. Taylor.—Thanks for problem. Very acceptable.

F. A. E.—The Solution Tourney will begin as soon as the minimum number (12) of competitors is made up. At present, nine have entered. So we can add your name with pleasure. The entrance fee is 6d.

W. Biddle.—We do not see any difference between your last and previous version. It, however, arrived too late for alteration.

H. Hancox.—In 1213, if 1. $\frac{\text{R-Kt 5}}{\text{P-Q 7}}$, and there is no mate.

W. Mackenzie.—Unfortunately, your problem can be solved thus: 1. Q-B 4 (ch); 2. Q-K 6 (ch); 3. B mates.

We are only waiting for one more entry to make the number in the two-move direct Tourney (A) complete; but we still want more entries in (B) Two-move Sui Tourney.

The entire area of the Canadian Dominion is computed at 3,470,257 square miles. Dr. G. M. Dawson calculates that an area of 954,000 square miles of the continent alone, exclusive of inhospitable detached Arctic portions, is for all practical purposes entirely unknown, or between one-third and one-fourth of the whole.

**A Universal Cement.**—A cement of universal adaptation, that is readily and permanently adhesive to any substance, has long been a desideratum, and to its realisation Prof. Alex. Winchell appears to have successfully directed his skill as a chemist. His method is to take two ounces of clear gum arabic, one and a half ounces of fine starch, and one-half ounce of white sugar, the gum being then pulverised and dissolved in the same quantity of water as is commonly employed in laundry operations for the quantity of starch indicated, and both starch and sugar are dissolved in the gum solution, the mixture being now suspended in a vessel in boiling water until the starch becomes clear. The cement should be as thick as tar, and remain so, prevention from spoiling being insured by dropping in a lump of gum camphor or a little oil of cloves or sassafras. This cement is so very strong and tenacious that it will hold immovably to glazed surfaces, will repair broken rocks, minerals, and fossils, and has innumerable adaptations in the mechanical and industrial arts.

## ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

### HINTS TO CORRESPONDENTS.

**1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.**

***** Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

**The following are the initials, &c., of letters to hand up to Wednesday evening, Aug. 27, and unacknowledged elsewhere:—**

J. D.—C. N. R.—J. Epps and Co.—C. H. Wingfield.—J. Mason.—W. T. Pierce.—Salus.—Amateur.—D. W—Geo. Hygiene.—G. C.—Butcher.—G. H. W. Fairbairn.—R.E. — B.Sc., Plymouth.—A Fellow of the Royal Astronomical Society.—Henry Stooke. — Theorem.—F. C. V.—Ch. J. D.—A. B. T.—Jack of All Trades.—S. Bottone.—Walter M. Hardie.—Caldemone.

J. A. Reeves. (Please see "Hints to Correspondents" above. We cannot give addresses of correspondents without their consent, and we cannot spare the time to ask for that consent. If an address is wanted it should be advertised for; but in the case in question it might easily be found, we imagine, by reference to the Directory. Whether it can or not, we do not give addresses.)—L. G. (Any bookseller will supply you with a list of astronomical works— Mr. Wesley, of Essex-street, Strand, for instance. But why not look through the back volumes, and choose for yourself?)—Leveron. (Get Watt's work on "Soap Making," from Crosby Lockwood and Son, and look up the back volumes for special information, which may not be found in that work.)—Robin Hood. (Please see back numbers. We cannot give recipes for dyeing grey hair and making blacking for shoes in every number. Let the grey hairs alone: no one of sense thinks them any detriment nowadays, and as to the blacking, you can buy it cheaper than you can make it in small quantities.)—Engineer. (We cannot pretend to decide which are the best books on electrical engineering, because the "engineering" introduces an element which has not yet been thoroughly worked out; but you will find several useful works advertised in our columns, and if you want to understand electricity as much as you possibly can, procure Sprague's work (E. and F. N. Spon, 125, Strand); for electric-lighting and accumulator work get Sir D. Salomon's book, and for other information look through our back numbers. Our opinion of Prof. Lodge's views is that they are certainly worthy of attention. He is a distinguished student, and knows quite as much about electricity as anybody else does.)—Anxious One. (Why not appeal to the makers of your gas-engine for information? or call in some one who understands that make to examine it? A gas-engine must of necessity get hot unless kept cool with water or something else.)—John Allison. (There is no trouble about it, and very little to explain. A needle is attached to one end of an electric circuit, either battery or coil, and the other conductor is applied just over the part when the needle is pressed under the root of the hair. A small spark passes, and the root is destroyed. It is a tedious operation; but the most effective known. You will find an article on the subject by Mr. J. Startin, late surgeon to St. John's Hospital, in No. 1131, Nov. 26, 1886.)—Working Man. (See the articles now appearing in series on "Telephones," and refer to indices. Anyone can make the English Mechanic telephone, but it would not be wise to depend on its manufacture for a living.)—C. T. Caplin. (All the information we have about the Renard cell was given in the article referred to. The chromic-acid cell is perhaps the best to use for lighting purposes, unless the battery can be kept where its emanations will not be offensive—then use the Bunsen. But see indices.)—Induction. (Don't make a "cylinder form." Make a Wimshurst, for which see indices; but you will find them all in back volumes.)—W. L. (We do not suppose you will find much to "enliten" you about squaring the circle in the whole series of back volumes—except that it cannot be done. Any of the textbooks containing such tables is sure to contain one giving the areas of circles. Try "Molesworth's Pocket-book," for instance.)—W. A. Evans. (See the index which will be published with the third number of this volume. No doubt the articles will subsequently appear in book form. As to Sprague's "Electricity," ask Messrs. E. and F. N. Spon, 125, Strand, London, and read "Hints" above.)—Young Reader (Probably you can find what you want in back numbers.)—Wm. Stamp. (Don't you think that you should look for the advertisement if you want the truss? "Eos" has had several letters about trusses, and we do not pretend to know which you mean; but you can see the volumes at the British Museum or the Patent Office Library, and search for yourself.)—G. (We know enough of Mr. Wenham to be sure that the matters you discuss have not been lost sight of, and we shrink from theological discussions.)—J. F. C. (Please see textbooks. We only care for mathematical problems a little out of the common, and three very ordinary ones all at once, with the space their replies would occupy—a page at least—are a little too much for us.)—A Deist. (We can think of nothing we published last week which should indu us to print your letter, and see no useful end to served by it. Matters of *belief* are beyond "The Wor of *Science*.")

**More Proof.**—The late Editor of *The Electric Engineer*, after a thorough examination of Mr. Harness' Curati Electropathic Belts, declares them to be perfect appliances for t self-application of mild, invigorating currents of electricity for t prevention or cure of disease. Copy of his report may be obtain gratis, on application to the MEDICAL BATTERY CO. (Ltd.), Oxford-street, London, W. Book of testimonials, descripti pamphlet, and consultation free. Rheumatic sufferers and tho troubled with any form of nervous, muscular, or organic weakne should call or write at once.—[Advt.]

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## OUR EXCHANGE COLUMN.

*The charge for Exchange Notices is 3d. for the fir 24 words, and 3d. for every succeeding 8 words.*

Wanted, first-class half-plate Camera, must be chea Exchange or cash.—C. Brodie, 31, Draffin by Lesmahago, Lanar shire.

7ft. 8in. **Iron Lathe**, 8½ centre, back-gear, slide-re hand-rest, &c. Will exchange for good Safety or 50in. Ordinary.— Owen, 8, Vincent-street, Butts, Coventry.

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Wanted, Breechloading Gun in exchange for amateur Tools.—J. R. Pybus, West Burton, Bedale.

Wanted to exchange, large Brass **Side Drum**, fo Screw-plate and Taps, small Dies, Drilling Machine, small Anvil, o sell.—T. Palmer, Keston, Kent.

**Iron Printing Press**, Type, &c., Demon Camer plates, and accessories; Mahogany Writing Desk, Flageolet. E change anything useful. Organ Materials wanted.—9, Forester street, Derby.

Exchange Seven Vols. of "**Mechanical World**" (unbound) for other Books, or Cyclist's Waterproof Cape, or offer.— 8, Gladstone-street, Battersea.

English Mechanic
WORLD OF SCIENCE AND ART.
*FRIDAY, SEPTEMBER* 5, 1890.

## BOTANY FOR STUDENTS.

WARD AVELING, D.Sc. Lond., Fellow of Univ. Coll., Lond.

### Chapter XXIII.—The Stem.

ealing with the stem, the same order ill be followed as in the account of the Definition, Morphology, Histology, ology.

*Definition.*—The stem is the ascending n of the axis of the plant, originating a bud (the plumule of the embryo, to with), and bearing lateral organs (buds, , &c.)

technical name, caulome (*caulis*, stem), lied to any stem or branch. All our

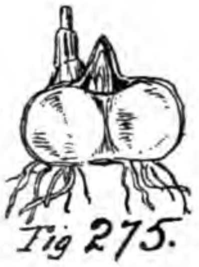


Fig 275.

ogamic plants have stems, and are fore Cormophytes or Axophytes; κορμος os), trunk; φυτον (phuton), plant. of the lower Cryptogamia, moulds, eeds, &c., do not present any distinction en a central axis and lateral append- When the body of a plant does not at this distinction it is called a thallus, he plant a Thallophyte. θαλλος (thallos), ng shoot.

*Morphology.*—Stems have three ns—the leaf-scale—the leaf—the bract n. See Chapter VI.

The leaf-scale region is subterranean, the internodes not developed, and the

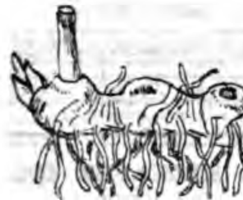


Fig 276.

hyllary leaves it carries are colourless. hief forms are the bulb—the corm—the —the rhizome.

e bulb (Chapter VI.) is a permanent with a short, central axis, and many apping scales. The order Liliaceæ is reat bulb-bearing order.

corm (Fig. 275) has a thick, large, al axis, and only one layer of scales. m bears buds only at one point. The s is a familiar example. κορμος mos), trunk.

tuber, as in the potato, is a thickened, hy, underground branch, with very mentary scales, in whose axils are ant buds—the eyes.

rhizome (Fig. 276) or rootstock is a sion, usually horizontal, of corms ng a long root-like stem, with leaf-, and sending up into the air herbaceous annually. The Ferns and Solomon's [Liliaceæ] furnish examples.

L. LII.—No. 1328.

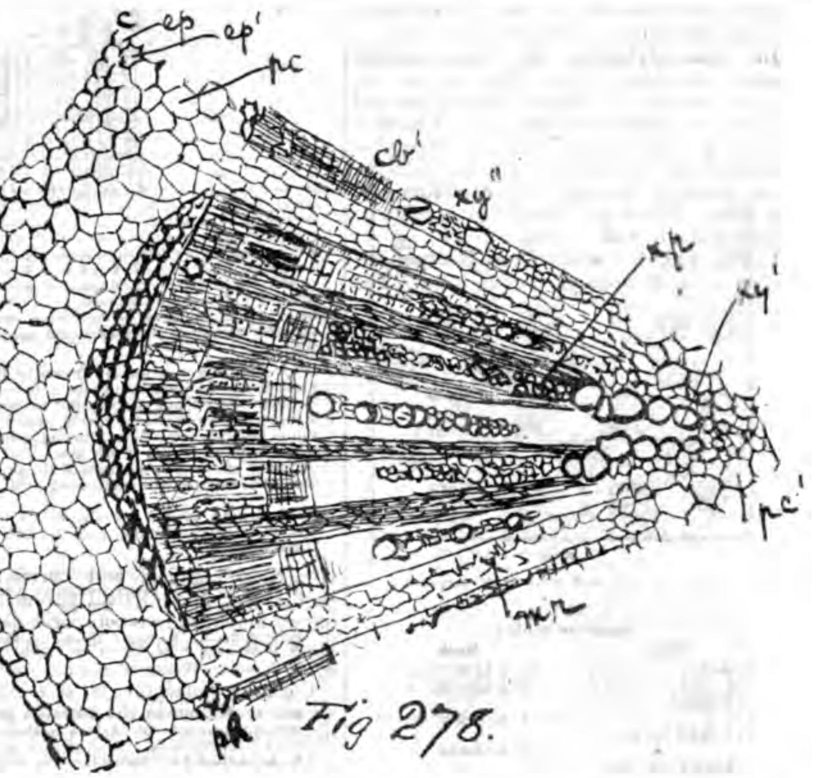


Fig 278.

(*b*) Leaf-region. This may be herbaceous, shrubby, woody; and it, or parts of it, may be modified into spines or thorns (Chapter XV.) or tendrils (VII.). The most remarkable modification of this region of the stem is that met with in the Butcher's Broom [Liliaceæ], Fig. 277. Each branch in this

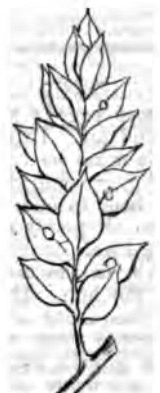


Fig 277.

plant is flat, expanded, leaf-like, is produced in the axil of the scale-like true leaf, bears the flower on its upper surface, and is called a phylloclade. φυλλον (phullon), leaf; κλαδος (klados), branch.

The methods of branching or ramification of stems was considered at length in Chapter XIV., when the history of the branching of plant-organs generally was considered.

The branching of the stem is intimately related to the position of its buds. These are generally axillary. The bud terminating any caulome is terminal. Adventitious buds are those that occur neither in the axils of leaves or branches, nor at the ends of caulomes.

The arrangement of the young leaves in the leaf-buds is called Vernation. *Ver*, spring. Two things have to be considered—the manner in which the individual leaves are folded; the arrangement of the leaves in relation one to another.

The individual leaves are either flat, plain, unfolded or folded, or rolled.

Folded leaves are conduplicate when the two lateral halves are folded face to face, as in the Oak [Cupuliferæ]; replicate when the apex of the leaf is folded down towards the base, as in the Tulip-tree; plicate, folded like a fan, as in the Beech [Cupuliferæ].

Rolled leaves are convolute, rolled from side to side map-fashion, as in the Cherry [Rosaceæ]; circinate, rolled from apex to base, as in ferns; involute when both margins are rolled in towards the midrib, as in the Apple [Rosaceæ]; revolute, when both margins are rolled outwards, as in the sorrel.

The two chief terms in respect to general arrangement are imbricate, when the margins overlap; and malvate when the margins simply meet. Both these terms have been explained and illustrated in our flower-work.

TABLE OF VERNATIONS.

| | | | | |
|---|---|---|---|---|
| Individual leaves. | Flat | | Plane. | |
| | Folded | Vertically. | Conduplicate. | Oak. |
| | | Horizontally. | Reclinate. | Tulip-tree. |
| | | Fan-fashion. | Plicate. | Beech. |
| | Rolled. | Laterally. | Convolute. | Cherry. |
| | | Vertically. | Circinate. | Fern. |
| | | Margins in. | Involute. | Apple. |
| | | Margins out. | Revolute. | Sorrel. |
| General arrangement. | | Overlapping. | Imbricate. | Poplar. |
| | | Meeting. | Valvate. | Apple. |

*Conduplico*, I double; *reclino*, I bend back; *plico*, I fold; *convoluto*, I roll round; *circino*, I make round; *involuto*, I infold; *revolutus*, rolled back; *imbrex*, a tile; *valva*, a folding-door.

(2) *Histology.*—A caulome begins as meristem. This differentiates off into the three regions already described—dermatogen, periblem, plerome. The dermatogen forms the cuticle *c* and epidermis, *e p*, *e p'* (Fig. 278.) The periblem forms the cortical parenchyma *p c* in a herbaceous stem. The plerome forms the fibro-vascular bundles.

These last consist of xylem and phloem, generally collateral, and with the xylem, *xy'*, *xy''*, nearer the axis of the stem; the phloem, *ph'*, *pp*, nearer the epidermis.

The xylem consists of xylemparenchyma (cellular), not always present; wood-fibres, *xy''*, vessels. (See also Fig. 259.) The phloem consists of phloem-parenchyma (*pp*, in Fig. 278); liber-fibres, *ph'*; sieve-tubes, D *t*. The first and third of the phloem constituents form the soft bast, the second—i.e., the liber-fibres—forms the hard bast.

In Monocotyledons, the fibro-vascular bundles developed from the cells of the plerome are wholly turned into xylem and phloem, are therefore incapable of further growth, and are called closed. In Dicotyledonous stems, some of the plerome cells remain cellular, forming the cambium, $cb'$, Fig. 278. Hence the bundle is capable of further growth, and is open.

In Fig. 279, A is a tranverse, B a vertical, section of a Monocotyledonous stem. The closed fibro-vascular bundles lie isolated in a mass of fundamental tissue, *p*, *p*, B; *w* are wood-cells; *s v*, spiral vessels; *a*, reticulate vessels—all three xylem elements; *v p*, vasa propria; *l*, liber-fibres—both belonging to the phloem.

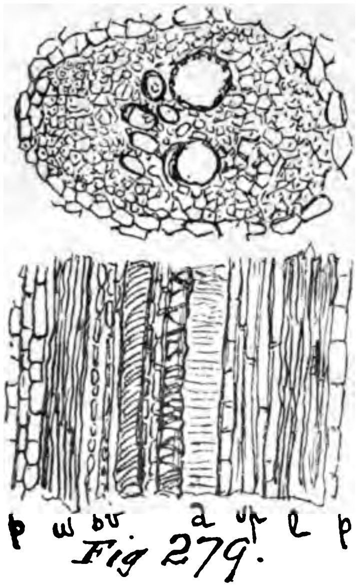


Fig 279.

The bundles can all be traced into the leaves above, and therefore are "common" bundles—i.e., common to both stem and leaf. Below they turn outwards, towards the circumference of the stem, and unite with one another to form a fibrous network separating the cortical parenchyma from the central fibrous region of the stem.

As the bundles are closed the stems of Monocotyledons do not generally increase in diameter. The cortex does not develop into bark.

In Dicotyledons (Fig. 278), the bundles are not isolated; they are open, only some of them are common, and they do not unite below in a fibrous network; the stem does increase in diameter, and there is a true bark if the plant is a shrub or tree.

In a young herbaceous stem of a Dicotyledon, we have, from without inwards, cuticle; epidermis; cortical parenchyma; bundles each of phloem, cambium, xylem; parenchyma; persistent parenchyma, which in the centre is the pith or medulla, and between the bundles is the medullary rays *mr*.

If the plant is longer-lived than one year, a new mass of xylem is developed from the cambium cells on the inner side of $cb^1$, and a new mass of phloem, also from the cambium cells is developed, but on the outer side of $cb^1$. And this process is repeated annually.

Hence the xylem or wood grows outwards by the formation of a fresh ring each year. And this growth is sometimes called exogenous. ἔξω (exo) on the outside.

In woody plants there is formed on the outside bark, and this, when fully formed, presents three layers. The inner, endophloem, is of liber-fibres and sieve-tubes. It corresponds with the phloem portion of the fibro-vascular bundles. The middle, mesophloem,

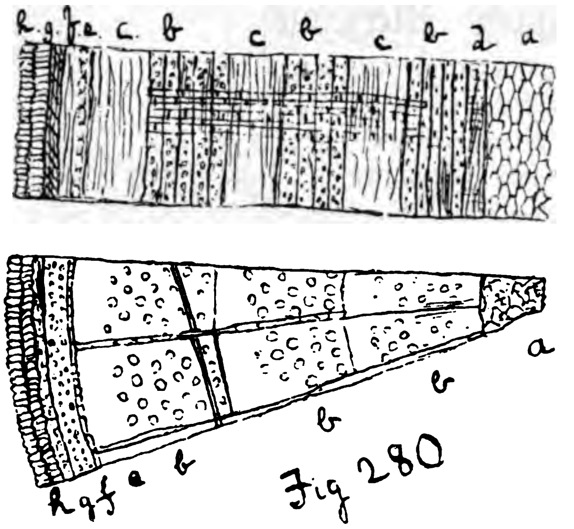


Fig 280

is mainly cellular, and corresponds with part of *p c*, the cortical parenchyma. The outer, epiphloem, is of cork, the suberous layer (*suber*, cork) and replaces the epidermis *e p*.

Cork or periderm is developed from a special meristem in the cortical parenchyma, called phellogen. φελλος (phellos), cork.

In a Dicotyledonous tree, therefore, we have, from within outwards, medulla or pith (*a*, Fig. 280), the medullary sheath *d*, of spiral vessels, forming with *b* the pitted vessels, and *c* the wood-fibres, the wood; *e* the cambium layers of endophloem, *g*, mesophloem, *h* epiphloem, *i* medullary rays.

In older trees the inner, older, harder wood is called the duramen (*durus*, hard), and the outer; younger, softer wood the alburnum (*albus*, white).

(3) *Physiology*. The chief general functions of the stem are (*a*) to support the leaves and flowers, (*b*) to carry gases and liquids, (*c*) to store up secretions.

(*a*) The stem carries the leaves and flowers, and enables these organs to be freely exposed to light and air. In connection with this function, it must be noted that in all plants the young, growing shoots circumnutate—i.e., they bend to one side, and travel slowly round to all points of the compass. This very general movement is only easily observable in the cases of climbing plants, such as the hop. The cause of this movement is inequality of growth on different sides of the stem, the longitudinal line of greater growth shifting round the stem. The movements of tendrils (see Chapter VII.) are a special case of this circumnutation.

In connection with these movements of stems, it should be noted that stems are negatively geotropic, and their growth, if they lie on the ground, is, as a rule, greater on the side next the earth, so that they turn upwards. Further, most caulomes bend towards the sunlight. This is due to the fact that growth is greater on the darker side. Light does not help, but, in point of fact, retards growth. This curvature is called positive heliotropism. ἥλιος (helios), the sun. Root-hairs are negatively heliotropic.

(*b*) The water absorbed by the roots passes up the stem towards the leaves—the so-called "ascent of sap." It passes through the xylem of the fibro-vascular bundles, through the wood fibres of that xylem (not the vessels, as a rule), and through the walls of those fibres rather than their cavities.

The causes of this general movement upwards are (i.) root-pressure; (ii.) capillary action — the wood-fibre walls are very narrow channels; (iii.) evaporation by the leaves. The nearer the surface, the greater is the influence of this evaporation, and therefore the denser the liquid. Hence of any two adjacent fibres, one above the other, the latter will have rarer watery sap in its walls than the former, and by the law of osmosis, there will be a flow from the lower to the upper fibre.

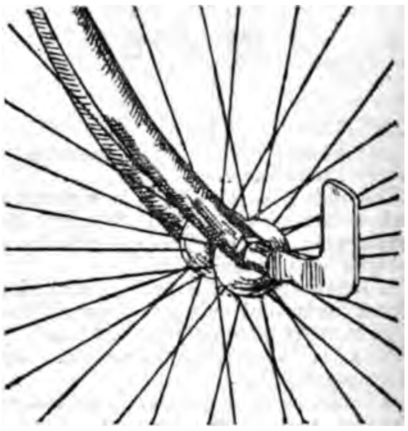
The student must bear carefully in mind the fact that although there is much, too much, talk of the ascent and the descent of the sap, there is not in plants any fluid like blood, of uniform composition in all parts, nor is there any definite course by which liquids flow from point to point in the plant. All that can be said is that there is a set, especially in the spring and summer, of watery fluid upwards, and that, after the constituents of this "sap" have been dealt with by the leaves (see next chapter) they individually, rather than the sap collectively, move towards the parts of the plant where they may be wanted for immediate use or storage. And this movement takes place chiefly through the walls of the xylem-fibres.

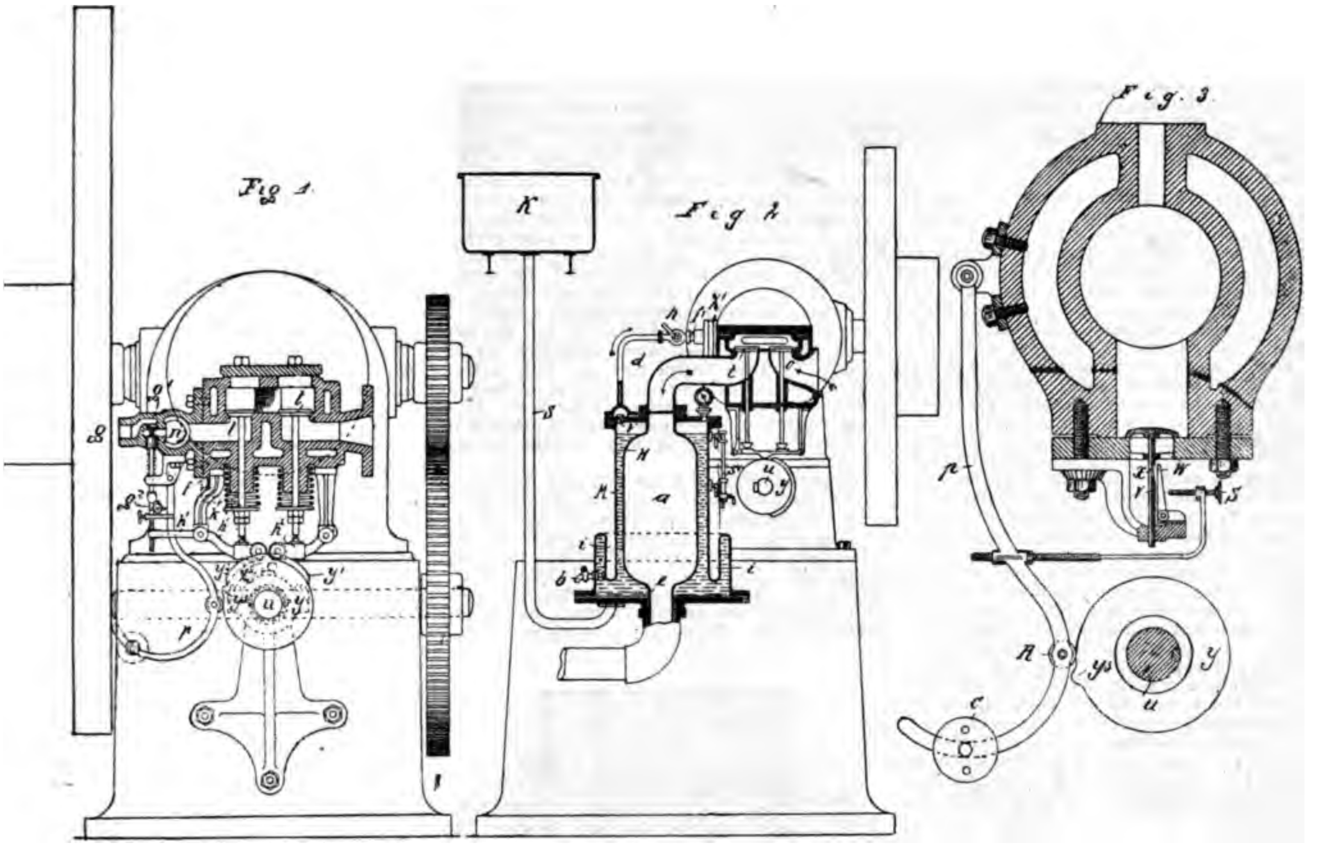
(*c*) The stem is often a reservoir of secretions. The resins in the pine and fir-stems are instances of this.

(*To be continued.*)

## AN IMPROVED CYCLE LAMP BRACKET.

MR. JAMES SCOURFIELD has recently filed an application for Letters Patent for a very neat and ingenious lamp bracket, which is admirably adapted for touring purposes, when, on account of the luggage carrier and touring bag, it is inconvenient to carry the lamp in the usual position on the handle bar, and whic we think, will meet with the approval of cyclists. The engraving shows the bracket perspective. It is of an L form, the verti limb being made flat for the attachment of t lamp in the usual manner. The horizontal li is rounded towards the end, and finished a hexagonal nut, for convenience in using





ner. An internal screw-thread is formed in nd, which is screwed to the end of the pin ring the bearings of one of the wheels. The ht of the lamp has a tendency to screw up racket, and thus secure it against the possi- y of working loose. Our engraving shows invention applied to the front wheel of a y bicycle.

## ERR'S IMPROVEMENTS IN GAS AND PETROLEUM MOTORS.

IE invention shown in the illustrations annexed has been patented by Herr F. r, of Munich, for the purpose of providing -engine which is capable of being converted out material alterations into a petroleum r—*i.e.*, by the insertion of a petroleum- orating apparatus. Fig. 1 is an elevation partial vertical section showing the governor anism with device for regulating the four- -momentums. Fig. 2 represents the petro- -evaporating apparatus, and Fig. 3 the lating device on an enlarged scale. The nlet *g*, Fig. 1, is adapted to be closed by $g^1$ with latch $g^2$; *n* designates the air-inlet *l* the inlet valve, *t* the exhaust valve, *k* the lever for actuating the slide or valve, *p* the lating pendulum.

l mechanisms which serve to effect the ssion of air and gas, exhaustion, ignition, regulation, are operated by the disc *y*, ited on main shaft *u*. The nozzle $y^1$ of *y* opens through lever $h^1$ simultaneously the valve $g^1$ and the inlet valve *l*. The adjust- bolt *z* of disc *y* actuates the ignition slide by ting against angle lever *k* in co-operation spring *f*. The nozzle $y^2$, occupying on disc lifferent position relatively to nozzle $y^1$ opens xhaust valve by aid of lever $h^2$. A regula- can be effected through regulating pendulum means of the stop or projection $y^3$ provided isc *y*.

four-time motors, therefore, all mechanisms ctuated by disc *y*. The regulation of the oved motor is so arranged, that when the ne works at an excessive speed the gas valve pt closed.

g. 3 is a detail showing the same regulating e as applied to a motor in which the regu- n is so effected as to cause the air in the fore on of the working cylinder to be compressed r in a lesser degree than is the case with al working of the motor, or not at all, which ose can be accomplished by correspondingly ing open the valve V of the working space.

With every revolution of the driving-shaft, the stop $y^3$ of disc *y* abuts against an easily movable roll, R, provided on the oscillating lever *p*. Thereby the lever is thrown aside to an extent dependent on its weight. By means of a set-screw, S, connected, as shown, with the pendulum, and forming an abutment for the angle lever, W, the proper distance of the latter from the extremity of the screw—that is to say, the normal extent of deflection of lever *p*, can be precisely regulated. Each normal revolution of the shaft causes the end of screw S, if correspondingly adjusted, to closely approach the angle piece W without coming in contact therewith. When, however, the shaft exceeds its normal speed, the stop $y^3$ comes into more energetic contact with roll R, and consequently the pendulum is turned aside farther than with normal speed. The disc *y* being so mounted on the driving-shaft that the deflection of the pendulum takes place shortly before the valve V tends to reclose—that is to say, shortly before the arrival of the working piston at its rear dead point, the set-screw S abuts against the longer arm of angle piece W, and presses it for an instant on to the guide pin of the valve. Consequently, the descending valve is detained by the top of the angle arm engaging into the recess *x* of the valve pin. Thereby the air is allowed to re-escape entirely, or to a great extent, through the suction valve V. With the next return stroke of the piston the valve is slightly raised, and the angle lever W allowed to return into its normal position. The pressure of pendulum lever *p* against the nozzle disc *y* can be regulated by means of the displaceable poise plate *c*.

To use petroleum as motive agent in the improved engine, the evaporating apparatus hereafter described may be suitably employed. The evaporator is merely incorporated in the motor, while the gas valve is either made considerably smaller or replaced by a small slide, which, however, must occupy the same place. This arrangement is shown in Fig. 2. The requisite petroleum vapour is produced as follows by means of an evaporator shown in Fig. 2, and essentially consisting of the evaporator proper *a*, the upright cooling pipe *s*, and the reservoir H. The evaporator proper resembles in its arrangement a low-pressure steam generator, and consists of: the mantle or jacket, M, with heating channel, $i^1$ $i^1$, water gauge, $s^1$, and outlet cock, *b*; the cover with manometer and vapour pipe, *d*, cock, *h*, and heating body, H; the bottom piece, *e*, with connecting muffle for the waste vapours.

The apparatus works as follows:—

Methylated spirits, or any other easily combustible liquid, is poured into the channel *i i* and inflamed. Thereby the inner sides of this channel, and a larger or smaller portion of the mantle surface, according to the quantity of combustible liquid contained in the channel, and the petroleum in the evaporator *a* commences to evaporate. The apparatus is to work with a pressure of 0, 2 atmospheres, which can be ascertained from the manometer The distance between the levels of the petroleum contained respectively in the evaporator *a* and in the reservoir K corresponds, in working, to the height of a petroleum column capable of balancing the said pressure.

A sufficient amount of petroleum vapour having been generated, the motor is started in the same manner as ordinary gas-motors. In the construction shown in the drawing, a small ignition slide, $z^1$, is employed for the admission of the petroleum vaponr. Beside the cock, *h*, a self-acting safety-valve, *v*, and a small stuffing-box, $f^1$, are situated between the evaporating apparatus and slide $z^1$. The flame from the combustible liquid is extinguished when the heating body, H, is sufficiently heated by the escaping vapours to enable the latter to evaporate with every stroke the requisite quantity of petroleum, which can be ascertained by experiments for each particular motor.

When the pressure in the apparatus becomes excessive, the petroleum column is forced towards the reservoir, which is safe from running over owing to its considerably larger cubic capacity. The upright tube may, moreover, be provided with ribs or with a water-jacket for cooling purposes. With greater pressure, also, the evaporating surface decreases, and an equal amount of thermal units being always supplied, the fluctuations of pressure can never be so great as to cause interruption in the working of the engine, as the heating surface has to be empirically predetermined for every size of motor. The air is admitted into the motor through an ordinary suction valve, *o*.

## PRACTICAL DETAILS OF BLACKSMITHING.*

WELDING is the uniting together of more or less separated masses of a metal which have been brought to a viscous, semi-fluid condition by heat. The operation is perfect when the internal structure of the piece is the same at the place where the parts have been joined as it is elsewhere, and approximates to perfection, in proportion to the extent of the region in which the particles of the original parts mingle and interlock with each other. Heat for welding may be generated at one operation by the combustion of fuel in a solid, liquid, or gaseous state, or by electricity. The line of probable improvement is in the perfecting of furnaces for coal or oil by the improved application of the blast, and discharge of the products of combustion with the retention of the heat—in the use of gas, or a combination of gases; and in the more extended use of electricity.

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* By B. F. Spalding, in *American Machinist*.

The use of electricity for the purpose of welding deserves consideration, for one of the principal advantages claimed for it is that it can be applied by persons unskilled in the trade; therefore, as its application becomes more extended, less skill will be required of the workman, and not less skill only, but less hardihood, and capability of bearing heat, for the reason that in electric welding all the heat generated is concentrated at the point where it is to be used, instead of nine-tenths of it being diffused, with the result of raising the temperature of the surrounding atmosphere, in which the workman must stand, to 30° or 40° above blood heat. According to the latest labour theories, this will have the effect to increase the wages of the operator, for although he may require less skill, he must exercise greater intelligence, and as employments recede from the barbarism of excessive manual exertion, and require greater intelligence, they are more liberally recompensed.

Among the illustrations which accompanied the description of the Bernando's system of electric welding, which met with such favour four or five years ago, was one of welding a patch into the shell of a boiler, by this process—a feat which one of the savants who had its promotion in hand was said to have successfully accomplished—and no one who gazed upon the picture of the cool, calculating scientist, deliberately directing the forces of nature to the purpose of his undertaking, could fail to mark the decided superiority in the appearance of that method of doing the work over the hot, blood-boiling, flesh-roasting, and ear-splitting old-fashioned method.

Every advance in the arts lessens toil and hardship. The puddler's rabble is superseded by aëration. Immaterial forces overcome the grosser. Wm. Denning, the Penn. Cumberland Co. blacksmith, who forged wrought-iron cannon during the revolutionary war, by welding hoops over staves, which were so laid as to break joints, complained that he could get no one to help him, as "the heat was so great as to melt the buttons off from his clothes"; but in later years these big heats are held off at the end of a long porter bar, swung to a crane, and moved up to receive the blows from a steam-hammer, while the forger can wear lead buttons, or a celluloid collar, if he chooses, without fear of the consequences.

By the use of the electric process of welding, the blacksmith will be relieved of much of the heat, uncleanliness, dust, and other discomforts which have generally been the accompaniments of welding operations, and if the heat can be controlled and regulated with the accuracy which is claimed for it, a piece can be kept at a welding heat—at a temperature between 2,400° and 2,800°—for an indefinite period, without loss by oxidation or otherwise, becoming thoroughly softened throughout the portion which is to be welded, and the operation of uniting the separate pieces can be carried on without haste, but with whatever deliberation may be necessary to insure a perfect union.

The term "welding" has come to be rather loosely applied. Probably platinum possesses what may properly be called the welding quality in a high degree. Advantage is taken of this in the manufactures of that metal, but it is so rare, and the processes by which it is wrought are so unfamiliar, that by general usage the term "welding" is principally confined to the uniting of similar or slightly varied forms of wrought iron, as wrought iron to wrought iron, or to steel, and steel to steel.

When two cold surfaces of metal are worked one upon another in such a manner as to exclude everything from between them, and bring their particles into immediate contact, they "catter-claw" and unite very firmly at whatever points are brought thus near. When pressure is applied to separate them, as when force is used to turn a shaft which has stuck in its boxes, or a wheel on an axle, or to move a slide stuck in its guide ways, the surfaces "rough up," form "cat teeth," and are then said to have been "cold welded." There is undoubtedly a knitting of fibre, and although the portion of fibre so knit is very short, its grip is as tenacious as many hot welds on thin pieces. A question may be opened whether the uniting of two different kinds of metal may properly be called welding. A chronometer balance-wheel has a steel centre and inner ring, and firmly united to this inner ring is an outer ring of brass, which in some places is put on in this way: Pieces of steel about 3in. long are carefully centred, and turned to the size of the outside of the steel ring; they are then coated with borax in aqueous solution, and driven into hollow cylinders of brass, which are then put into clay crucibles, which they just fit, and the open end is closed with clay. They are then subjected to a heat high enough to melt the brass, and set aside to cool. When cool, the centres are carefully cleaned, and the brass being turned on the same centres, is concentric with the steel. They are cut up into the required lengths for the balance wheels, and the brass is found to be thoroughly united to the steel. These two metals are united for the sole purpose of getting the result of their unequal expansion. Changes occur at every variation of temperature; they are irregular, but continual, yet do not affect the union of the metals, because they are free to move. The steel points of mathematical instruments are united with the brass or German-silver heads in a very perfect manner; but I do not know that, until quite recently, it has ever been claimed, by parties engaged in that kind of work, that this uniting of two different kinds of metal constituted a weld.

It would be exceedingly difficult to find any two metals which have not been intimately united together for some useful purpose, with a firm jointure, while their surfaces were in a fluid or pasty condition from the action of the heat. It is an art which has so long been practiced that it may probably date from the first discovery of the metals.

The best conditions for the thorough welding of iron are probably present in the manufacture of the muck bar, which is the direct product of the puddling process. When iron has been subjected to this process, it "comes to nature" by appearing in the fluid mass, which is melted down on the hearth, in the form of grains, which assemble together, and are brought into a rough ball by the puddler's rabble. These grains are separated from each other, more or less, by the melted silica, which envelopes each one, and which forms a large part of the melted slag in which they are immersed. This puddler's ball is squeezed by some form of squeezer, which presses these grains together, so that they intermingle with each other, and the slag is forced out from between them. They are then run through the puddle rolls, and these carry on the process thus begun—of uniting the grains and squeezing out the fluid slag. It is curious that, in passing from the puddle ball to the puddle bar, the percentage of carbon thrown off should exceed that of silicon, being in one case a loss of 61·6 per cent. of the carbon, against 28·5 per cent. of the silicon.

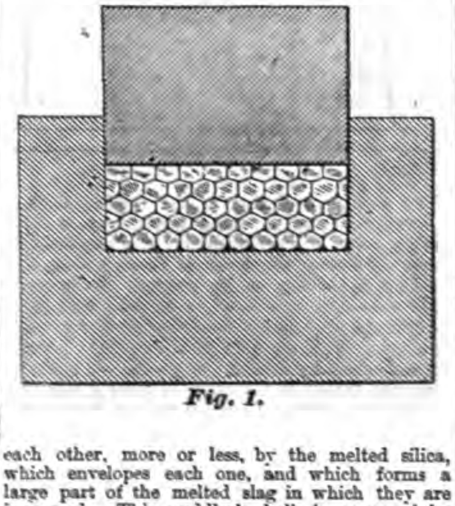


*Fig. 1.*

When the iron appears in the form of the puddle, or muck bar, the surface grains, having been acted upon directly by the unyielding surfaces of the rolls, have become flattened more on the outside than on the inner side, where this action was resisted only by the slag-supported grains. Those lying furthest from the surface are less flatted than those lying near it, in proportion as their distance from the surface increases. An illustration of this may be obtained by placing some bird shot in a box, just wide enough to receive it, and of such length and depth as may be suitable, and pressing it therein with a movable close-fitting die, as shown in Fig. 1. The grain at the surface of the bar would be flatted like the shot immediately under the die, while that in the interior would be more globular in form.

The puddled bars are very rough and imperfect, and to make the iron fit for use they are cut to lengths, and these are piled upon each other; and for merchant iron the pile is reheated to a welding heat, and reduced by rolling or hammering to the form and size required.

The tendency of matter in a fluid condition is to form globules. When two pieces of merchant iron are heated, and their surfaces brought together, the work done on them, having made the top of their granules flat, the joint produced is continuous, like that between two planed boards, which will not glue as well as if they are somewhat roughened; but if the heat is raised so that the fluid tendency to form globules will be exhibited, those on one bar will fall in between those of the other, producing a more thorough interlocking. If the liquidity extended through the bar, it would not cohere strongly enough to hold itself together; but it may be brought nearly to this state on the outside, and there not being so rapid a conduction of heat as to cause it to become so at once inside, there will be below the exterior, when it is finally brought to a fluid state, a semi-solid condition, in which the globular form is exhibited, and as this is more or less developed, so will the weld approach to a homogeneous combination of the two individual masses, the melted portion of each uniting, and adapting the form of its particles to the shape of the firmer base on which they rest.

With the exception of the flattened form of the exterior particles, the conditions for securing good welding are present when the pile of puddled iron is worked over into merchant iron; and it would appear that if thorough incorporation of separate and distinct masses of iron into one mass can be produced by welding, the merchant bar would be a fair sample of such an incorporation; but one of the first things which an apprentice discovers is that such iron is more liable to split when punched in the seam than when punched the other way of the bar. This seam is the weld between two of the pieces which were piled together, and the fact that the bar is more liable to open in these seams than when punched through them, shows that the bars of the pile are not united as strongly as the grains are united which compose the bars.

The committee on chain cables of the United States board appointed to test iron, steel, &c., reported that the blows struck in making the lap amalgamated the fibres together so that "when the two laps are brought into contact, the fibres of each do not intermingle thoroughly, and they, too, are frequently simply stuck together, adhesion taking the place of a process similar to felting, which occurs in welding iron of rather an open fibre." "Welding power was traced to the reduction of the bar by direct experiment." "Omitting one course of piling and hammering largely helped its welding power." "Carbon notably affected welding." It "promotes fluidity, hence the iron is 'burned' at the ordinary welding temperatures of low carbon irons." "Slag should theoretically improve welding like any other flux, but its effect in these experiments could not be definitely traced." Slag was highest in a bar which welded less soundly than any other bar of the same iron and below average as compared with other bars. The conclusion they reached after many experiments is given in these words: "The ordinary practice of welding is capable of radical improvement. The perfection of means for welding in a non-oxidising atmosphere would seem to be the most promising direction of improvement."

As steel is of less open grain than iron, this is one reason why it is not so easily and thoroughly welded. There are other reasons, and as throwing some light on the welding of steel, the behaviour of copper may be noted. If it be attempted to weld copper as iron is welded, great difficulties are encountered. Two bolts of copper may be put in the fire of a blacksmith's forge, and the heat raised on them until the ends are hot enough to melt and flow; but as fast as any portion arrives at this heat it becomes so fluid that it drops off, and if the bolts are pulled out and laid on the anvil to unite them, it will be found that there is no longer a liquid surface on them to make them stick together. The conductivity of the metal is so great that the heat needed to flux it is almost instantly conveyed away.

The distinction must be made that the melting of metals together and the welding of them together are two different things, and yet it is not an easy matter to determine the limits of the processes and define their confines. Perhaps the best way to illustrate may be with irons of different degrees of carbonisation. Cast-iron pieces may be melted together, as is often done in mending castings. The steel faces of cast-iron anvils have been put on by a modification of this process. The harder steels containing 1·35 to 2 per cent. carbon will not weld; when they are hot enough to unite they will not bear to be struck. As the amount of carbon falls below 1·35 per cent. the thickness of melted metal coherent enough to remain attached to the heated piece increases from the mere film which just barely coats steel to the spongy mass into which wrought iron may be brought, so deep that shafts 20in. or more in diameter are forged at a temperature as hot as a welding heat throughout, the whole mass being in a soft, nearly molten condition.

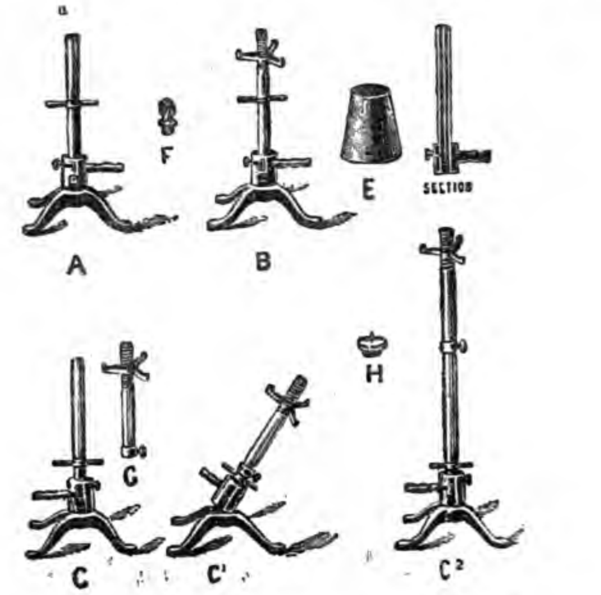
In non-weldable metals there is a distinct narrow line of demarcation between the melted and the unmelted condition. In weldable metals the li is considerably broader. There is a conditi between these states, and in the most weldable middle condition is the most considerable. Sil may retain its integrity at 1,800°, and have appearance of fluidity, but at 1,850° it is melte but wrought iron has a fluid surface at 2,400°, a does not melt and disintegrate at less than 2,80 thus having a range of 400° in which the process of uniting separate pieces may be effected. Steel ma have a film of liquid surface at a little above 2,30 and melts at 2,450°, or less, according to the p ı of carbon it contains. Cast iron melts at and becomes fluid without passing through termediate range of temperature.

ught iron softens by heat step by step by gradual degrees than any other metal in n use. In copper it is a short and sudden om the solid bar to the liquid mass, but in ıere are regular gradations of growing visfrom hardness to fluidity which are so dismarked as to be perceptible. The presence of the substances which promote fluidity the range of the welding temperature. The d conductivity of the material has a great upon limiting the range of the welding ature.

## RMS OF BUNSEN'S BURNER.

a recent meeting of the Society of Chemical Industry, Mr. J. R. Griffin exhibited some rms of Bunsen's lamp. The first, A, was the ion of G. Reimann, of Berlin, Eng., pat. of December 24, 1889. The others were ed forms of Reimann's lamp made by Mr. 's firm (J. R. Griffin and Sons), at the sugı of Mr. Watson Smith, and with the consent r Reimann.

fly it may be stated that in this new lamp the is the simultaneous and corresponding ion of the admission of gas and air to Bunrners. To this end the short vertical tube or ed in ordinary Bunsen burners for the admisf gas into the outer tube (the lamp) is disl with, and the burner—or outer—tube is to act as a regulating cock both for gas r.



rder thus to serve as a regulating cock, the nity of the burner tube tapers to a conical , and is ground so as to fit the tube forming se of the lamp and containing the air-holes, o form in it a kind of plug cock, as a stopper n the neck of a bottle. The gas enters the of metal tube, fixed at right angles to the r tube, but at its extremity directly enters the r by a horizontally disposed orifice, which, on g the burner tube, is gradually closed. This ement obviates the objectionable "firing of the flame when the supply of gas is re- . Mr. Watson Smith's additions consist (1) lescope tube, G, fixed around the burner tube ordinary lamp C, the effect being to make le the raising or lowering of the position of mp flame at will (*vide* $C^2$); (2) in a hinge ement at the base, such that the lamp tube e inclined at any angle (as at $C^1$), or placed orizontal position if desired; (3) in a cylindriass perforated shield placed around the base ning the air-holes, so that by revolving this d the base the air-holes are either gradually last entirely closed, or gradually and at last ly opened, as the case may be, and with ease; ) in the addition of a gallery with chimney E otecting the flame. No. 2 addition is most ally useful in the process of soldering, or in the ıg of filters over glazed paper in gravimetric is, &c. The telescopic arrangement (No. 1) nd very useful in fractional or ordinary disons.

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ε plans for effecting improvements in the port tend, so as to make it safely accessible for the it vessels, have been completed. The improvewill not, it is said, cost more than 3,500,000f.

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## HOME-MADE GRILLS AND GRATINGS.

A DWELLING-HOUSE without ornamentation of the class mentioned above indicates one of two things—either the owner or occupant does not appreciate the value of this kind of home decoration, or he does not possess the skill to make or the ability to purchase it. It is true, the beautiful metal and wood-work now manufactured for this purpose is very expensive; but it is also true that something equally as beautiful may be had without much trouble or expense.

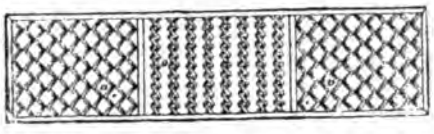

FIG. 1.

The grills shown in Figs. 1, 2, and 3 are made of rope, sized, bent into shape, dried, glued in a wooden frame, and finally painted an appropriate colour, or gilded, or bronzed. These ornaments, when placed in a doorway or window, or across a hall from the stairway to the wall, or in some corner of the library, add wonderfully to the appearance of the room.

The materials required are some $\frac{5}{16}$in. sash-cord, glue, round sticks or dowelling $\frac{5}{16}$in. in diameter, paraffin (a paraffin candle will do), some strips of wood, and paint or varnish.

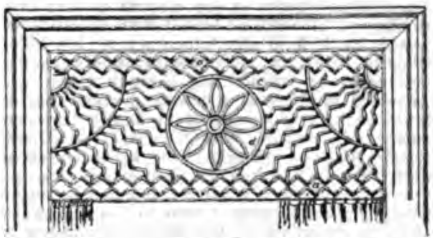

FIG. 2.

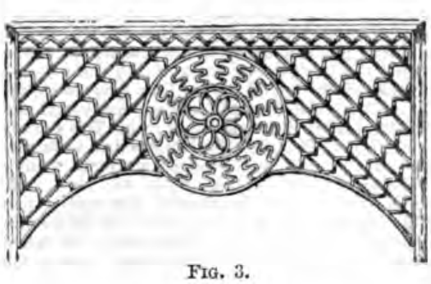

FIG. 3.

There are in the present case only two fundamental forms for the spindles or bars; but these are combined in several different ways, as shown in Fig. 6. The spindle most used is shown in Fig. 4. It is formed by winding the sash-cord—which has been previously steeped in the glue-size—upon the wooden rod. The rod is coated with melted paraffin before use, to prevent the size from adhering, and equidistant marks are made upon the rod as guides for the winding. These marks are 1¼in. apart. The winding can be easily done by placing one end of the wooden rod in a vice, driving a tack through the end of the rope into the rod. If every turn of the rope around the rod is made to coincide with one of the marks, the spindle will be true enough for all purposes. A tack should be driven through the end of the finished spiral into the rod to prevent the rope from unwinding. A number of rods will be required. Part of the spindles should be wound in a right-handed direction, and the remainder in a left-handed direction. The rope should be allowed to stand for a day or so dry. It is well, especially in warm weather, to add to the size some oil of cloves or carbolic acid to prevent it from souring while drying.

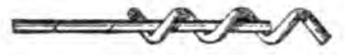

FIG. 4.

The other form of spindle is shown in Fig. 5.

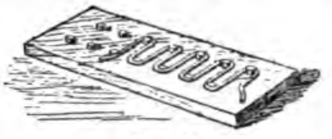

FIG. 5.

This is made by bending the sized rope around pins driven into a board in two rows, the pins of one row alternating in position with those of the other row. The board and pins are covered with paraffin, as in the other case.

The spiral spindles may be combined with each other, as shown at *a*, *b*, *c*, *d*, and *e* in Fig. 6, and with a straight rod, as shown at *f*. At *g* they are shown by combination with the zigzag rope. At *h* the zigzag rope is shown in combination with straight rods.

The circles and segments of circles shown in Figs. 2 and 3 are made by winding the sized rope around a tin pail, a can, or some other cylindrical body, and allowing it to dry. To form a complete ring, one turn of the rope is cut off, its ends are cut off diagonally and fastened together with strong glue.

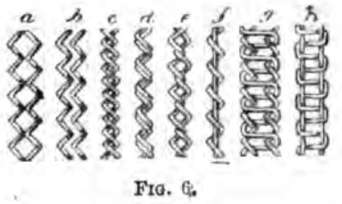

FIG. 6.

The spindles are cut by means of a sharp knife. The various parts of the work are fastened together and attached to a light wooden frame, and, as a rule, no fastening other than glue will be required. If, however, a stronger fastening is necessary at some points, small brads or wire nails, or even screws, may be used.

In Fig. 3, the rosette *d* is formed of a circular ring filled with segments of a similar ring in the manner shown. Each pair of spirals, *a*, consists of one right-handed one and one left-handed. The spindles *b*, *c* are spirals.

Grills made in this way may be finished in the same manner as wood. They may be stained or painted to match the work into which they are fitted, or they may be painted white and relieved by a little gilt on the projecting part.

It is obvious that a large number of patterns may be worked out by the aid of these suggestions. Different kinds and sizes of rope may be used alone or in combination.

These grills may be placed in windows, doorways, across halls, above mantels, across niches, between windows, and in many other places which will suggest themselves. Like many other household ornaments, if well and carefully made, they will repay the labour and trouble of making.—*Scientific American.*

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THE quantity of coal raised in New South Wales increased from 1,466,180 tons in 1880, to 3,203,444 tons in 1888, and last year the total further expanded to 3,655,000 tons. This represented a rate of increase far more rapid than that of the population.

# BRITISH ASSOCIATION.

## PRESIDENT'S ADDRESS.

THE sixtieth annual meeting of the British Association for the Advancement of Science was commenced at Leeds last Wednesday, when the President, Sir F. A. Abel, C.B., D.C.L. (Oxon.), D.Sc. (Cant.), F.R.S., P.P.C.S., Hon.M.Inst. C.E., delivered an address, from which we extract the following portions, which give an idea of the wide field covered by the President.

More than one-half the period of existence of this Association has passed since Sir Richard Owen presided over its meeting in this town. Alas! what gaps have been created in the ranks of those who then were prominent for activity in advancing its work: the then General Secretary, Sir Edward Sabine; the all-popular Assistant-general Secretary, John Phillips; the Treasurer, John Taylor, now live with us only through their works and the enduring esteem which they inspired. But very few of those who held other prominent positions at that meeting have survived to see the Association reassemble in this town. Whewell, Herschel, Hopkins, the elder Brodie, Murchison, William Fairbairn, all Presidents of Sections in 1858, have long since been removed from among us; and the then President of Section F, Edward Baines, a much-honoured and highly-talented son of the "Franklin of Leeds," whom we had hoped to count among those Vice-Presidents representing the city on this occasion, has recently passed away, in his ninetieth year, after a most honourable and useful career, during which he especially distinguished himself by his successful exertions in the advancement of the great educational movements of his time. To not a few of those who have flocked to Leeds to attend the annual gathering of this Association, our present meeting-place is doubtless known chiefly by its proud position as one of the most thriving manufacturing towns of the United Kingdom; of ancient renown, especially in connection with one of the chief industries identified with Great Britain in years past. But this good town of Leeds, whose cloth market was described by Daniel Defoe, one hundred and sixty odd years ago, as "a prodigy of its kind, and not to be equalled in the world," and whose present position in connection with divers of our great industries would have equally excited the enthusiasm of that graphic writer, is famous for other things than its prominent association with manufactures and commerce.

### Advances in Electricity.

Among the branches of science in the practical applications of which the greatest strides have been made since the Association met at Leeds in 1858, is electricity. That year witnessed the accomplishment of the first great step towards the establishment of electrical communication between Europe and America, by the laying of a telegraph-cable connecting Newfoundland with Valencia. Through this cable a message of thirty-one words was shortly afterwards transmitted in thirty-five minutes; an achievement which, though exciting great enthusiasm at the time, scarcely afforded promise of the succession of triumphs of ocean telegraphy which have since surpassed the wildest dreams of the pioneers in the realms of applied electricity. The laying of the earliest submarine cables, between 1851 and 1855, led Sir W. Thomson, in conference with Sir George Stokes, to work out the theory of signalling in such cables, by utilising the mathematical results arrived at by Fourier in his investigation of the propagation of heat-waves. The failure of the first Atlantic cable led to the survey of the bottom of the Atlantic, which was the forerunner of deep-sea explorations, culminating in the work of the *Challenger* Expedition, and opening up new treasures of knowledge scarcely dreamt of when last the British Association met at Leeds. In some important directions we may lay claim to rank foremost in the application of the electric light: thus, our large passenger-ships and our warships are provided with efficient electrical illumination; to the active operations of our Navy the electric light has become an indispensable adjunct; and our system of coast defence, by artillery and submarine mines, is equally dependent, for its thorough efficiency, upon the applications of electricity in connection with range-finding, with the arrangement and explosion of mines, and with the important auxiliary in attack and defence, the electric light, which, while so arranged, at the operating stations, as to be protected against destruction by artillery-fire and difficult of detection by the enemy, is available at any moment for affording invaluable information and important assistance and protection. Other important applications of the electric light, such as its use as a lighthouse illuminant, for the lighting of main roads in coal-mines, where its value is being increasingly appreciated, and even for signalling purposes in mid-air, through the agency of captive balloons, are continually affording fresh demonstrations of the value of this particular branch of applied electric science.

### Applications of Electricity.

The successful transmission of the electric current, and the power of control now exercised over the character which electrically-transmitted energy is made to assume, are not alone illustrated by the efficiency of the arrangements already developed for the supply of the electric light from central stations. Siemens dwelt upon this subject at Southampton with the ardent interest of one who had made its development one of the objects of his energetic labours in later years, and also with a prophet's prognostications of its future importance. In speaking of the electric current as having entered the lists in competition with compressed air, the hydraulic accumulator, and the quick-running rope driven by water-power, Siemens pointed out that no further loss of power was involved in the transformation of electrical into mechanical energy than is due to friction, and to the heating of the conducting wires by the resistance they oppose, and showed that this loss, calculated upon data arrived at by Dr. John Hopkinson and by himself, amounted at the outside to 38 per cent. of the total energy. Subsequent careful researches by the Brothers Hopkinson have demonstrated that the actual loss is now much less than it was computed at in 1885; as much as 87 per cent. of the total energy transmitted being realisable at a distance, provided there be no loss in the connecting leads used.

### Utilisation of Water Power.

The idea cherished by Siemens, and enlarged upon by him in more than one interesting address, of utilising the power of Niagara, appears about to be realised, at any rate in part; as a large tract of land has been recently acquired, by a powerful American Association, about a mile distant from the Falls, with a view to the erection of mills for utilising the power, which it is also proposed to transmit to distant towns; and an international Commission, with Sir William Thomson at its head, and with Mascart, Turrettini, Coleman Sellers, and Unwin as members, will carefully consider the problems involved in the execution of this grand scheme. The application of electric traction to water-traffic, first successfully demonstrated in 1883, is receiving gradual development, as illustrated by the considerable number of pleasure-boats which may now be seen on the Upper Thames during the boating season, and in connection with which Prof. George Forbes proposed, at our meeting last year, that stations for charging the requisite cells, through the agency of water-power, should be established at the many weirs along the river, so as to provide convenient electric coaling-stations for the river pleasure-fleet.

### Electrical Welding.

Amongst the many subjects of importance studied by Joule with the originality and thoroughness characteristic of his work, was the application of voltaic electricity to the welding and fusing of metals. Thirty-four years ago he published a most suggestive paper on the subject, in which, after dealing with the difficulties attending the operation of welding, and of the interference of films of oxide, formed upon the highly-heated iron surfaces, with the production of perfect welds either upon the hammer or by the methods of pressure (of which he then predicted the application to large masses of forged iron), he refers to the possibility of applying the calorific agency of the electric current to the welding of metals, and describes an operation witnessed by him in the laboratory of his fellow-labourer, Thomson, of fusing together a bundle of iron wires by transmitting through them, when imbedded in charcoal, a powerful voltaic current. Joule afterwards succeeded in fusing together a number of iron wires with the current of a Daniell battery, and of welding together wires of brass and steel, platinum and iron, &c. In discussing the question of the amount of zinc consumed in a battery for raising a given amount of iron to the temperature of fusion, he points out that the same object would probably be more economically attained by the use of a magneto-electric machine, which would allow the heat to be provided by the expenditure of mechanical force, developed in the first instance by the expenditure of heat; and he indicates the possibility of arranging machinery to produce electric currents which shall evolve one-tenth of the total heat due to the combustion of the coal used, so that 5,000gr. of coal applied through that agency would suffice for the fusion of one pound of iron. The successful practical realisation of Joule's predictions in regard to the application of electric currents, thus developed, to the welding of iron and steel, and to analogous operations, through the agency of the efficient machines devised by. Prof. Elihu Thomson, was demonstrated to the members of the Association by Prof. Ayrton at Bath two years ago, and was shown upon a larger scale to visitors at the Paris Exhibition last year, and recently to highly interested audiences in London by our late President, Sir Frederick Bramwell. Another very simple system of electric welding, especially applicable to thin iron- and steel-sheets, hoops, &c., has been cotemporaneously elaborated in Russia by Dr. Bernados, and is already being extensively used. The required heat at the surfaces to be welded is developed by connecting the metal with the negative pole of the dynamo-machine, or of a battery of accumulators, the circuit being completed by applying a carbon electrode to the parts to be heated; the reducing power of the carbon is said to preserve the heated metal surfaces from oxidation during the very brief period of heating.

### Aluminium Alloys.

After referring to the labours of the Messrs. Cowles in developing a method of obtaining aluminium by electrical methods, the President went on to say that the electric process of producing aluminium-alloys has, however, to compete commercially with their manufacture by adding to metals, or alloys, pure aluminium produced by processes based upon the method originally indicated by Oersted in 1824, successfully carried out by Wöhler three years later, and developed into a practical process by H. St. Claire Deville in 1854—namely, by eliminating aluminium from the double chloride of sodium and aluminium in the presence of a fluoride, through the agency of sodium. An analogous process, indicated in the first instance by H. Rose—namely, the corresponding action of sodium upon the mineral cryolite, a double fluoride of aluminium and sodium—has also been recently developed at Newcastle, where the first of these methods was applied, upon a somewhat considerable scale, in 1860, by Sir Lowthian Bell, but did not then become a commercial success, mainly owing to the costliness of the requisite sodium.

### Uses of Aluminium.

The reduction which has been effected in the cost of production of aluminium through this and other processes, and which has certainly not yet reached its limit, can scarcely fail to lead to applications of the valuable chemical and physical properties of this metal so widespread as to render it as indispensable in industries and the purposes of daily life as those well-known metals which may be termed domestic. The Swedish metallurgist, Wittenström, appears to have been the first to observe that the addition of small quantities of aluminium to fused steel and malleable iron had the effect of rendering them more fluid, and, by thus facilitating the escape of entangled gases, of ensuring the production of sound castings without any prejudicial effect upon the quality of the metal. The excellence of the so-called Mitis castings, produced in this way, appears thoroughly established, and the results of recent important experiments seem to be opening up a field for the extensive employment of aluminium in this direction, provided its cost becomes sufficiently reduced. The valuable scientific and practical experiments of W. J. Keep, James Riley, R. Hadfield, Stead, and other talented workers in this country and the United States, are rapidly extending our knowledge in regard to the real effects of aluminium upon steel, and their causes. Thus, it appears to be already established that the modifications in some of the physical properties of steel resulting from the addition of that metal are not merely ascribable to to its actual entrance into the composition of the steel, but are due, in part, to the de-oxidation by aluminium of some proportion of iron-oxide which exists distributed through the metal, and prejudicially affects its fluidity when melted. In the latter respect, therefore, the influence exerted by aluminium, when introduced in small proportions into malleable iron and steel, appears to be quite analogous to that of phosphorous, silicum, or lead when these are added in small proportions to copper and certain of its alloys, the de-oxidation of which, through the agency of those substances, results in the production of sound castings of increased strength and uniformity. It is only when present in small proportion in the finished steel that aluminium increases the breaking strain and elastic limit of the product. The influence of aluminium, when used in small proportion, upon the properties of grey and white cast iron, is also of considerable interest, especially its effect in promoting the production of sound castings, and of modifying the character of white iron in a similar manner to silicium, causing the carbon to be separated in the graphitic form; with this difference—that the carbon appears to be held in solution until the moment of setting of the liquid metal, when it is instantaneously liberated, with the result that the structure of the cast metal and distribution of the graphite are perfectly uniform throughout.

### Alloys of Iron and Steel.

**After referring to the influence of manganese o steel, and the work accomplished by Robert Hadfield, the President proceeded: The importance manganese in connection with the metallurgy iron and steel is in a fair way of finding its rival that of the metal chromium, the employment which, as an alloy with steel, was first made th subject of experiment in 1821, by Berthier, who was led by the important experiments of Faraday and Stoddart, then just published, to endeavour alloy chromium with steel, and obtained good**

results by fusing steel together with a rich alloy of chromium and iron, so as to introduce about 15 per cent. of the former into the metal. Further small experiments were made the year following, by Faraday and Stoddart, in the same direction: but chrome-steel appears to have been first produced commercially at Brooklyn, N.Y., sixteen years ago. Ten years later its manufacture had become developed in France, and the varieties of chrome-steel produced in the Loire district now receive important and continually-extending applications, on account of their combining comparative hardness with high tenacity, and only little loss in ductility, and of their acquiring great closeness of structure when tempered. The influence of chromium upon the character of steel differs in several marked respects from that exercised by manganese; thus, chrome-steels weld badly, or not at all, whereas manganese-steels weld very readily, and work under the hammer better than ordinary carbon-steel. Again, the remarkable influence of manganese upon the magnetic properties of steel and iron is not shared by chromium. Chrome-steel has for some time been a formidable rival of the very highest qualities of carbon-steel produced for cutting-tools, and of the valuable tungsten-steel, which we owe to Robert Mushet. The great hardness, high tenacity, and exceeding closeness of structure possessed by suitably-tempered steel containing not more than from 1 to 1·5 per cent. of chromium, and from 0·8 to 1 per cent. of carbon, renders this material invaluable for war purposes: cast projectiles, when suitably tempered, have penetrated compound steel and iron plates over 9in. in thickness, such as are used upon armoured ships of war, without even sustaining any important change of form. The proper tempering of these projectiles necessitates their being produced hollow; their cavities or chambers are only of small capacity, but the charge of violent explosive which they can contain, and which can be set into action without the intervention of fuse or detonating appliance, suffices to tear these formidable punching-tools into fragments as they force their way irresistibly through the armoured side of a ship, and to violently project those fragments in all directions, with fearfully destructive effects. The employment of chromium as a constituent of steel plates used for the protection of ships of war is already being entered upon, and the influence exerted by the presence of that metal in small quantities in steel employed in the construction of guns is also at present a subject of investigation. At Crewe, Mr. F. Webb has for some time past used chromium, with considerable advantage, in the production of high quality steels for railway requirements. The practical results attained by the introduction of copper and of nickel as components of steel have also recently attracted much attention. At the celebrated French Steel Works of M. Schneider, at Creuzot, the addition of a small percentage of copper to steel used for armour-plates and projectiles is practised, with the object of imparting hardness to the metal without prejudice to its toughness. James Riley has found that the presence of aluminium in very small quantities facilitates the union of steel with a small proportion of copper, and that the latter increases the strength but does not improve the working qualities of steel. With nickel, Riley has obtained products analogous in many important respects to manganese steel; the remakable differences in the physical properties of the manganese alloys, according to their richness in that metal, are also shared by the nickel alloys, some of these being possessed of very valuable properties; thus, it has been shown by Riley that a particular variety of nickel steel presents to the engineer the means of nearly doubling boiler-pressures, without increasing weight or dimensions. He has, moreover, found the co-existence of manganese in small quantity with nickel in the alloy to contribute importantly to the development of valuable physical properties.

### The Effects of Alloying.

Such systematic researches as those upon which Osmond, Roberts-Austen, and many other workers have been for some time past engaged, may make us acquainted with the laws which govern the modifications effected in the physical characteristics of metals by alloying these with small proportions of other metals. The suggestion of Roberts-Austen, that such modifications may have direct connection with the periodic law of Mendeleeff, which may furnish explanations of the causes of specific variations in the properties of iron and steel, has been followed up energetically by Osmond, who has experimentally investigated the thermal influence upon iron of the elements phosphorus, sulphur, arsenic, boron, silicium, nickel, manganese, chromium, copper, and tungsten. He regards his results as being quite confirmatory of the soundness of Roberts-Austen's suggestion, as they demonstrate that foreign elements having atomic volumes lower than iron tend to make it assume or preserve the particular molecular form in which it has itself the lowest atomic volume, while the converse is the case for the foreign elements of high atomic volume. An analogous influence was found to be exerted by those two groups of elements upon the permanent magnetisation of steel. Captivating as such deductions are, those who have devoted much attention to the practical investigation of iron, steel, and other metals, cannot but feel that much caution has to be exercised in drawing broad conclusions from the results of such researches as these.

### Effects of Vibration on Steel.

Another important subject connected with the treatment of masses of steel, and with the influence exercised upon their physical characteristics by the processes of hardening and tempering, and by submitting them to oft-repeated concussions or vibrations, or frequent or long-continued strains, is the development and maintainance, or gradual disappearance, of internal stresses in the masses—one of the many important subjects to which attention was directed by Dr. Anderson, the Director-General of Ordnance Factories, in his very suggestive Address to the Mechanical Section last year. This question is one of especial interest to the constructor of steel guns, as the powers of endurance of these do not simply depend upon the quality of the material composing them, but are very largely influenced by the treatment which it receives at the hands of the gun-maker. Indeed, the highest importance attaches to the processes which are applied to the preliminary preparation of the individual parts of which the gun is constructed, and to the putting together of these so as to insure their being and remaining in the physical condition best calculated to assist each other in securing for the structure the power of so successfully resisting the heavy strains to which it has to be subjected as to suffer little alteration other than that due to the superficial action of the highly-heated products of explosion of the charges fired in the gun.

### The Appliances of War.

What really can be said in favour of the advances made in the appliances of war—and this is, perhaps, the view which in such a town as Leeds we should keep before our eyes to the exclusion of the dark side of the picture—is, that by continuous competition in the development of their magnitude, diversity, and perfection, the resources of the manufacturer, the chemist, the engineer, the electrician, are taxed to the uttermost, with the very important, although incidental, results that industries are created or expanded and perfected, trades maintained and developed, and new achievements accomplished in applied science, which in time beneficially affect the advance of peaceful arts and manufactures. In these ways the expenditure of a large proportion of a country's resources upon material which is destroyed in creating destruction does substantially benefit communities, and tends to the accomplishment of such material progress by a country as goes far to compensate its people for the sacrifices which they are called upon to incur for the maintenance of their dignity among nations. Since the meeting of the Association in this town in 1858, the progress which has been made in the regulation of the explosive force of gunpowder, so as to adapt it to the safe development of very high energy in guns presenting great differences in regard to size and to the work which they have to perform, has been most important. The different forms of gunpowder which were applied to war purposes in this and other countries, until within the last few years, presented comparatively few differences in composition and methods of manufacture from each other, and from the gunpowder of our ancestors. The replacement of smoothbore guns by rifled artillery, which followed the Crimean War, and the great increase in the size and power of guns, necessitated by the application of armour to ships and forts, soon called, however, for the pursuit of investigations, having for their object the attainment of means for variously modifying the action of fired gunpowder, so as to render it suitable for artillery of different calibres whose power could not be effectively, or, in some instances, safely, developed by the use of the only kind of gunpowder then employed in English artillery of all calibres. When our attention was first actively directed to the modification of the ballistic properties of powder, the subject had already been to some extent dealt with, in the United States, by Rodman and Doremus, and the latter had proposed the employment, in heavy guns, of charges consisting of large pellets of prismatic form. While this prismatic powder, which was first used in Russia, was being perfected, and extensively applied there as well as in Germany and England, the production of powder masses more suitable, by the comparatively gradual nature of their explosion, for the very large charges required for the heavy artillery of the present day, was actively pursued in Italy, and by our own Government Committee on Explosives, the outcome of very exhaustive practical investigations being the very efficient Fossano powder, or *poudre progressif* of the Italians, and the boulder and large cylindrical-powders produced at Waltham Abbey.

### Smokeless Powder.

The importance which machine-guns and comparatively large, quick-firing guns have assumed in the armament of ships has made it very desirable to provide a powder for them which will produce comparatively little or no smoke, as their efficient employment becomes greatly limited when, after a very few rounds rapidly fired with black powder, the objects against which it is desired to direct the fire are more or less completely hidden by the interposed smoke. Hence much attention has of late been directed to the production of smokeless, or nearly smokeless, powders for naval use. At the same time, the views of many military authorities regarding the importance of dispensing with smoke in engagements on land have also created a demand for smokeless powders suitable for field-artillery and for small-arms. The properties of ammonium-nitrate, of which the products of decomposition by heat are, in addition to water-vapour, entirely gaseous, have rendered it a tempting material to those who have striven to produce a smokeless powder; but its deliquescent character has been a formidable obstacle to its application as a component of a useful explosive agent. By incorporating charcoal and saltpetre in particular proportions with ammonium-nitrate, F. Gaus recently claimed to have produced an explosive material free from the hygroscopic character common to other ammonium-nitrate mixtures, and furnishing only permanently gaseous and volatile, or smokeless, products of explosion. These anticipations were not realised, but they led the talented German powder maker, Mr. Heidemann, to produce an ammonium-nitrate powder possessing remarkable ballistic properties, and producing comparatively little smoke, which speedily disperses. It yields a very much larger volume of gas and water-vapour than either black or brown powder, and is considerably slower in action than the latter; the charge required to produce equal ballistic results is less, while the chamber-pressure developed is lower, and the pressures along the chase of the gun are higher, than with brown powder. No great tendency is exhibited by it to absorb moisture from an ordinarily dry, or even somewhat moist, atmosphere; but it rapidly absorbs water when the hygroscopic condition of the air approaches saturation, and this greatly restricts its use. About five years ago reports began to reach us from France of the attainment of remarkable results with a smokeless powder employed with the repeating or magazine rifle then in course of adoption for military service, and of marvellous velocities obtained by the use of this powder in specially constructed artillery of great length. As in the case of the explosive agent called Mélinite, the fabulously-destructive effects of which were much vaunted at about the same time, the secret of the nature of this smokeless powder was well preserved by the French authorities; it is now known, however, that more than one smokeless explosive has succeeded the original, and that the material at present in use with the Lebel repeating rifle belongs to a class of nitro-cellulose or nitro-cotton preparations, of which several have been made the subject of patents in England, and of which varieties are also being used in Germany and other countries. A comparison between the chemical changes attending the burning or explosion of gunpowder, and of the class of nitro-compounds represented by gun-cotton, at once explains the cause of the production of smoke by the former, and of the smokelessness of the latter. Whilst the products of explosion of the nitro-compounds consist exclusively of gases and of water-vapour, gunpowder, being composed of a large proportion of saltpetre, or other metallic nitrate, mixed with charred vegetable matter and variable quantities of sulphur, furnishes products of which over 50 per cent. are not gaseous, even at high temperatures, and which are in part deposited as a fused solid—which constitutes the fouling in a firearm—and in part distributed in an extremely fine state of division through the gases and vapours developed by the explosion, thus giving to these the appearance of smoke as they escape into the air. So far as smokelessness is concerned, no material can surpass gun-cotton (or other varieties of nitro-cellulose); but, even if the rate of combustion of the fibrous explosive in a firearm could be controlled with certainty and uniformity, its application as a safe propulsive agent is attended by so many difficulties that the non-success of the numerous early attempts to apply it to that purpose is not surprising. There now appears little doubt that in future warfare belligerents on both sides will alike be users of these new powders; the screening or obscuring effect of smoke will therefore be practically absent during engagements between contending forces, and while, on the one hand, the very important protection of smoke, and its sometimes equally important assistance in manœuvres, will thus be abolished, both combatants will, on the other hand, secure the advantages of accuracy of shooting and of the use of individual fire, through the medium of cover, with comparative immunity from detection. Such results as these cannot fail to affect, more or less radically, the principles and conditions under which battles have hitherto been fought. With respect to the naval service, it is especially for the quick-firing guns, so important for defensive purposes, that a smokeless powder has been anxiously looked for; by the adoption of such a powder as has during the past year been elaborated for our artillery, should experience establish its reliability under all service conditions and its power to fulfil all reasonable requirements in regard to stability, these guns will not only be used by our ships under conditions most favourable to their efficiency, but their power will also be very importantly increased.

### Melinite.

Between four and five years ago intelligence first reached us of marvellously destructive effects produced by shells charged with an explosive agent which the French Government was elaborating. The reported results surpassed any previously recorded in regard to violently destructive effects and great velocity of projection of the fragments of exploded shells, and it was asserted that the employment of this new material, Mélinite, was unattended by the usual dangers incident to this particular application of violent explosive agents, an assertion scarcely consistent with accounts which soon reached us of several terrible calamities due to the accidental explosion of shells loaded with Mélinite. Although the secret of the precise nature of Mélinite has been extremely well preserved, it transpired ere long that extensive purchases were made in England, by or for the French authorities, of one of the many coal-tar derivatives, which for some years past has been extensively manufactured for tinctorial purposes; but which, although not itself classed among explosive bodies until quite lately, had long before been known to furnish, with some metals, more or less highly explosive combinations, some of which have been applied to the production of preparations suggested as substitutes for gunpowder. The product of destructive distillation of coal from which, by oxidation, this material is now manufactured, is the important and universally-known antiseptic and disinfectant, carbolic acid or phenol. Originally designated carbazotic acid, the substance now known as picric acid was first obtained in small quantities as a chemical curiosity by the oxidation of silk, aloes, &c., and of the well-known blue dye indigo, which thus yielded another dye of a brilliant yellow colour. To the many who may regard this interesting phenol-derivative as a material concerning the stability and other properties of which we have little knowledge, it will be interesting to learn that it has been known to chemists for more than a century. It was first manufactured in England for tinctorial purposes by the oxidation of a yellow resin (*Xanthorrhœa hastilis*), known as Botany Bay gum. Its production from carbolic acid was developed in Manchester in 1862, and its application as a dye gradually extended, until, in 1886, nearly 100 tons were produced in England and Wales. Although picric-acid compounds were long since experimented with as explosive agents, it was not until a very serious accident occurred, in 1887, at some works near Manchester where the dye had been for some time manufactured, that public attention was directed in England to the powerfully explosive nature of this substance itself. The French authorities appear, however, to have been at that time already engaged upon its application as an explosive for shells. It is now produced in very large quantities at several works in Great Britain, and it has been extensively exported during the last four years, evidently for other than the usual commercial purposes. Large supplies of phenol, or carbolic acid, have, at the same time, been purchased in England for France, and lately for Germany, doubtless for the manufacture of picric acid, very extensive works having been established for its production in both those countries. It has been made the subject of experiment by our military authorities, and its position has been well established as a thoroughly stable explosive agent, easily manufactured, comparatively safe to deal with, and very destructive when the conditions essential for its detonation are fulfilled. The precise nature of Mélinite appears to be still only known to the French authorities: it is asserted to be a mixture of picric acid with some material imparting to it greater power; but accounts of accidents which have occurred even quite recently in the handling of shells charged with that material appear to show that, in point of safety or stability, it is decidedly inferior to simple picric acid.

### Explosives in Mines.

Although the subject of the development of explosive force for purposes of war has of late received from workers in applied science, from seekers of patentable inventions, and even from the public generally, a somewhat predominating share of attention, considering that we congratulate ourselves upon the enjoyment of a period of profound peace, yet the production of new explosive agents for mining and quarrying purposes, which present or lay claim to points of superiority over the well-established blasting-agents, has been by no means at a standstill. For many years the main object sought to be achieved in this direction was to surpass, in power or adaptability to particular classes of work, the well-known preparations of nitro-glycerine and gun-cotton, which, during the past twenty years, have been formidable competitors and, in many directions, absolutely successful rivals of black powder. It is both interesting and satisfactory to note, however, that this object has of late, and especially since the publication of the results of labours of English and foreign Commissions on the causes of mine accidents, been prominently associated with endeavours to solve the important problems of combining, in an explosive agent, efficiency in point of power with comparative non-sensitiveness to explosion by friction or percussion, and of securing its effective operation with little or no accompaniment of projected flame. Safety-dynamites, flameless explosives, water-cartridges, and other classes of materials and devices connected with the getting of coal, the quarrying of rock, or the blasting of minerals have claimed the attention of those who guide the miner's work; in some of these directions the practical results obtained have been beyond question important, and, indeed, conclusive as regards the great diminution of risks to which men need be exposed in those coal-mines where the ordinary use of explosives, although not altogether inadmissible, may at times be attended with danger. It is to be feared that those results are still far from receiving the amount of application which might reasonably be hoped for; but, at any rate, there are, among the extensive mining districts where the employment of explosives in connection with the getting of coal cannot be dispensed with, several of importance where the use of gunpowder has almost entirely given place to the adoption of blasting-agents or methods of blasting, the employment of which is either not, or only very exceptionally, attended by the projection of flame or incandescent matter into the air where the shot is fired. The mining public is especially indebted to German workers for much of the success which has been obtained in this direction, and also to the eminent French authorities, Mallard and Le Chatelier, for their thorough theoretical and practical investigations bearing upon the prevention of accidental ignition of fire-damp during blasting operations. Having arrived at the conclusion that fire-damp and air-mixtures are not ignited by the firing of explosive preparations which develop by their detonation temperatures lower than 2,220° C., they found that ammonium-nitrate, although in itself susceptible of detonation, does not develop a higher temperature than 1,130° C., while the temperature of detonation of nitro-glycerine and gun-cotton are, respectively, 3,170° and 2,636°. The admixture of that salt with nitro-glycerine or gun-cotton in sufficient proportion to reduce the temperature of detonation to within safe limits allows, therefore, of the employment of those explosive agents in the presence of fire-damp mixtures without risk of accident, and this has led to the effective use of such mixtures as safe blasting-agents in coal.

### Coal-Mines and Safety-Lamps.

The fearful dangers arising from the accumulation of inflammable dust in coal-mines, and the equality of mine-dust with fire-damp in its direful power of propagating explosions, which may sometimes even be, in the first instance, established chiefly or entirely through its agency, have now been long recognised as beyond dispute; and it is satisfactory to know that permission to fire shots in mine-workings which are dry and dusty has, by recent legislation, been made conditional upon the previous laying of the dust by effective watering. In some mining districts, moreover, the purely voluntary practice has been extensively adopted by mine-owners of periodically watering the main roads in dry and dusty mines, or of frequently discharging water-spray into the air in such roads, which must tend greatly to reduce the possible magnitude of the disastrous results of a fire-damp or dust explosion in any part of the mine-workings. The encouragement given to the application of the combined resources of ingenuity, mechanical skill, and knowledge of scientific principles, through the elaborate, but thoroughly practical, comparative trials to which almost every variety of safety-lamp has, during the last few years, been submitted by competent and conscientious experimenters, has resulted in the provision of lamps to the hand of the miner which combine the essential qualities of safety, under the most exceptionally severe conditions, with good illuminating power, simplicity of construction, lightness, and moderate cost. Very important progress has also been made, since the first appointment of the late Accidents in Mines Commission, towards the provision of thoroughly serviceable and safe portable electric lamps for use in mines. Of those which have already been in the hands of the miner, several have fairly fulfilled his requirements as regards size, weight, and illuminating power of sufficient duration; but much still remains to be accomplished with respect to durability, simplicity, thorough portability, and cost, before the self-contained electric lamp can be expected to compete successfully with the greatly-improved miners' lamps which are now in use, or available.

### Petroleum.

The creation and rapid development of the petroleum industry has, indeed, furnished one of the most remarkable illustrations which can be cited of industrial progress during the period which has elapsed since the British Association last met in Leeds. One year after that meeting—viz., on August 28, 1859—the first well, drilled in the United States with the object of obtaining petroleum, was successfully completed, and the rate of increase in production in the Pennsylvania oil-fields during the succeeding years is shown by the following figures:—In 1859, 5,000 barrels (of 42 American gallons) were produced. In the following year the production increased to 500,000 barrels; while in the next year (1861) it exceeded 2,000,000 barrels, at which figure it remained, with slight fluctuations, until 1865. The supply then continued to increase gradually, until, in 1870, it reached nearly 6,000,000 barrels; while in 1874 it amounted to nearly 11,000,000 barrels. In 1880 it amounted to over 26,000,000 barrels, and in 1882 it reached 31,000,000. Since then the supply furnished by the United States has fallen somewhat, and last year it amounted to 21,500,000 barrels. The production of crude petroleum in the Pennsylvanian fields, large as it has been, has not, however, kept pace with the consumption, for we find that the accumulated stocks, which on December 31, 1888, amounted to over 18,000,000 barrels, had become reduced to about 11,000,000 barrels at the close of last year. At this rate the surplus stock above ground will have vanished by the end of the current year. In addition to the petroleum raised in Pennsylvania, there is now a very large production in the State of Ohio; but this has not as yet been employed as a source of lamp oil. It is, however, transported by pipe line in great quantities to Chicago, for use as liquid fuel in industrial operations. A few years after the development of the United States petroleum industry, the production of crude petroleum in Russia also began to extend very rapidly. For more than 2,500 years Baku, on the borders of the Caspian Sea, has been celebrated for its naphtha springs and for the perpetual flames of the Fire Worshippers, fed by the marvellous subterannean supplies of natural gas. To a limited extent, neighbouring nations appear to have availed themselves of the vast supplies of mineral oil at Baku during the past thousand years. By the thirteenth century the export of the crude oil had already become somewhat extensive; but the production of petroleum from it by distillation is of comparatively recent date. Another important feature connected with the development of the petroleum industry is the great extent to which the less volatile products of its distillation have replaced vegetable and animal oils and fats for lubricating purposes in this and other countries. The value of petroleum as a liquid fuel and as a source of gas for illuminating purposes has, moreover, been long since recognised, and it is probable that one outcome of the attention which is now being given to the hitherto unworked deposits of petroleum in the East and West Indies, South America, and elsewhere, will be a very large increase in its application to these purposes. In the East Indies there are vast tracts of oil-fields in Burmah, Baluchistan, Assam, and the Punjab. The native Rangoon oil industry is one of great antiquity, although the oil was only used in the crude condition until about 35 years ago, at which time Dr. Hugo Müller, with the late Warren De la Rue, whose many-sided labours and generous benefactions have so importantly contributed to the advancement of science, made valuable researches on the products furnished by crude oil imported from Rangoon. The resources of the oil-fields of Upper Burmah, especially of the district of Yenang-young (or creek of stinking water), have since then been developed by British enterprise, and have attained to considerable importance since our annexation of Upper Burmah.

### Natural Gas.

Another most remarkable feature connected with the development of the petroleum industry is presented by the utilisation, within the last few years, of the vast supplies of natural inflammable gas furnished by the oil fields. In America this remarkable gas supply was for a long time only used locally; but before the close of 1885 its conveyance to a distance by pipes, for illuminating and heating purposes, had assumed large proportions, one companies in Pittsburgh having alone lai miles of pipes of various sizes, through whic was supplied equivalent in heating value to 3,6 tons of coal per annum. Since then the cons tion in and around Pittsburgh has probably b least tripled. At the close of 1886 six dif companies were conveying natural gas by pi Pittsburgh from 107 wells; 500 miles of ranging in diameter from 30in. to 3in., wer by these companies, 232 miles of which wer within Pittsburgh itself. The Philadelphia pany, the most important of these associations owned the gas supply from 54,000 acres of situated on all the anti-clinals around Pittsb but drew its supplies only from Tarentum an

urraysville field. It supplied, in 1886, 470 fac-
ies and about 5,000 dwellings within the
y, besides many factories and dwellings
Alleghany, and in numerous neighbouring
lages. The average gas-pressure at the wells,
en the escape is shut off, is about 500lb.
· square inch, and in the case of new wells
s pressure is very greatly exceeded. In order to
nimise the danger from leakage, the gas-pressure
the city is reduced to a maximum of 13lb., and is
ulated by valves at a number of stations under
control of a central station. The usual pres-
e in the larger lines is from 6lb. to 8lb., while in
low-pressure lines it does not exceed 4oz. to 5oz.
e effect of the change from coal gas to natural
upon the atmosphere over Pittsburgh has been
st marked: formerly the sky was constantly
cured by a canopy of dense smoke; now the
nosphere is clear, and even white paint may with
unity be employed for the house fronts.

### Water-Gas.

. form of gaseous fuel which has long been
wn to technical chemists and metallurgists, but
ch has of late attracted considerable attention,
cially in connection with the recent interesting
k relating to its applications pursued by Mr.
ison Fox, of Leeds, has become, within the last
years, a competitor in the United States, both
he natural gas of Pennsylvania and of coal-gas.
e Felix Fontana first produced so-called water-
in 1780, by passing vapour of water over highly-
ed fuel, many methods, differing chiefly in small
ils, have been proposed for carrying out the
ation, with a view to the ready and cheap pro-
tion of the resulting mixture of hydrogen and
onic oxide, and numerous technical applications
rater-gas have been suggested from time to time,
n no very important results, excepting as regards
ise for lighting purposes. Being of itself non-
inous, its utilisation in this direction is accom-
hed either by mixing it with a highly luminous
, or by causing a hydrocarbon vapour to be
used through it, or the non-luminous flame, pro-
ed by burning it in the air, is made to raise to
ndescence some suitably-prepared solid substance,
h as magnesia, lime, a zirconium salt, or plati-
n, whereby bright light is emitted. The objection
ts employment as an illuminant for use in build-
s, to which great weight is attached by us, and
itly, as sad experience has shown—viz., that, as
onsists, to the extent of about one-half its
ame, of the highly poisonous gas carbonic oxide,
atmosphere in a confined space may be rendered
spirable by a small accidental contamination
h water-gas, by leakage or otherwise, not de-
able by any odour—appears to constitute no
at impediment to its employment in the United
tes, as it is now manufactured for illuminating
heating purposes by a large proportion of their
works, being in some places employed in admix-
s with a highly luminous coal-gas, in others
dered luminous by the alternative methods men-
ed. It is stated that about three-fourths of the
minating gas now supplied to the cities of New
k, Brooklyn, Philadelphia, Jersey, St. Paul,
Minneapolis is carburetted water-gas; in
cago the entire supply now consists of this gas,
Boston will also soon be supplied exclusively
h it.

### Schools of Science.

n examination into the present educational
urces of Leeds places beyond any doubt the
that her present prosperity in commerce and
ustries is in no small degree ascribable to the
amount importance long since attached here to
liberal provision of facilities for the diffusion of
wledge among the artisan and industrial classes,
especially for the acquisition of a sound ac-
istance with the principles of the sciences and
ir applications to technical purposes, with parti-
ar reference to the prominent local industries, by
gades of those who pursue or intend to pursue
m. There is, probably, no town in the kingdom
e amply provided with efficient elementary and
anced schools for both sexes, while the special
uirements of the artisan are efficiently met by
prosperous School of Science and Technology.
e resources of the Yorkshire College provide, in
ition, a combination of thorough scientific edu-
n with really practical training in the more
rtant local industries; indeed, during the
n years of its continually-progressive work,
institution has acquired so widespread a repu-
n that students come from abroad to reap the
ages afforded by the unrivalled textile and
departments of the Leeds College. The
competition now existing between these
nents and the corresponding branches of the
younger but most vigorous sister college at
rd can only conduce to the further develop-
f both, and to their thorough maintenance
he requirements of the day.

very important pecuniary aid afforded to
establishments, and to a number of other
al schools in Yorkshire, by one of the most
ant of the ancient companies of the City of
n, the Clothworkers, affords an interesting illustration of the good work in the cause of education performed by those guilds and, especially of late years, by means of their flourishing institute for the advancement of technical education which, through its two great instructional establishments in London, and through the operation of its system of examinations throughout the country, extending now even to the colonies, has afforded very important aid towards eradicating the one great blot upon our national educational organisation. To have been first in the field in practically developing a far-reaching scheme for the advancement of technical education in this country must continue to be a source of pride to the City of London and its ancient guilds in time to come, when the operation of efficient legislation, supported and extended by patriotic munificence and by the hearty co-operation of associations of earnest and competent workers in the cause, shall have placed the machinery and resources for the technical instruction of the people upon a footing commensurate with our position among nations.

## USEFUL AND SCIENTIFIC NOTES.

It has been found that steel blades, such as razors, scissors, pocket and table-knives, and also files, suffer complete deterioration to a considerable depth from the surface of the metal when immersed in the soft upland waters supplied to Sheffield for several years. This has been proved by the recovery from time to time from the reservoirs of bundles of such steel articles, which had doubtless been placed there in connection with trade outrages in times past. The steel was found to have become converted into plumbago, whole bundles of blades being capable of being scraped away with a penknife.

**Treating Fibres.**—A new mode of treating hemp, jute, and other fibres for making materials for the manufacture of tiles, slabs, cisterns, boats, and other articles or structures has been described in a patent specification by B. A. Weatherdon. The fibres are cut and boiled four to six hours in a strong solution of lime by steam at a pressure of from 20lb. to 40lb. to the square inch. After being thoroughly washed, the material is passed to a pulping machine, where it is treated with alum about 7lb. to 14lb. to the cwt., and in some cases with animal size, and in others with vegetable or other oils. From the pulping machine it is run into receiving or storing tanks, fitted with machinery for keeping the pulp in agitation, and whilst therein it can be dyed if required. Now the pulp fibre is pumped into vats, and from thence into wire moulds, to be formed into slabs, blocks, &c., the liquor being extracted by suitable pressure. The slabs, blocks, &c., are brought into the drying-room, and when dry passed through solid steel rollers four to twelve times, steeped in a warm solution of alum, and again subjected to hydraulic pressure. Then they are brought into a bath of vegetable or other oil for four to six hours, and again pressed and steam-rolled as many times as necessary. To finish the process they are dried in hot air, and in some cases passed through the rollers once more.

**Leather Belting.**—Although some writers contend that leather belting should be run with the flesh side to the pulley, while others are equally strong in their claim that it should run with the hair side to the pulley, they all agree that for general use a good leather belt, when properly adjusted to carefully balanced pulleys, is both satisfactory and economical. It is estimated that every inch in width of good double leather belting, travelling at the rate of 500ft. per minute, will transmit one horse-power; and that every inch in width of good single leather belting, travelling at the rate of 800ft. per minute, will transmit one-horse power. If the belt is allowed to accumulate dust and dirt, such accumulations will absorb the moisture of the belt, and it will become hard and dry, and begin to crack and slip. If the face of the pulley becomes bright and smooth, it shows that the belt is slipping, even though the eye fails to detect it otherwise. A belt can be cleaned by means of warm water, applied with a stiff brush, or by holding a square-edged board against the belt, while in slow motion. Belts should be cleaned regularly, and after cleaning, a good belt dressing should be applied. A proper dressing will keep the belt soft and elastic. It will cause the belt to hug the pulley and transmit its greatest power. The use of a good belt dressing is superior in economy to any other method for correcting a slipping or slightly loose belt. The custom of tightening a belt whenever it slips is not a good one. The belt is liable to be made too tight, which heats the bearings and strains the belt. Great care, however, should be taken in preparing a belt dressing. Castor oil is an article in very general use, but experts have found that it contains an active acid principle, and is drying in its nature. The use of soap, resin, tar, &c., cannot too strongly be condemned. They are only temporary stimulants, and eventually destroy the belt.

## SCIENTIFIC NEWS.

AMONGST the photographs of spectra, taken by Mr. Bailey, of Closica, Peru, Prof. E. C. Pickering, of Harvard, notes some of more than usual interest. Thus, a photograph of R Carinæ, taken on April 4 last, shows that the G and *h* lines, due to hydrogen, are bright; two photographs of the star numbered 15177 in the Cordoba General Catalogue, show a spectrum mainly of bright lines, while D.M. + 30°, 3699, has bright lines in its spectrum on the photographs taken at Harvard with the 8in. Draper telescope in June last.

A publication of the Nice Observatory has recently appeared, with an atlas containing M. Thollon's drawings of the solar spectrum, to which Mr. Ranyard draws attention in this month's issue of *Knowledge*, accompanying his notes with some reproductions of photographs of portions of the solar spectrum taken by Mr. G. Higgs, of Liverpool, with the aid of one of Prof. Rowland's concave gratings. The definition obtained by Mr. Higgs is extremely sharp, and we understand that he intends to publish a photographic map of the spectrum extending from wave-length 2990 to wave-length 8500. To those possessed of spectroscopes, Mr. Ranyard's paper will be found of great interest, and the friendly rivalry which it will probably set up between M. Thollon and Mr. Higgs may be of great ultimate value to spectroscopy.

Dr. Palisa, of Vienna, discovered another small planet on the 17th ult. It will reckon as 295, and is his seventy-third.

Denning's comet on Sept. 12, Berlin midnight, will, according to Herr Berberich, have a position —R.A. 15h. 47m. 42s., N. Dec. 9° 43·5′, which, with the figures given in previous numbers, will suffice for all practical purposes, though the comet is then at twice its discovered brightness.

The death is announced at Christiania of the eminent Norwegian astronomer, Carl Frederik Fearnley, who has been Director of the Observatory and Professor of Astronomy at the University of Christiania since 1857. He was born at Frederikshalb in 1818. He was the author of numerous astronomical and meteorological publications.

The sudden death, on the 27th ult., of Mr. Carnelley, Professor of Chemistry in the University of Aberdeen, is announced. In 1879 he was elected to the Professorship of Chemistry in Firth College, Sheffield; in 1882 to the chair of Chemistry at University College, Dundee; and in 1888 to the Chemistry chair in Aberdeen. He was only thirty-eight.

From Victoria news has been received of the death of Mr. Robert Brough Smyth (a Tynesider), who emigrated to Australia, and was appointed director of Meteorological Observations, and subsequently director of the Geological Survey of the colony.

A second edition of Father Cortie's "sketch" of the life, work, and death of Father Perry has been issued, the demand for some notes of the distinguished astronomer and man having soon exhausted the first.

In the recently issued number of the *Asclepiad*, Dr. Richardson protests against execution by electricity, and, in fact, against any member of the profession being called upon to witness "capital murder." He has a more interesting paper, entitled "Lessons from the Fasting Mania," suggesting that the "extreme limit" is from fifty-three to fifty-five days.

At the Anthropological Congress held lately at Münster, Prof. Waldeyer, of Berlin, spoke on the brains of man and of the anthropoid apes. He described the forms of the brains in question, with their typical convolutions and furrows, and dwelt on the great resemblance between the human brain and those of the gorilla, the chimpanzee, the orang, and the gibbon. This resemblance is, he contends, much greater than that of the simial brain to those of lower animals, such as the wolf, the fox, and the dog. At the same time there are unmistakable and regularly recurrent differences. In man, for instance, the furrow which runs out from the middle furrow about midway between its ends, and nearly at right angles to it, is extremely slight, whereas in the ape it is very long and deep. The occipital lobe is also incomparably better developed in man, which makes the course of the furrow separating it from the parietal lobe more longitudinal. Finally, the human brain is much richer in orifices in the part connected with the centre of language, whereas in the ape a long furrow divides this portion into two, and thus cuts off orifices.

Extensive tests have recently been undertaken in Russia as to colour-blindness among the various railway servants. The result was that of 12,542 pointsmen, 68 were colour-blind; of 4,620 station-masters, 17 were colour-blind; of 6,321 machinists, 21 were colour-blind; and of 18,600 watchmen on the railways, 140 were colour-blind. The various colour-blind officials have now been either transferred to occupations where this defect is of no importance, or dismissed.

The *Journal* of the Anthropological Institute contains some curious observations by Mr. T. W. Shore, on the surviving signs of Celtic influence in Hampshire. In this county no fewer than 70 of the oldest churches trend 20° north of east, instead of due east and west. Their orientation is thus on the line of the old May-day sunrise, a position reverenced by the Celts.

At the recent meeting of the French Association, M. Cobes, of Buenos Ayres, read a paper, in which he contended that all living animals have a surface of absorption and respiration; and that oxygen introduced by hypodermic injection is absorbed by the capillaries in the same way as the oxygen which is inspired by the lungs. The artificial, or hypodermic, respiration thus set up is suggested as likely to be useful where the proper action of the pulmonary apparatus is defective.

Amongst the appeals recently decided by the Camberwell Assessment Committee is one of more than local interest, viz., whether an observatory, built in the grounds attached to a gentleman's residence for purposes of observation and scientific research, can be said to add to the annual value of the premises. Sir Henry Bessemer, at considerable cost, erected, not long since, an observatory in his grounds, and in due course the overseers assessed it at £100 gross value. Sir Henry objected particularly to the assessment placed upon the observatory, on the ground that, instead of adding to the annual value of the hereditament, the observatory had reduced it. Overseers were too prone to assume that an expenditure of money must necessarily increase annual value: whereas it often, as in Sir Henry Bessemer's case, operated the other way. The observatory, fitted as it was with one of the most magnificent telescopes to be found in the country, was doubtless a source of amusement and instruction to Sir Henry: but if the house and grounds were in the market to-morrow, a great difficulty would be experienced in finding a tenant who would use the observatory as it was being used at the present time. In the end the Assessment Committee, whilst not conceding all that was asked on behalf of the appellant, made a substantial reduction on the assessment.

**Photographic Card Frames.** — We have received from Messrs. Marion and Co., of Soho-square, some samples of their newly-registered card frames. The idea is quite novel; each frame is illuminated with designs and mottoes, appropriate for Christmas and other seasons, and when a photograph, drawing, or painting is placed in the frame the whole forms a very charming, as well as a very sensible, present for friendly souvenir. Each frame is also fitted with a strut back, and, considering their artistic appearance and general utility, should be in great demand with photographers and the public generally.

DR. TAYLOR, of the Department of Agriculture in Washington, has invented a new flash-light, intended to take the place of several which have of late proved dangerous in practice. The composition consists largely of charcoal made from the silky down of the milkweed, a form of carbon which he prefers because of its freedom from ash.

**The Iridium Light.**—Upon a suitable plate or support, such as wax, the form of the desired filament is pencilled with plumbago; this is placed in an electrical iridium bath. When a film of sufficient thickness is deposited upon the stencilled design, the filament is peeled off from the beeswax and the plumbago brushed off the back. Iron wires are used as conductors. The filament is incandesced in the atmosphere, as it is practically non-combustible, or, for security against breakage, it may be incandesced in any suitable gas or in a vacuum.

# LETTERS TO THE EDITOR.

*[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]*

*All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

*All Cheques and Post-office Orders to be made payable to* J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

> "I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."
> —*Montaigne's Essays.*

### THE INSTITUTE OF THE URANIA GESELLSCHAFT—CHROMATIC ABERRATION — THE MOON — THE NEW ASTRONOMICAL SOCIETY — ATMOSPHERE, ETHER, OR EITHER?—EXEGESIS IN EXTREMIS—BOOKS ON GEOLOGY AND THE MICROSCOPE—LUNAR PHOTOGRAPHS—RAZORS—DIURNAL NUTATION—AN ASTRONOMICAL DIRECTORY—REFLECTOR v. REFRACTOR—STAR MAPS—RIGHT ASCENSION AND DECLINATION—CAMERA LUCIDA—THE BIRTH OF THE MOON—LOGARITHMS—DIP OF THE HORIZON—RELATIVE VISIBILITY OF SATELLITES—NEPTUNE—POWERS OF BIG TELESCOPES.

[31530.]—THE ninth number of Vol. II. of the *Publications* of the Astronomical Society of the Pacific contains a very interesting description of the Institution of the Urania Gesellschaft (translated by Mr. J. E. Keeler from the original) by Dr. M. W. Meyer, its Director. This remarkable building is erected in the Park for the National Expositions in Berlin, and contains four departments—the astronomical, the physical, the mechanical, the microscopical, and the department of scientific lectures in connection with the theatre or auditorium. Beginning with the astronomical department, the observatory is furnished with a 12in. equatorial refractor, embodying every recent improvement, a 6in. refractor, a 4in. equatoreal, a 6in. reflector, a 5in. equatorially-mounted comet seeker, and a 2½in. transit. It also possesses a Standard clock, electrically controlling two less perfect ones, and a chronograph. This portion of the institution is so thronged by the public on clear evenings that nothing can be afforded to any individual member of it but a temporary peep, as it were, through the telescope to which he may have access; but the dissatisfied observer is passed on from the observatory to the lecture theatre, where astronomical lectures are given, illuminated by views projected on to a screen by the aid of a lamp of 6,000c.p. The physical department is replete with apparatus illustrating the theory and practical employment of electricity and magnetism, with instruments exhibiting the phenomena of acoustics (among which the phonograph naturally plays a conspicuous part), &c. Fifty compound achromatic microscopes and many simple ones form the furniture of the microscopical department, and aid in rendering intelligible the marvels of the invisible world. Of the lecture theatre I have already spoken. Besides all this are the laboratories, engine-rooms, &c. What the old Polytechnic Institution in Regent-street did in a humble way for a limited part of the population of London, the Urania Institute apparently aims at performing in a very much more effective fashion for a much larger public. How far it has succeeded may be gathered from the fact that last year visitors were admitted on 228 days, and that £5,339 were taken at the doors in small sums.

In the number of the serial from which I have gathered the above details is another paper by Mr. Keeler which will at once astonish and instruct those who approach the consideration of its subject for the first time. It is on "The Chromatic Aberration of the Thirty-six Inch Refractor of the Lick Observatory." Its amount, in this and other gigantic instruments, will come as a revelation to the majority of those who will read it.

Mr. Dixon (letter 31475, Vol. LI. p. 552) argues as though the meteoritic dust (which he postulates as the cause of the colour-patterns on the moon's disc) had fallen, once for all, years, centuries, or chiliads ago: whereas, as a matter of fact, it is always raining down upon her surface. Furthermore, I must leave him to settle up with Mr. Peal *re* the "gradual settling down along certain lines of yielding." I wonder what would happen to Mr. P.'s Apennines, consisting of solid snow, in places 20,000ft. high (equal, say, to a mountain range on earth having an altitude of 14 miles or so) if any fracture or dislocation of the lunar crust were to happen in their neighbourhood? The question of an atmosphere in the Moon need scarcely be reopened here. I have seen Saturn, under a high power, dichotomised by the Moon during occultation, and could trace the very minutest detail on his surface where it was in contact with her limb. And, what is even more to the purpose, Dr. Huggins noted, during the occultation of a star, that the entire spectrum vanished absolutely instantaneously, an effect wholly irreconcilable with the existence of a refracting medium, however tenuous, at the Moon's limb.

It might interest Mr. Broughton (letter 31476, Vol. LI. p. 552) to turn to pp. 64 and 65 of Proctor's "Essays on Astronomy," published by Longmans, Green, and Co. in 1872.

In connection with letter 31480 (Vol. LI. p. 554), it has struck me that the title of the "British Astronomical Association" would have removed all possible suspicion of an attempt even to imitate, far less "to include," the title of the Royal Astronomical Society: but it is probably too late to change the adopted designation now. I would add a few words with regard to letters 31506 and 31510 (on p. 10). "Imprimis," then "An Old Member of the L. A. S.," apparently ignores the fact that among the "methods" set forth in the prospectus of the British Astronomical Society (ENGLISH MECHANIC, Vol. LI. p. 527) is included "the holding of meetings, not only in London, but also at provincial centres, *wherever the number of members justifies it*, and the members themselves desire it." Surely your correspondent does not labour under the hallucination that amateur astronomy is a monopoly of the Northern counties. It would be just as reasonable for West-countrymen to seek to fix the head-quarters of the Society at Bristol or Exeter, or for Scotch residents to clamour for Berwick-on-Tweed, as for a Liverpool man to ask that a *national* association should meet at Manchester. In connection with Mr. Wangh's suggestion to raise the entrance fee, I would merely remark that the less costly the membership of the Society can be made consistently with its paying its way, the greater its chance of enduring success. I, for one, should be delighted to see the higher class of artificers coming in in their numbers. Probably, as a whole, no mere intelligent a set of men exist than they are, and their mechanical aptitude places them in an exceptionally favourable position to construct to a large extent (at least, the mounting of) their own instruments. But if you call upon the average turner or fitter to pay down £1 at once and 10s. a year thereafter for his lifetime, he wi be apt to ask himself where the money is to co from?

In reply to the catechism contained in lette 31496 (Vol. LI. p. 557), I may begin by saying th I *do* believe that the gravity of the constitu parts of the atmosphere would balance its elasti force before we reached a height of anything lik 200 miles above the earth's surface. Why, ca Mr. Stooke be ignorant that the densities of vario strata of air, or, to put it in another way, the weig of the masses incumbent in them, decrease *geometrical* progression as their altitudes increase arithmetical progression? Calling the density the air at the sea level 1, at 3½ miles high it wo be twice as rare; at 7 miles four times as rare; 14 miles sixteen times as rare; . . . . at 56 mi 65536 times as rare—and so on. So far in shape of a reply. Now I want to ask a questi Where on earth did your correspondent hea read (in connection with Crookes's experiments radiant matter) that "no light was seen thro or in the tubes"? Was there ever such st Why, I have, over and over again seen through the highest vacuum producible by hu art. Let Mr. Stooke appeal to Mr. Crookes him upon this point, as he has, obviously, most serio misapprehended his source of information.

Mr. Garbett's method of playing fast and lo with the plain, obvious meaning of the Scriptu in letter 31497 (Vol. LI. p. 557) is worthy of geological reasoning. I need scarcely say mo His Biblical exegesis irresistibly reminds me that of the gentleman who insisted that vaticina reference was made to our leading low comed in Judges iv. 21, on the ground that the ha mer with which Sisera was killed *must* have be a Jael tool!

I do not know enough of botany to feel co petent to advise "Canterbury" (query 72 Vol. LI. p. 552) as to the choice of elementary bo on that subject; but with reference to his requ for the names of geological ones, I would reco mend him to begin with Geikie's "Primer Geology," published at 1s. by Macmillan and in their Science Primer series; to go on to D Page's "Advanced Text-book of Geology," p lished by William Blackwood and Sons for 7s. and then to proceed to the fourth revised editio Lyell's "Student's Elements of Geology," lished at 9s. by John Murray. By that time he will have gained a sufficient mastery of his subject to enable him to select works for himself. He may begin the study of the microscope with "Practical Microscopy," by G. E. Davis, price 7s. 6d., published by W. H. Allen and Co., and then procure "Carpenter on the Microscope," published by J. and A. Churchill, price, I think, £1 1s.

"F. C. V." (query 72172, Vol. LI. p. 563) will be quite safe in photographing Proctor's reproductions of Rutherford's lunar photographs, if he does not do so for exhibition or sale.

I strongly recommend Mr. Bean (query 72188, Vol. LI. p. 563) to carefully study pp. 1146 to 1156 inclusive of Vol. III. of Holtzapffel's "Turning and Mechanical Manipulation."

Three or four years ago I referred more than once in these columns to a bizarre hypothesis started by M. Folie, the Belgian Astronomer Royal, of the diurnal nutation of the earth's axis (English Mechanic, Vols. XLII. p. 446, XLIV. 171 and 430, &c.) Your excellent contemporary, *The Observatory*, too, pointed out shortly the fallacy of M. Folie's mode of procedure, but apparently with but little effect. Like a notorious promulgator of (his own—or other people's) "theories" in this country, the official head of Belgian astronomy has gone on simply making assertions, in sublime disregard of the objections which have been established to his "discovery"; but it would appear that, at last, that very competent critic, M. Lehmann-Filhès, has seriously discussed the whole question in a contribution to the *Astronomische Nachrichten*, with some very conclusive results indeed. In short, M. Lehmann-Filhès shows conclusively that M. Folie's alleged proofs of diurnal nutation (the one derived from the comparison of the azimuths of a circumpolar star, and the other founded on the variations of the meridian marks at Strasburg) are perfectly worthless, inasmuch as the first rests on a calculation which seeks to determine three—or even four—unknown quantities by two equations of condidition, and knowing what practical astronomers do of the inevitable influence of instrumental errors, the worth of these results may be accurately estimated as *nil*. As for M. Folie's second alleged proof, it has its origin in an absolutely inexplicable confusion between Time, and *Sidereal* Time. By this time my brother astronomers will probably agree with M. Lehmann-Filhès in his conclusion (as given in *L'Etoile Belge*). "C'est que les preuves, jusqu'ici données en faveur de l'existence de la nutation diurne, ne reposent sur rien."

As I write there lies before me the third edition of M. A. Lancaster's valuable "Liste générale des Observatoires et des Astronomes, des Sociétés et des Revues Astronomiques," which, as a kind of astronomical directory, will be found very useful indeed by all astronomers who have correspondence with their confrères, either in their own country or abroad. It commences with a list of nearly every observatory of any importance in the world, in connection with which particular pains have been taken by the editor to secure the greatest accuracy in their geographical co-ordinates; in fact, his list might be advantageously employed to correct these data in those which appear in the *Nautical Almanac*, the *Connaissance des Temps*, and the *Berliner Jahrbuch*. Then we have an account of the constitution and object of every existing society connected with astronomical science, which is followed by a descriptive list of the principal scientific bureaus, committees, &c. Fourthly, we have a catalogue raisonné of astronomical publications; and after that a list of the names and addresses of all the best-known astronomers in the world; the work concluding with a similar directory of astronomical-instrument makers. It is furnished with a copious, in fact exhaustive, nominal index to the entire work. The mistakes are singularly few. I note that the lamented Dr. Guthrie's name still appears among those of the living men of science, and that General Tennant's late address, and not his present one at Ealing, is given; but so far have detected no more errata. Every astronomer should possess this useful little book, which is published by Hayez, of Brussels.

Do not the letters which have appeared on the question of Reflectors v. Refractors (and notably such a one as that of Mr. Muschamp Perry, 31514, on p. 11), furnish yet additional proof of the truth of the aphorism, that "It is not so much a question of the telescope, as the man at the eye-end of it."

In reply to Mr. Tothill (query 72204, p. 20) I do not think that he can improve on Proctor's large Star Atlas for general purposes, unless he chooses to go to the cost of procuring Mr. Cottam's splendid series of Star Charts, which you reviewed on p. 232 of your Lth volume. These contain every object in the "Celestial Objects," and the "Cycle," together with numerous additions from other sources. I think that my querist must be mistaken about the insertion of Piazzi's Stars in Webb's book, unaccompanied by their R.A. and Dec. I have run cursorily through the volume as I sit here at my library table, and have failed to find a single instance of such omission.

As to Mr. Tothill's difficulty concerning Right Ascension and Declination (query 72205) he will, I think, require but little recondite study to overcome it. If we suppose the plane of the terrestrial equator to be produced to the Heavens it will trace out the celestial equator there; a circle of course everywhere 90° from each pole of the sky. Now our geographical co-ordinates of latitude and longitude answer precisely to declination and right ascension. For example, London is 51° 30′ north of the earth's equator, and is said to be in 51° 30′ North Latitude, just as $\gamma$ Draconis is 51° 30′ north of the equator of the heavens, and is said to have 51° 30′ North Declination. In a similar fashion, as we take Greenwich for our terrestial initial meridian and say Melbourne is in 9h. 40m. East Longitude; so, taking that part of the celestial equator on which the sun's centre is situated as he crosses it at the Vernal Equinox (the technical "First Point of Aries") as our starting point, we say that the right ascension of $\epsilon$ Leonis—which is reckoned towards the east—is 9h. 40m. Mr. Tothill must refer back to pp. 551 and 629 of your XVth volume for explicit directions for the adjustment and use of an equatoreal.

I think that the prism of "Remo's" camera lucida (query 72218, p. 20) may possibly want cleaning. If his own sight is normal, the images seen in it have no business to be hazy. I am practically certain that he is wrong about one of his round glasses being *plane*. It is doubtless a convex lens of very long focus, and is used to bring the paper and pencil point to a focus simultaneously with the objects seen by reflection in the prism. If one of the glasses is plano-concave it must be designed to serve the same end for a myopic draughtsman.

Curiously enough, I have never seen Proctor's "Mysteries of Time and Space"; but I think that "F. C. V." (query 72219, p. 20) might advantageously study Sir R. S. Ball's excellent little book "Time and Tide," published by the Society for Promoting Christian Knowledge.

The mistake made by Mr. Webb (query 72228, p. 21) is akin to that of using a knitting-needle to prize up a heavy balk of timber with. Instead of six-figure logarithms, he ought to have employed 15 or 20-figure ones to obtain a rigidly accurate result in such a piece of involution as his. With six-figure logs. the result is trustworthy (save towards the end of the tables) to seven or eight figures; with seven-figure logs. to eight or nine figures, and so on.

In answer to Mr. Grant (query 72252, p. 21), the formula from which I computed the dip from Snowdon is that given in Chauvenet's "Spherical and Practical Astronomy" (p. 177), which takes account of atmospheric refraction. It is: Dip $= 58{\cdot}82'' \sqrt{\text{height of eye in feet}}$. Young's is professedly only an approximate one. But I do seem to have made some odd mistake, as the real dip is only 58′ 35″.

Query 72257 (p. 21) is not a very easy one to answer, as so much depends upon the acuteness of the observer's vision, and his idiosyncrasy to boot. But I should say that Hyperion is the most difficult object among those named by "A. C.," though it is run hard by Mimas and the two inner satellites of Uranus. Oberon and Titania and the satellite of Neptune are somewhat easier. With reference to Neptune himself, a 4in. refractor with a power of 300 or so, will suffice to show that it is not a star; but that is all. The highest magnifying power employed on the mammoth Lick refractor is 3,360, and the lowest 180. I am ignorant of the greatest amplification of which the 6ft. Parsonstown reflector admits, but have an impression, well or ill founded, that very high powers are never used with it.

**A Fellow of the Royal Astronomical Society.**

## THE NEW EDITION OF THE RED STARS.

[31531.] — Will you allow me to thank "F.R.A.S." (let. 31412, p. 511) for his kind remarks on the new edition of the "Red Stars," and, at the same time, to correct two slips in a note on the same in your "Scientific News," p. 527? The "striking disagreements" amongst spectroscopists which are there referred to, were mentioned by Mr. Birmingham, and not by me, and Mr. Maunder, in a late number of the *Observatory*, which I cannot this minute lay my hands on, says that the disagreement is more apparent than real. The second correction is that line 11 the first hydrogen line, is printed *c* in mistake for C.

May I point out one or two lines of research in connection with the red stars which possessors of small telescopes might take up? First of all, many new stars have been added to the catalogue, and in many cases there are no observations of them except by the discoverers. These require careful observation to determine whether they should be retained in any future edition. There are numerous stars in the catalogue, and in the additional list of ruddy stars which are too far south to be observed in England. These require attention badly, and it is to be hoped that these lines may meet the eye of someone in the Southern Hemisphere willing to observe them. A second line of research would be a careful investigation of the magnitude of the red stars by comparison with neighbouring stars. Many of the stars of the third type are probably more or less variable, but when the variation is small, the difficulty of determining it is great. An apparent variation of half a magnitude may be caused by a bright background, by the position of the two stars under comparison, and, possibly, by selective absorption in the atmosphere. I have a suspicion, too, that reflectors make small red stars brighter than refractors. For those who have large apertures a great field is open in the spectroscopic observation of the red stars. The spectroscopic information is, for the most part, meagre, and in some cases entirely wanting, especially in the case of Southern stars. **T. E. Espin.**

Towlaw, Darlington, Sept. 2.

## THE PERSEID RADIANT.

[31532.] — I am glad that the question has caused such interest among your readers, and hope it may receive a special solution. Mr. Booth's letter is not entirely favourable to the shifting theory. He obtained a radiant at 47° + 55° on the 13th August in the present year, and at 47° + 53° on the same date in 1887. Now on this day Mr. Denning places the shifting radiant at 51° + 57° (*Monthly Notices* for December, 1884), agreeing with Mr. Booth's determination in 1888, but differing from those in 1887 and 1890.

The shifting of the radiant is, as I already noticed, an inference from observations, and when the observations have been published (as Mr. Denning's have been), it is open to anyone to draw such inferences. In drawing his inference, I think Mr. Denning has dealt with facts in a somewhat arbitrary manner. For instance, when he meets with meteors from a radiant at 11° + 48° on July 11, 13, and 14, he notes them as "Perseids," but when he meets the meteors from the same point (11° + 47°) on the 30th and 31st of July he declines to give them the name, though he notes that they were of the same swift, streaky character. He gives the designation of Perseids to meteors from 32° + 53° on the 30th and 31st of July, but when he meets with meteors from the same point (32° + 50°) on the 14th and 23rd of August, he denies them the name. Again, when he meets with meteors from 43° + 58° on the 27th, 28th, 29th, and 31st of July, he declines to give them the name of Perseids, but he gives that name to meteors from the same point when he meets them on the 10th of August. I think most of your readers will be of opinion that this is not the manner in which the shifting of a radiant should be proved, and I think Mr. Denning has no ground to quarrel with any one who accepts his observations, but disputes his deductions from them. This is my position.

August 29th. **W. H. Monck.**

## JUPITER'S SATELLITES—SUNSPOTS.

[31533.]—On Saturday, at 9h. 20m., No. IV. was a conspicuous object, more than half-way across the planet's disc, very dark and large, and travelling along the north portion of the north belt. IV. was seen dark between 10h. 35m. and 10h. 40m. for the last time, when the fleecy film over the sky thickened and hid the satellites. I. had been seen to pass north of III. without actual contact. The satellites were seen for a second or two at 11h. 12m., IV. being some distance outside the planet, faint and small. It may be remembered that IV. made a dark transit on the last occasion on July 11. An interesting group of spots was seen on the sun yesterday.

Hendon, Sept. 1. **P. F. Duke.**

## JUPITER.

[31534.]—The eclipse of the second satellite of Jupiter was well seen in Portland with a 4·5in. Wray refractor. Its emergence from the shadow was sufficiently gradual to render the phenomenon very interesting as the light of the satellite somewhat slowly increased in intensity. The time of emergence was 11h. 8m. Aug. 29. Some few minutes before the actual emergence, the satellite was feebly glimpsed as a very faint reddish object. As it was glimpsed several times, there can be little doubt concerning the reality of the perception, suggesting that the satellite was receiving reflected light from the small illuminated portion of the planet's disc visible from the satellite, or possibly emitted light; if so, proving that Jupiter, as Uranus, is still in a state of semi-incandescence. As Jupiter is well situated at present for the observance of satelline eclipses, it is to be wished that observers, with superior optical means, should seek to verify, or at least to determine, the truth of the above suggestion. Atmospheric conditions were very favourable on the occasion of the observation, the moonlight but little interfering with definition. The low altitude of Jupiter had the usual effect of causing vibrations on the planet's limb; but the satellites seemed but slightly affected by vapour, and the eclipse was as well seen as at a higher altitude.

Aug. 30. **W. R. Waugh.**

### JUPITER—THE REFLECTING TELESCOPE—THE NEW ASTRONOMICAL SOCIETY.

[31535.]—The remarkable little red spot on Jupiter, to which Mr. Smart calls attention in his interesting letter on p. 9 (31503), has been a noticeable object for some time past. To me it has appeared so dark as to be more blackish than red. Probably, however, Mr. Smart's 10in. would show the colour more distinctly than my 6½in. Somewhat curiously, there is an almost exactly similar spot situate about 2½ hours *preceding* the great red spot. These two markings seem particularly worthy of attention, and it would be interesting if different observers would describe their exact appearance at the present time, and their relationship with regard to the north equatorial belt. They are both followed by a very bright region or spot. The region about the north equatorial belt seems decidedly to show increased activity, and as to this it contrasts rather strongly with the present remarkably quiescent state of the south equatorial belt.

"Tenebris" inquires (letter 31512) if a reflector will fairly define the planets Jupiter, Venus, and Mars at the present time. My instrument is a 6½in. Calver reflector, and though the altitude of Jupiter at present is so low that there is bound to be usually much disturbance of the image, yet there have been quite a number of nights during the present summer in which the planet has been sharply and steadily defined with a power of about 225. Mars has not been observed during the last few weeks; but earlier in the year, when he was but little better situated than at present, some sharp and fairly steady views were obtained with powers of about 325 and 430. "Tenebris" does not say with what power on his refractor he now sees these planets fairly defined.

Has not "An Old Member of L.A.S." overlooked the clause in the programme of the new society, on p. 527, relating to the holding of meetings, not only in London, but also at provincial centres? The holding of meetings in the manner proposed, probably by rotation, seems to meet his objections, whilst the headquarters would be fixed where there will probably be the greatest number of members.

Sept. 1. **A. Stanley Williams.**

### COMET-SEEKING.

[31536.]—Will you allow me to express the hope that the new "British Astronomical Society" will endeavour to arrange a cometary section, and organise the work of comet-seeking? It is in such a field as this that the collective efforts of several observers are likely to be fruitful. The cloudy nature of our climate is an impediment, it is true; but there is no reason why English observers should not score a fair number of successes in this department. Speaking for myself, I regret that circumstances prevent my giving much time to this very interesting work, and I should be delighted to see that others had taken it up.

Observers who joined this section might aim at discovering new nebulæ as well as comets, and some valuable materials might also be obtained as to telescopic meteors.

Bristol. **W. F. Denning.**

### THE BRITISH ASTRONOMICAL SOCIETY.

[31537.]—Will you allow me, in the absence of my brother, to inform the many readers of your paper who are interested in the above society, that Mr. W. H. Maw, F.R.A.S., 18, Addison-road, Kensington, W., has kindly consented to undertake the duties of treasurer (pro tem.) As no formal election is practicable in the case of original members, the payment of the first year's subscription will be taken as constituting the act of enrolment. It is intended to hold a general meeting, of which due notice will be given at the earliest possible date; it is desirable, therefore, that subscriptions should be remitted to the treasurer as soon as possile. Cheques and postal orders to be crossed National and Provincial Bank of London, St. James's Branch, Piccadilly. The following ladies and gentlemen have joined the Provisional Committee since the list last publised by you. The Earl of Rosse, J. Bartlett, M.A., Miss Agnes M. Clerke, Miss Agnes Giberne, Sir Howard Grubb, F.R.S., M.I.C.E., F.R.A.S., John Haswell, M.A., D.C.L., Mrs. Huggins, Ed. B. Knobel, F.R.A.S., J. A. Westwood Oliver, Rev. T. Perkins, M.A., F.R.A.S., Wm. Schooling, F.R.A.S., Arthur W. Thomson, B.Sc., and W. H. Wesley. I hope, with your permission, to give further information next week; but so many members of the Provisional Committee are at present out of town that consultation is difficult.

In reply to "An Old Member of L.A.S." (letter 31508), I would draw his attention to the following sentence in our programme, under the heading of Methods: "The holding of Meetings, not only in London, but also at Provincial centres, wherever the number of members justifies it, and the members themselves desire it."

**Thos. Fred. Maunder.**

[31538.]—

The sun, great monarch, trav'ling on his way
Through space immense, ne'er ceasing night or day,
Review'd each tiny globe in passing by;
Some pleas'd him well, but one to him look'd shy:
That was our earth, for there a mist he saw—
The clouds of wrath, which darken every door
That lead to union—that grand, firm abode
Which most men seek, but some have lost the road.
For seeking through the clouds of discontent,
Were lost in fog, although their lives well meant;
Until the sun, in gorgeous golden dress
Pour'd down his light to these men in distress,
To let them see the good ship B.A.S.
For as the sun each tree and herb doth bring,
From winter garb to verdure in the spring.
The rays of zeal soon warm'd each frozen mind,
Dissolv'd the snow that o'er some hearts had climbed.
Men are but mortal, and may disagree—
May take wrong views, and miss what they should see—
May fail to work as others think they should,
Yet ever ready for their fellows' good.
Then let the sails of concord deck our mast—
Let's kindle friendship and forget the past.
Yes, may our bark, now nam'd the B.A.S.,
When put to sea, ne'er signal in distress—
May it be mann'd by men who fear no sea,
Who'll keep the deck however rough it be;
Until in calmer water she may glide,
A ship well worthy of our British pride—
Her cargo safe; no thought or fear of wreck,
With pilot Maunder standing on the deck.

**R. E.**

### VENTILATION OF BEDROOMS.

[31539.]—Last summer, with a view to ascertain the extent of the public appreciation by the different classes in society of pure air, especially in the home, I counted on three separate early mornings the number of windows open (from, say, ½in. to wide open) in apparently occupied bedrooms. The time of count was from 4 to 6 or 6.30 a.m. No rain had fallen during each night. The classes of houses selected were those of rents about £5 to £16, £16 to £25, and £25 to £45, all in the immediate vicinity of our Woodhouse Moor.

This year I made similar counts to those above named, one exception being that in the case of the £5 to £16 houses I selected a different neighbourhood altogether, viz., that abutting on Kirkstall-road, where the houses are on a much lower level, and all about £8 to £10 rent. The tabulated results of the two years, counts are as follows:—

| Date. | Rents. | Windows counted. | Windows open. | Windows shut. |
|---|---|---|---|---|
| 1889. | | | | |
| Aug. 12 | £5 to £16 | 1,066 | 233 | 833 |
| July 2 | £16 to £25 | 464 | 147 | 317 |
| July 30 | £25 to £45 | 1,284 | 334 | 950 |
| | | 2,814 | 714 | 2,100 |
| 1890. | | | | |
| Aug. 5 | £5 to £16 | 1,318 | 460 | 858 |
| July 14 | £16 to £25 | 1,097 | 227 | 870 |
| July 22 | £25 to £45 | 1,264 | 304 | 960 |
| | | 3,679 | 991 | 2,688 |

As it is certain that many of the bedrooms were not occupied during the night of the count, let us, in order to arrive at as accurate a result as possible, deduct from the "windows counted" one-sixteenth from those of £5 to £16 rent, one-eighth from those of £16 to £25, and one-fourth from those of £25 to £45. We thus arrive at the following per centages, which, in Leeds, may be taken as a rough estimate of the value set by the different classses of the community upon bedroom ventilation:—

| 1889. | Windows open. per cent. | Windows shut. per cent. | Outside temperature in shade. |
|---|---|---|---|
| £5 to £16 | 23·56 | 76·44 | 57° ? Fahr. |
| £16 to £25 | 36·20 | 63·80 | 69° ? ,, |
| £25 to £45 | 34·68 | 65·32 | 60° ? ,, |
| Average. | 31·48 | 68·52 | 62° ? ,, |

| 1890. | Windows open. per cent. | Windows shut. per cent. | Outside temperature in shade. |
|---|---|---|---|
| £6 to £16 | 37·23 | 62·77 | 59·5° Fahr. |
| £16 to £25 | 23·64 | 76·36 | 61·0° ,, |
| £25 to £45 | 32·07 | 67·92 | 58·5° ,, |
| Average | 30·98 | 69·02 | 59·7° ,, |

In all cases where two windows appeared to belong to one bedroom, I was, of course, careful to count them as one only. The temperatures given under 1890 were noted at the time, whilst those under 1889 were not noted—these latter being given from memory, must therefore be considered as approximate only. It will be noticed that the "windows open" of the £5 to £16 houses show an increase in 1890 of nearly 14 per cent, whilst the £16 to £25 houses show a decrease of 12½ per cent. The localities counted in 1890 being nearly altogether different from those counted in 1889, probably explains most of this difference. Still, it is curious that the averages of the two years should so closely approximate.

Amongst the numerous streets which yielded the above statistics, I noticed great variation in the percentage per street of open windows. For instance, of two streets quite near each other, one showed (after allowing for unoccupied rooms) 58 per cent. open, the other giving only 17 per cent. One street, in which I counted 396 bedrooms, gave on one side, 38, and on the other 42·8 per cent. of windows open. Now and then I noticed a long succession of houses in which every window was fast closed. Had a famine of the vitalising oxygen prevailed, it could not have been worse—and, indeed, what else was it but a famine, and that voluntarily produced in every instance? Here and there appeared a "sandbag" resting on the ledge between the upper and lower sashes, as if the inmates dreaded the entrance of Heaven's appointed messenger of life and health. On the other hand, I passed now and then a succession of houses with windows refreshingly open, and blinds trembling in the breeze, suggestive not only of purity and sweetness within, but of an intelligent appreciation of those conditions of health upon the fulfilment of which depend both longevity of life and freedom from disease.

Leeds, Aug. 26th. **Salus.**

### THE THERMODYNAMICS OF THE VACUUM BRAKES.

[31540.]—The letter of Messrs. Archbutt and Deeley which appears upon pages 13 and 14 so completely admits the main points of my contention, that, practically, there is but little remaining open to discussion. In an article which was published in the *Engineer*, July 11th, 1890, those gentlemen wrote:

"There seems to be a very general impression that this current of air becomes cooled by expansion much below the temperature of the atmosphere, that it consequently deposits moisture in the cylinders, ball valves, and train pipe, and that if the temperature should fall below the freezing point, the water so collected congeals, and renders the brake inoperative. To prove the fallacy of the supposition," Messrs. Archbutt and Deeley proceed to give details of their theory, and conclude with the statement, "(5) That the automatic vacuum brake is therefore essentially a 'dry brake.'"

I differ from the above statements on the ground that I know from actual practice that the automatic vacuum brake is very frequently rendered inoperative in winter time, and that having seen ice and water in the pipes and apparatus, I cannot agree that it is a *dry brake*.

Now, in your issue of last week, p. 14, Messrs. Archbutt and Deeley write: "Undoubtedly water which has got into the brake apparatus will freeze if the temperature be low enough." In the same letter they admit the facts recorded in the Board of Trade returns, and they discontinue the use of the words "dry brake."

The one practical point in this discussion is, Does the automatic vacuum brake become frozen up and useless in winter time or does it not? As a matter of fact it does, and it is satisfactory to find that Messrs. Archbutt and Deeley have arrived at this conclusion.

As pointed out in my letter (p. 14, 31523), the original articles were calculated to do a great injustice to engine-drivers. However, the present letters of Messrs. Archbutt and Deeley, showing conclusively that the vacuum brake may freeze from causes quite beyond the control of the driver, will no doubt be of the greatest assistance to enginemen who in future may be arrested for manslaughter in consequence of the vacuum brake having been frozen up and inoperative.

**Clement E. Stretton.**

40, Saxe Coburg-street, Leicester, Aug. 30.

[31541.]—The thanks of all enginemen will deservingly be given to Mr. Stretton for speaking out in your paper last week, p. 14, 31523, about the vacuum brake freezing. I say it is one of the grossest injustices possible for people to put all the blame on the drivers. Who are Archbutt and Deeley, who are writing round to all the papers saying the vacuum brake cannot freeze; are they engineers, or railway men, or brake inventors, or what? At any rate, they do not understand much about brakes, or they would know that the vacuum freezes up very often.

The North-Western have put that rule in force about blowing through the brake pipes to clear out the water; well, Sir, it is very well for clearing the pipe, but it does not fetch the water and ice out of the brake cylinders and ball valves.

Perhaps Mr. Deeley and Mr. Archbutt will say the drip valve drains off the water, but, as a practical man, I say it does not; the drip valve itself freezes, and then it is no good, as it does not open.

It is all clear enough for people to talk a lot of theory, but give me an ounce of practice. All who have to work the vacuum know how it freezes and will not work when you want it. I know, because I am **A Driver who Works it.**

Manchester, August 29th.

### CYCLE CONSTRUCTION.

[31542.]—A great deal has been written lately on locomotive cycles, with very little effective result. Have we quite exhausted the possibility of still further perfecting the mechanism, treating the human element as part of the machine? Here is an idea which has occurred to me, and which I should be glad to see discussed in these columns. It is well known that the leg when bent is weakest, and strongest when stretched. A gentleman living at Tunbridge wrote to the *Pall Mall Gazette* some time since, stating that he had derived great benefit from using an elliptical wheel for the chain wheel connected with the crank: the wheel was so placed that at starting the minor axis of ellipse was uppermost, and at hind stroke the major. The obvious objection to this construction is that the chain surrounding a circular wheel at the axis of driver and an elliptical wheel at crank, would not work with equal tension throughout the revolution, but would in one part hang slack. To prevent this, and also to help the idea, I propose that both the chain wheels shall be elliptical and equal; but placed in such a manner that at starting, when the knee is fully bent, the minor axis of crank-wheel shall be uppermost and parallel to the major axis of the elliptical wheel attached to the driver; the machine will be then geared down, and *power* is obtained when most needed—namely, when the crank is at its dead point and the knee joint, being bent, is at its weakest state: then, at midstroke, when the leg is fully stretched and strongest, the major axis of the crank wheel ellipse will be uppermost and parallel to the minor axis of that of the driving wheel; the machine will be geared up, and speed obtained. In consequence of the two ellipses being equal and placed transversely to each other, the variation from the circular form need not be very great, as they will each assist the other in that respect, and as they are equal, the length of [illegible] will be equally taut throughout—the same, in fa[illegible] if it run on two circles. The power of speed p[illegible]d during each stroke of the leg being perfectly a[illegible]d to the varied strength of the leg, considered [illegible] of the mechanism, will tend to produce a [illegible]ing of equal force employed throughout, and the extra speed acquired at midstroke will assist to bring the driver on the dead point of crank. I may add that I have made a model of the idea, and find it works perfectly smoothly. The question is, Is the idea new? and if so, is it worth taking out a patent for?

**W. Timbrell Pierce.**

### MOTOR FOR CYCLES.

[31543.]—I fancy "Petrotryke" (p. 13) is rather aggrieved that I did not "pounce" on his design at once. I had some thought of penning a few lines beginning "How doth a little petrotryke improve each shining hour," but business of, yes, I think more importance, took me away. If "Petrotryke" takes his money to the Patent Office to protect that "invention" (great Scott!), I suspect he will leave more there than ever he will find back in his pocket. I have already given the "key" to the reasons why motive power will not do on cycles, and write now to say pointedly that "Nun. Dor" is not "P. W.," as suggested by this peccant "Petrotryke" on p. 13. **Nun. Dor.**

[31544.]—Please allow me a little space on this subject. I think those who have had a voice in this subject must be very dull of comprehension or going dotty, not to see the advantages of the ideas as put forth in sketches in Vol. LI. No. 1324, p. 515. The steam-engine as it stands is a disgrace to our mechanical world. Here is our coal consumption going on at a ruinous rate; and we are daily wasting that rendered in generating power, only to throw it away; when this simple arrangement would utilise the whole of it, and, according to the author of it, a greater gainer to boot. It is well known that the cylinder as now constructed with one piston: more than half the power is wasted. For instance, you put steam into it at one end at so much per square inch, and the piston recedes. Is not the same pressure upon the cylinder cover? Decidedly so. Then we get no power out of that, as it is a fixture; but if we let the power in between two pistons, we then utilise the whole of the power, and do away with the kicking action that takes place in the engines at the present time, as, in this case, the power being introduced between two pistons is like inserting a fine wedge, power given to both pistons, and the motion as smooth as kissing your hand. The great wonder is that the engines, as at present constructed, do not knock themselves into smithereens. You will see that the advantage to be gained, if constructed upon this principle, are many. One cylinder—long, of course—and any number of pistons in pairs, and any number cranks. These acting and re-acting one upon the other that the affair is so nicely balanced that, in a locomotive for instance, the cylinder can be strung on next to nothing—i.e., except enough to sustain its weight—and I do not know that this is absolutely necessary. No covers are required; and as to stays, anything more than a bare framing is not wanted, as there is no rock or tear upon the mechanism.

Now, as I have fully described the affair, I have not the least doubt you will be able to see quite clearly with half an eye. I should not have been able to explain the affair so intelligibly to you, only some years ago it was forwarded to me in the shape of sketch, and fully explained, and I think may be found in the back vols. of the "E. M.," cropping up more than once or twice, but under what head I cannot say. This, with some other curios, I have destroyed recently. One on hydraulics and steam—a scheme for making a 1H.P. engine drive an engine of 1,000H.P., with a complicated set of pumps, cogs, &c.; another in hydrostatics—for instance, a large tank containing a thousand cubic feet of water, and a good head flowing in to keep up a supply. Now the water, say, weighs 60,000lb., and, as water presses everywhere alike, here you have evidently 60,000lb. per square inch. Now, if a hole is pierced at the bottom of the tank, and a pipe led to an engine, see what an enormous power you would get, and constant, reliable, steady pressure. Of course, if you want a quicker speed, replace the reciprocating engine by a turbine. But, my dear sir, if you want a pressure anything like that, you will have to erect a tank 180,000ft. high—oh, nonsense!—and the novel engine is expansion engine. By the pistons and expansions of the rods I have had, they are no strangers to me. Now, I have an idea that you will find some records of a patent taken out in 1844, or from that to '46, for a locomotive with a long cylinder with two pistons in it; the said locomotive had three cylinders and five cranks—three upon the axle, and the other two outside, being crank-pins put into the boss of the wheel. It was patented. I believe these things, like the sea-serpent, have their seasons for repetition. **Jack of All Trades.**

[31545.]—Having read with some interest the discussions that are now being carried on in the columns of the "E. M." with regard to motive power being employed on bicycles, I would like to suggest to the gentlemen interested in the above discussion a plan to mount their saddles on springs, and by means of connecting rods permanently attached to the treadles, and having means of being attached to the saddle only when required, and when not required to be attached in such a manner to any part of the machine so as not to be in the way, and not to impede the motion of the treadles; *foot-rests* to be attached to the main supports of the underpart of the spring connections, so as not to be in the way; to be about 1ft. at right angles to the supports and parallel to line of movement.

Should the rider feel inclined to change his means of locomotion, he has only to remove his feet from the treadles, place them on the foot-rests, at the same time attaching the connecting rods to the saddle.

I do not mean the above suggestions to be taken as though I thought that was the only means of changing the present means of locomotion—far from it. I simply mean it as a slight change. Some riders, I am sure, will not like the spring motion, which will cost very little additional outlay, and can be easily removed if not liked.

With regard to motive power, I have very little hope of steam being used for that purpose. I have great hopes in electricity as the only means of remedying this evil. What with the improvements that are going on with regard to the accumulator system, it seems as if, in the near future, it will be a very easy matter.

Dominica, B.W.I. **G. L. Law.**

### DEMAGNETISING WATCHES.

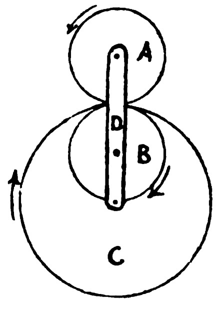
[31546.]—It may interest a few of the readers of this paper (some, perhaps, may be able to explain), how my watch became demagnetised.

A few months ago I put together a small shunt-wound Manchester dynamo. Finding a strong magnetic pull at the yoke while the machine was running, I amused myself by holding a piece of iron against the yoke, and then pulling it away. During this time my watch was not thought of as regards how it would be affected; but next day I found that my time was about 30 minutes behind. That, for the moment, puzzled me, for I always could depend on my watch. Then it dawned on me that the watch was magnetised. From that time it lost 10 minutes per 24 hours. My treatment was as follows: I hung the watch to my iron bedstead, facing west. I wound the watch every night, and put it on 10 minutes. This treament was cotinued for three months, with no good result. At the end of this time I removed to another house about a quarter of a mile further west. Here again the watch was hung to the bedstead, facing north, with a better result—two minutes was gained during 24 hours, making the loss eight minutes instead of 10 minutes. This position was kept for three months; but no further gain. I then put the watch in a watch-case, and placed it on the kitchen mantelpiece, where the temperature is about 75° Fahr. Here it remained 14 days, but being carried into the bedroom at night. I awoke one morning, and was agreeably surprised to find the watch 15 minutes fast. I then regulated it, and now it is quite right again, and keeps good time. **S. Robert Bonney.**

### A MECHANICAL PARADOX.

[31547.]—Perhaps the following may interest those who have investigated "W. E. H.'s" cog-wheel problem:—

A, B, and C are wheels moving together by



mutual friction, and held in contact by the link D joing their centres. C is a mere rim without appreciable thickness. The diameters of A and B are each one-half that of C.

If C be rotated once (the link D being held stationary), A and B must each make two rotations in the same time—B in the same direction as C, and A in the opposite direction. If, however, C being held stationary, the link D is made to carry A and B one revolution around C, it will be found that A has thereby been rotated three times, and B only once.

In these two movements the rotations of the wheels in relation to each other are apparently the same, yet why is the result so different?

**Walter M. Hardie.**

### BEE-STING AS A POISON AND AS A MEDICINE.

[31548.]—Apropos of the item (p. 564) while reading it an under-gardener from Lydney Park brought me a quantity of bees for the purpose of extracting the valuable medicinal agent, their stings by solution. Mrs. Newton's experience of the bee-sting is identical with that of my housekeeper, except that with the latter far more serious consequences followed, for she swelled up from head to foot on that side of the body on which she was stung (on the neck), and on the throat to such a degree as to threaten death from choking. Having invested some £10 in the bee business, I hesitated to destroy them; but the nuisance became so intolerable that one day I cleared away the whole lot. Some years afterwards she happened to have a severe attack of erysipelas, a hard swelling becoming an alarming feature. Now, remembering the intensity of the symptoms which followed her bee-stings and *œdema* (swelling) was a leading feature, this gave me the information that she was specially sensitive to that medicinal (and poisonous) agent Apis, one of the tinctures of homœopathy; therefore Apis was at once prescribed, and with the best of results.

That the frequent bee-stings undergone by the experts of apiaries has, during their novitiate period, a very unfavourable action on their health, the Hereford expert, Mr. Hole, gave me some interesting accounts of; while the late head-gardener at Lydney Park, who conducted one of the largest apiaries in the kingdom, died from a rather peculiar form of heart-disease, and which I think was in a great measure due to his many years of bee-stings, and t[illegible]which I saw him to be sensitive enough at 55 yea[illegible] age.

Scattered throug[illegible] the literature of homœopathy are numerous instances of death from the bee-sting, and also instances of the great value of the bee-sting as a medicine; it is known as Apis, and is in the form of a tincture.

It was the great American experimentalist and homœopathic author, Dr. Herling, who, I believe, introduced the bee-sting as a medicine, while the Paris Homœopathic Hospital author, Dr. Claude, in his useful little book, "Premières Notions" (Balliere, King William-street, Charing Cross, London) describes the action of the medicament, and Farrington's "Materia Medica" prescribes it frequently.

Personally, I am of hard muscular fibre to a high degree, and therefore non-sensitive to the œdematous consequence of the bee-sting, which is specially energetic on the phlegmatic, soft-fibred individual. **The Lydney Dispenser.**

### THE BANANA.

[31549.]—"F. B." (letter 31518) states the fact of the tablet in the temple of Philæ, which entirely corroborates the opinions given by Volney a hundred years ago (see Volney's "Ruins of Empires," page 169) tracing the "history" given by Moses to their "originators," the Egyptian priests, by whom Moses was educated. In the same book is a plate, showing the astrological origin of the whole history —viz., Boötes, or Adam, signifies the constellation of the same name; Eve, the constellation Virgo, with constellation Serpent (the Persian Ahrimanes, or Serpent of Eve) behind the tree bearing the golden apples of the Hesperides, or the garden of eternal summer. Constellation Virgo, or Eve, sinking below the horizon first appears to draw after her Boötes by holding out to him a bunch of fruit, while on the opposite side is Perseus with the flaming sword, appearing to drive them from the summer-"heaven," the time or garden of fruit and flowers, into the winter (as Shakespeare has it) of distress and discontent. There is also a picture in "Hyde" (p. 3, edition of 1760) of Mithod, giving the virgin holding a bunch of fruit in her hand, extended towards the herdsman, or the fruit of winter and summer, placed so as to appear to open the door, and to give the knowledge, or the key, of good and evil—viz., of the difference between summer and winter physically, and by allegory morally. A similar picture was found in an Arabic manuscript, according to the same authority, in the library of the King of France, marked 1165, giving the twelve signs of heaven, and representing the birth of Jesus, notably the constellation Præsepe Jovis Heniochi, or the stable of Jose, or Joseph; the constellation of the Bull, attendants of the manger, with the ass of Typhoon, &c., and the whole host of heavens—viz., the rest of the stars.

**F. W. H.**

[31550.]—WOULD "E. B." (31518, p. 13) be surprised to hear what is known to even fewer than his fact?—that Adam was overheard confidentially telling a friend that it was neither the banana nor pomegranate that caused his fall, but the fruit of the Tabernæmontana dichotoma, which at that time was "good for food and pleasant to the eyes," but has ever since been very poisonous, and bears the evident marks of Eve's teeth, which appear to have been very even and good, to judge from specimens of the fruit which I saw in Ceylon some years ago. The English there call it "The forbidden fruit."

**Solanum.**

### LATHE APPLIANCES—HAYDON CUTTER BAR.

[31551.]—I HAVE been very much interested in the articles on lathe appliances, and would like to ask the author if he has any intention of describing a heavier drill spindle suitable for metal work in a 5in. centre lathe to be fixed under an ordinary Willis tool-holder. I presume that the centre of drill should be in the line of the lathe centres. The tool plate-of my slide rest is $\frac{7}{16}$in. below the lathe centres, so the one described would be too low; if any reader of "Ours" is using such a one, perhaps he would give a sketch of it.

About a year ago we had a discussion on the Haydon cutter-bar—F. Carre objecting that $\frac{3}{16}$in. cutters were too small; I have since made some for my holder out of $\frac{1}{4}$in. square steel, with the side edges filed off, so as to let them slide into the sling. This makes a much stronger cutter; and I should advise him to try it. I don't think any of us would really assert that a cutter bar is better than a solid tool (or even as good), if both are properly ground and placed; but for an amateur who has no forge (and if he had one could he forge a tool properly?) it is very handy, as it requires no packing, and anyone could make a cutter if he once understands the grinding. As "J. K. P." says, it is all in the grinding, and I believe I could go to my own grindstone and sharpen a cutter in the dark. I only use two sorts of cutters—one of 120°, and one of slightly under 90° angle for getting into corners. I have never seen the fancy cutters, but I think they must be very weak. **Dunelm.**

### ACTION AT A DISTANCE.

[31552.]—WITHOUT entering into the general discussion as to the existence or non-existence of an etherial medium between the atoms of matter, you will perhaps allow me to ask those of your correspondents who believe that all natural phenomena are due to *matter in motion*, and cannot conceive the idea of action at a distance, what they regard as the nature, or rather structure, of that all-space-filling medium. We are told that the ether will fulfil its various duties if it be endowed with rigidity, incompressibility, and elasticity. But is the medium regarded as absolutely homogeneous? If so, how can it move in any way except as a whole? The same question arises if we regard it as composed of homogeneous particles in contact. And if we consider it to be composed of particles not in contact and diffused uniformly in space, how is the medium to perform its functions unless there is action between these particles—i.e., action at a distance?

**S. S. R.**

### REFLECTORS — AUDIPHONE — OBSERVATORY.

[31553.]—Is not one cause of the alleged inaccuracy of reflectors for delicate observations the rotating body? I can speak from experience of the great difficulty (to me) in constructing this portion of a 6½in. reflector of avoiding a complete derangement of the readings of circles by it. Would not a rotating top to carry flat and eye-tube be possible, and avoid to some extent the element of instability introduced by a revolving body? Of course the mirror would require centring screws in such a construction.

Perhaps the following description of the audiphone may help "Afflicted One" (72084). It consisted, if I remember right, of a disc of thin wood or ebonite, about 10in. or 12in. diameter, clipped in a handle at one point on the edge, and with a hole or hook at about 3in. from the opposite edge, from which a wire or string was carried to the point of attachment of handle, and tightened by a screw or peg till the whole disc was slightly curved.

Has any correspondent had experience of Willesden paper for the dome of an observatory? I am about to build a 10ft. dome, and thought of employing this material. Does it require repainting unreasonably often? Also, should preference be given to a concrete floor, bedded round equatorial pillar, or to a wooden floor carried clear of it? I suppose the concrete would be less likely to cause air-currents than a ventilated wooden floor raised from the ground. **R. W. B.**

### ATOMIC WEIGHTS.

[31554.]—WOULD "E. L. G." (p. 556) kindly favour us with the date of the *Annuaire* from which he extracts the atomic weights he gives in letter 31494? I have been unable to trace it; but as far as the numbers go, it might be 50 years old. If he has made no mistakes in attempting to convert "combining" into "atomic" weights, the *Annuaire's* ideas are very antiquated. Defining the combining weight (Morley and Muir) as the smallest mass of the element which combines with 8 parts by weight of O, 1 part of H, or 35·5 of Cl, we have for these elements quoted:—

Cl = 46·6 (× 3 = atomic weight) = 139·8
La = 46·17 (× 3 = ,, ) = 138·51
Rb = 85·2 (× 1 = ,, ) = 85·2
Sc = 14·66 (× 3 = ,, ) = 43·98
Ta = 60·67 (× 3 = ,, ) = 180·01
Th = 57·97 (× 4 = ,, ) = 231·88
U = 60· (× 4 = ,, ) = 240·
V = 17·07 (× 3 = ,, ) = 51·21

There is, no doubt, from consideration of specific heat, vapour density, isomorphism, or the periodic law, that the above views of the valency of the elements in question are quite correct.

To come now to those differences due to errors of determination only. The numbers given for indium, iridium, osmium, and platinum are the old ones of Berzelius in the last three, and of Reich and Richter in the first one. They are quite exploded now—in fact, "E. L. G." must be very much out of the chemical progress of the last fifteen years to mention them at all. As for the atomic weight of zirconium given, it is hopelessly out. I have been unable to trace more than three separate determinations; but none of them come above 91.

The atomic weight of bismuth is not so easily disposed of. The struggle which went on about it for several years was nearly as well contested as that in the case of antimony. It was first determined by Lagerhjelm, who oxidised Bi to $Bi_2O_3$ with $HNO_3$. His results were rough, and gave 212·86 when worked out against O = 16. Then Schneider repeated this method in 1851, using great precautions against loss, and obtained 208·00. Dumas prepared $BiCl_3$, and estimated the Cl in weighed portions with silver solution. He obtained 210·44 (O = 16), and for many years this was accepted, in spite of the fact that his results in different experiments were very discordant. The instability of $BiCl_3$ is so well known that it seems certain that it was chiefly Dumas's great name that allowed his results to oust those of Schneider. Subsequent researches by Löwe and Marignac, who employed variations of Schneider's method, have shown that Dumas's value was too high, and it is now pretty certain that the atomic weight of bismuth does not exceed 208.

The value given to tellurium (128·4) in "E. L. G.'s" table is the old one of Berzelius, Von Hauer, and Dumas, and is interesting as being one of the former exceptions to the periodic law. For tellurium to fill the space which evidently belonged to it, its atomic weight would have to be between 120 and 125. Wills attempted the problem in 1879, but could not bring it lower than 126. Finally, Dr. Brauner undertook a complete investigation of the methods and materials employed by his predecessors, and succeeded in showing, in 1883, that their "tellurium" was a mixture, and that the true atomic weight of the element is not more than 125. (J. de Russ. Phys. Chem. Gesell, 1883.) Thus was an apparently important exception to Mendeljeff and Newland's grand generalisation shown to be really a great support.

With regard to Ostwald's table (letter 31470), it appears to be based upon O = 16. I rather fancy that Ostwald shirks the difficulty of the ratio H : O not being exactly 16, and does not adopt any decided course. I am strongly of opinion that our great chemical societies and institutions should unite in an endeavour to settle once for all that oxygen shall be adopted as the unit, and be considered for convenience to be 16. There would then not be all the alterations now necessitated in nearly all the elements every time someone discovers one more of the apparently inexhaustible sources of error in the determination of the oxygen-hydrogen ratio. What with Lord Rayleigh corrections and all the other difficulties, it seems that this unhappy ratio will always be uncertain, and a very slight change in it makes a very considerable change in metals of high atomic weight. Until this agreement is generally adopted, we can never hope for much improvement in our tables of these so-called constants.

**Director R.R.L.**

### JOSHUA'S (?) COMMAND.

[31555.]—WHAT "Tyler" (p. 10) calls "Joshua's command" never gave me the idea of his commanding anything. "Then spake Joshua to the *Lord*, in the day that the *Lord* delivered up the Amorites before the children of Israel; and he said"—(*who* said?)—"in the sight of Israel," &c. I am no Hebraist; but is Joshua the most natural or grammatical nominative? I had always supposed "the *Lord*" was implied as giving this oracular answer to Joshua, in some way acknowledged as supernatural, "in the sight of Israel." Whether by an angelic voice (as in another part of the book), or by inspiring Eleazar the priest, or Joshua himself, or some prophet unnamed, the narrative does not say.

But notoriously all modern versions, by which I meant *all* versions current (even the LXX.), mistranslate the oracular sentence in two points. They alter "Be silent" into "Stand still," and they make the two objects addressed (to both of which this single verb alone applies), the celestial luminaries, whereas they were the "sun in (or at or upon) Gibeon," and the "moon in (or at or upon) Ar-ajalon." If the subsequent quotation from Jasher be true, which says (though the intermediate sentence does not say) that the sun stayed "in the midst of heaven," this stupendous prodigy was, so far as the narrative goes, meaningless and no "miracle." It is essential to a miracle to have been predicted. If the earth's rotation were to stop for an hour to-morrow, it would be no miracle unless some prediction thereof were proved. In Acts v. the death of Sapphira is the only miracle. That of her husband was not one, because it was not predicted. If the engineers who testified to a coroner in 1853, that the scaffolding which fell at Sydenham Crystal Palace had been so constructed that it was physically safe, testified truly, then it fell preternaturally, or in other words, these was a suspension of natural law; but that constitutes no miracle unless the event had been predicted. Equally meaningless was Jasher's stoppage of the sun "in the midst of heaven," if it happened, for the narrative implies no such thing to have been foretold. Hence Josephus merely says (as if Joshua might, for aught he knew, have had nothing to do with it), "It happened that the day was lengthened." This prodigy, he implies, like the hailstorm, providentially occurred that very day. The Son of Sirach had held that "the sun went back by his (Joshua's) means." Josephus never hints by whose means.

But supposing only a narrator recording that this strange phenomenon occurred, was there ever an army, even of savages, wherein any would locate the luminaries as being (not south or south-west, or in any such bearing, but) "in Gibeon," or some such spot? Could a whole army (even if stationary), all its regiments at once, have the sun over or "in" Gibeon? Not only so, but during a pursuit through many miles! Nay, when the sun was also, observe, "in the midst of heaven," which can hardly mean near the horizon!

If the writer, as Bryant and I suppose, quoted Jasher only to account for that book's error, we must remember the whole has reached us through many generations of copyists quite ignorant of that intention, and we cannot expect it to retain a construction quite grammatically consistent therewith. Only a difficult muddle was to be expected, such as we find. Two very notable points, however, have to be kept in view. The end of Deuteronomy, plainly not written till long after Joshua's time, denies that any wonders to rival those of Moses's time occurred afterwards. Again, the New Testament is not only without a hint at this marvel, but the writer to the Hebrews, in his chap. xi., makes the falling of the walls of Jericho the chief miracle of Joshua's time—indeed, the only one he deems worth mention.

A recent book hereon by the Rev. A. S. Palmer, "A Misunderstood Miracle," proposes another solution, but plainly in ignorance of Bryant's, though it collects a vast chain of comments, Jewish and Christian, of all ages. As early as 1370, it seems, Rabbi Levi ben Gershon held that what Joshua asked was that the Israelites might conquer in the short space of time ere the sun should seem west of Gibeon, or the moon beyond Ajalon; and the miracle consisted in the speed with which victory was accomplished. None of the critics, nor Mr. Palmer himself, seem to have noted the probability that Gibeon, being "a great city, as one of the royal cities," may have contained, like Beth-shemesh or Heliopolis, Palmyra, and many others, a shrine of sun-worship, where oracles were given: and that Joshua and his people, having been entrapped into an alliance, could use no violence against the Gibeonite temples, so that unless miraculously stopped, these unholy rites must have permanently disgraced the heart of their land.

E. L. G.

## USEFUL AND SCIENTIFIC NOTES.

THE French Post-office authorities have lately been making experiments with a new wire, known as the "bi-metallic Martin," composed of steel with a surface of copper. The result is that the wire has been adopted to replace the wires in the telegraph service, and it will also be used upon the telephone systems.

A REPORT issued by the Japanese Home Department states that during the month of April last there were 80 earthquake disturbances, felt on 26 days, the day on which the largest number was felt being the 17th, when there were 17 oscillations. The earthquake, the effects of which were most extensively felt, was that which occurred on the 16th of April, extending over 20 provinces. Fortunately, none of the shocks were of a very serious character, the worst effects reported being the appearance of cracks in the ground, the displacement of doors and screens, the throwing down of small articles on shelves, and the stoppage of clock pendulums.

**Acids in Oils.**—Geissler's method for determining free acids in oils, consisting in dissolving the oil in ether-alcohol and titrating it with decinormal alcoholic—50 per cent.—alkali, is accurate, and can be used in all cases, save where the oil is so dark-coloured as to hide the change of the indicator—phenolphthalein—used. By employing a cylinder about 4cm. in diameter instead of a flask, this difficulty is much lessened. The process is especially suited for clear mineral oils. Burstyn's plan of shaking the oil with an equal volume of alcohol, drawing off and titrating an aliquot portion, is fallacious, as the whole of the free fat acid is only extracted by repeated treatment with alcohol, and thus the results are low when compared with those given by Geissler's method—e.g., a refined rape oil containing 0·730 per cent. of acid, calculated as $SO_3$, gave only 0·374 per cent. when thus treated. Merz shakes the oil with alcohol in a stoppered flask and titrates the mixture with repeated agitation. This gives accurate results, and is well adapted for oils containing a considerable quantity of free fat acid, as if treated by Geissler's method they require an inconveniently large amount of alcohol to prevent the oil being precipitated from its ethereal solution by the standard caustic alkali in weak alcohol. Burstyn's physical method, which consists in shaking the oil with alcohol of known specific gravity and deducing the quantity of fat acid it extracts by the increase in density it suffers is quite untrustworthy; e.g., an oil containing 0·091 per cent. of acid, calculated as $SO_3$, gave 0·280 per cent. Many causes conduce to this result; among them may be mentioned the different specific gravities of the acids extracted, the error caused by the presence of a mineral acid, such as sulphuric acid, and the varying quantity of neutral oil dissolved. The *Oil and Colourman's Journal* says the following method is adapted for opaque mineral oils; 25c.c. of the oil is shaken with 50c.c. of absolute alcohol in a stoppered cylinder about 2cm. in diameter, and the mixture allowed to settle; 25c.c. of the alcohol is then drawn off, 10c.c. of ether added if turbid, and titrated with decinormal caustic soda. If more than 2c.c. be used, the rest of the alcohol is poured off, another 50c.c. added, and the process repeated. The free acid has been calculated as $SO_3$ throughout for the sake of uniformity.

## REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[71439.]—**Aniline Colours.**—If "Glatton" intends his directions to stand as a test for aniline dyes, I may say that they are valueless. Chemical analysis alone will identify the source of the colour. It is, however, a fact that some aniline colours are bleached by strong sunlight. SM.

[71705.]—**Cycle Gold Transfers (U.Q.)**—The paper is sized with white of egg, the copper stencil plate laid on, and the gold applied with a pad.

A. F. SHAKESPEAR.

[71729.]—**Bourdon Pressure-Gauge.**—I believe the usual material is hard brass; but one maker at least (I think, but am not sure, that it is Schaffer and Budenberg) makes them of steel. He once brought one to show me; but I forget the details. The steel tube was turned in a lathe, I think, and flattened while bending. GLATTON.

[71735.]—**Steel Gearing (U.Q.)**—If to drive in one direction only, the smoothest action is obtained by having only the tops of teeth in whichever drives—for instance, if the wheel is the driver, all its teeth will be outside the pitch circle, and only the bottoms, or parts of teeth between the roots and the pitch line, on that which is driven by the other. Epicycloidal teeth are preferable to involute. Gee's gearing, in which the teeth are buttress-shaped, is the strongest; but is only suitable for driving in one direction. See Unwin's "Machine Design," and the articles on "Gearing" now appearing in this paper. GLATTON.

[71738.]—**Needles and Pins (U.Q.)**—Cramp in the legs at night is easily prevented by wearing a garter in bed, made by stitching a row of cork discs (slices of wine-bottle corks) on one side of a piece of tape. The cork is worn next the skin. As I know from many instances the value of cork so applied, I would suggest that it might possibly do good in this case if bound in some way next the affected parts. Perhaps if cut in sheets as thin as paper it could be sewn inside a glove to be worn at night.

GLATTON.

[71753.]—**Calculating Circle (U.Q.)**—Stanley, the instrument maker, of Great Turnstile, supplies a small book of instructions with each instrument. I should think he would be willing to let you have one. GLATTON.

[71772.]—**Coil Boiler (U.Q.)**—Herreshof's boiler of an early form, of which the sketch referred to is a representation, is very much lighter than a locomotive boiler to do the same work. It requires a great deal of attention, and from what I have seen of it I cannot recommend it. In the later form a second coil was placed outside the inner one, forming a wall of comparatively cool water, and the double casing became a single one. The top of outer coil joined the pipe marked "from feed-pump," and at its lower end was the inlet for feed-water. The steam was led from the bottom of inner coil as before, but in some boilers it was carried through a superheating coil in the top of boiler before being led to the separator. The same fault of great unsteadiness unless carefully nursed still remains.

GLATTON.

[71781.]—**H.P. of Oscillating Engine (U.Q.)**—What is steam pressure, and number of revolutions, and is the engine condensing or non-condensing? What is area of steam ports, and are they liable to be much throttled up by the mode of distributing steam? Without such data your query cannot be answered, supposing you mean *indicated* horse-power. The *nominal* horse-power, if non-condensing, may be taken at 9 square inches per H.P. This will be (since the area of $3\frac{7}{8}$ is 11·79), $\frac{11\cdot79}{9}$ = about 1·3. This is, however, not a measurement of the actual power. For so small an engine the fly-wheel may be designed so as to look well, without regard to the actual weight; say 20in. diam. and $2\frac{1}{2}$in. wide. GLATTON.

[71839.]—**Cyanide.**—My query on this subject no doubt is very hazy; but it was not my fault. Somehow the gist of my query was dropped in the printing, and which was as follows: "Will Mr. Bonney, or any of 'ours' who have a knowledge of the previous use of cyanide, or a cyanide-yielding substance, such as cyanide of potassium, say how far we may use these without infringing this patent?" The patent referred to in my former query is for dissolving gold and silver from ores and other compounds after being ground to a powder. As far as my limited knowledge went, I could see no reasons for such a patent, and that the readers of the "E. M." could use cyanide, or a cyanide-yielding substance, in any way they thought proper so far as dissolving the precious metals were concerned. From what Mr. Bonney now says, it would seem that this same substance has been a fertile subject for patents, and it would seem rather novel for anyone to claim the exclusive right to its use at this time of day. When I peruse Mr. Gore's work on electro-metallurgy I hope to have

MORE LIGHT.

[71860.]—**Speaking Tubes (U.Q.)**—Cheapest material, probably iron gas-pipe; best, any smooth pipe. There should be no sharp bends, only gradual curves. Diameter 1 to $1\frac{1}{4}$in. While it lasts gutta-percha would probably be the best material. I should use lead or compo. if the pipes can be protected from crushing. They should be arranged so as to avoid moisture collecting in them. You need not be afraid of making tube too large.

GLATTON.

[71864.]—**Heat from Electricity (U.Q.)**—Ayrton gives $H = \cdot0315\,A^2rt$, where $H$ = the number of pounds of water heated in $t$ minutes from 0° to 1° Centigrade by a current of $A$ ampères flowing through a resistance of $r$ ohms. Let $V$ = volts, then $A = \frac{V}{r}$; $Ar = V$, and $A^2r$, therefore = $VA$ or watts. Hence $H = \cdot0315 \times t \times$ watts. Let $p$ be the electrical horse-power in the circuit or (watts ÷ 746). Then, as $\cdot0315 \times 746 = 23\cdot5$ nearly, $H = 23\cdot5\,pt$. If the mechanical efficiency of the engine is taken as 80 per cent., and the electrical efficiency of dynamo as 90 per cent., the electrical horse-power will be $\cdot8 \times \cdot9 = \cdot72$ of the indicated horse-power. Calling the indicated power $P$, $H = 16\cdot92\,Pt$. Of course the above calculation assumes that the whole power $p$ is used only for heating. GLATTON.

[71874.]—**Cupric Sulphate.**—I suspect Mr. Grey can take care of himself; but I should like to inform a "Foreigner" that colour is not an inherent property of a substance. Colour depends upon the power of substances to reflect or absorb light. A substance appears white when it reflects all rays and absorbs none; black when it absorbs all rays and reflects none. The colour of crystallised copper sulphate is due to the fact that its molecules, when combined with water, are of such a form that they reflect the blue and absorb the red and yellow. On heating, the crystalline form, and consequently the blue colour, is lost. That colour is often dependent on crystalline form may be observed in the change from yellow to red mercuric iodide; it is an instructive experiment when seen under the microscope. "Foreigner's" list of questions are in the light of this reply seen to be of no value. SM.

[71874.]—**Cupric Sulphate.**—As "Foreigner" remarks, the subject involves many interesting questions, and although not appealed to, I take the liberty of correcting what I consider to be the fundamental error which gives rise to many of your queries. While to the majority answers are almost, if not wholly, impossible, those to many of the remainder would necessitate slight incursions into the realm of metaphysics. As to why the colour of cupric sulphate is bluish-green rather than any other colour, all we can say, I should think, is that it is the nature of the salt to be so; we might as well ask why the earth exists as it does and not in some other way. Then again, "Foreigner" seems to look upon colour and odour as material things which can be separated from bodies and set aside by themselves. You ask: What has become of the bluish-green? Wherefrom comes the odour? Colour, odour, taste, &c., are not inherent properties of bodies which, as such, exist independently of and apart from ourselves; they are our sense translations as it were, or our ways of conceiving of differences in motion and arrangement of the constituent parts of the bodies producing these effects. When a body changes colour, as we say, it is because a displacement and consequent rearrangement of its parts, atomic or molecular, takes place, its manner of dealing with the light it receives is altered, our eyes appreciate this alteration as a change of colour—this latter phenomenon being entirely subjective. I am afraid "Foreigner" will find some difficulty in obtaining chemico-physical explanations to all the phenomena enumerated; I therefore look forward with interest to Mr. Gray's reply. DUBITO.

[71902.]—**Centrifugal Pump (U.Q.)**—The useful power is obtained by multiplying the number of pounds of water pumped per minute by the mean height in feet to which it is lifted above its original level, and then dividing the product by 33,000. The result is the effective power, or water horse-power as it is sometimes called (W.H.P.) Besides this power, the steam (supposing the pump to be driven by a steam-engine) has to overcome the friction of the pump and also of the engine, so that the indicated horse-power, or horse-power of the steam, is greater than the water horse-power. In some trials with large pumps in Egypt, lately described (p. 193, Vol. CI. *Minutes Proc.* Inst.C.E.), the indicated horse-power was from 67 to 82 per cent. greater than the W.H.P. Hence, in this case, the W.H.P. calculated as above would have to be multiplied by from 1·67 to 1·82 to get the I.H.P. On p. 138, Vol. XXXVII. *Engineering*, some experiments are given, in which the multiplier is as high as 2·6 to nearly 3 for pumps arranged as usual without any guide-blades, and 2·42 to 2·7 when guide-blades were added in somewhat the same way as in a turbine. On p. 130, Vol. XLII. *Engineering*, a curve is given from which the multiplier comes out 1·42 when pump was doing its best, and about 1·9 at lower efficiencies. On p. 215, Vol. XL. *Engineering*, trials of pumps by J. and H. Gwynn and Co. give a multiplier of 1·72, 1·76, 1·87, and 1·8. Say water raised per minute = W pounds; say height to which it is raised = H feet. Then indicated horse-power = I.H.P. = $\frac{W\,H}{33{,}000} \times C$, where C is the multiplier given above from various experiments as from 1·42 to 1·87. The trials giving 2·6 to 3 are exceptionally bad, and may be neglected. To be on the safe side C may be taken as 2.

GLATTON.

[71930.]—**Drying Wood.**—Expose the wood to a current of dry air for a few hours, and it will soon get dry enough to burn readily. S.

[71943.]—**Clarionet.**—Any music-seller can supply an instruction-book for the clarionet; but I dare say Boosey's is as good as any. T.

[71958.]—**Flint Glass.**—The proportions of materials given by "Baryta" ought to have melted very easily indeed; in fact, the glass would be much too rich in alkaline (basic) substances to withstand the action of weak acids, or even of the atmosphere, for any length of time. I should say that this was the cause of the failure of Mr. Wenham to obtain a polished surface on his prism, as related by himself on page 496. I have seen and heard of numbers of similar instances arising from this cause. Looking over my notebooks, I find that some time ago I made some baryta glass of the following composition: Sand 560, barium carbonate 276, sodium carbonate 190 parts. "Baryta" will see at once that this is a much cheaper and more stable compound than the one he quotes, and he may rely upon it as being a practical one. My note says, "the metal was pale-green in colour," but this was mostly owing to the common quality of the materials used. I use the word "mostly" advisedly, for it is practically impossible to obtain glass-making materials absolutely pure. The best advice I can give "Baryta" on this point is to use the best sand (Fontainebleau), washed and burnt; soda-ash, made by the ammonia process, 58 per cent. $Na_2O$; and precipitated barium carbonate, as I am afraid the raw material cannot be obtained pure enough to do what "Baryta" apparently requires. The use of the precipitated carbonate will, of course, prove rather expensive. Even when the purest possible materials are used, a little manganese dioxide will be required to counteract, by the "pinky" colour it imparts to the glass, the green tint given by the iron invariably present even in the best sand. The precise amount of $MnO_2$ required can only be obtained by trial, but the less used the better. I trust "Baryta" will record his experience for the benefit of "ours." By the way, why does "Baryta" call this glass "flint glass"? Flint glass, properly speaking, must contain lead in greater or lesser quantity. Other kinds may resemble it in colour, but they cannot justly be called by the same name. MONS.

[71961.]—**White Marble, to Polish.**—Directions for polishing marble have been given many times. Use marble dust, a felt rubber, and water; then the finest emery, and subsequently rouge on the palm of the hand. S.

[71980.]—**Dolomite—Slag.**—After this there will be no bounds to my conception of human foolishness. The "Lydney Dispenser" has the amazing assurance to say that he has experimented on the human subject with slag. I can only suppose the foolish subject was ignorant of what he was taking. Might I ask the "Lydney Dispenser" whether he takes all these wild remedies himself? I can understand it if his is the "human body" mentioned. However, he runs in two tracts even on this subject. I feel constrained to say again, "Well done! Old Fox!"

INNOMINATE.

[71980.]—**Dolomite.**—In reply to "Lydney Dispenser," the blue colour of the furnace slag to which he refers is probably due to the presence of "ultramarine," a compound of alumina, silica, soda, and sulphur, the rational formula of which has not yet been determined. It may also be what is known as Prussian blue, seeing that all the substances required to form that compound are discovered in the gases and slags thrown off from the blast furnace. The formula of Prussian blue is: $2Fe_2 3Fe(Cn)_6$ (ferric ferrocyanide). Hydrate of iron is also blue, but it turns brown on exposure to the atmosphere. Furnace slag is not by any means a definite chemical compound, so that I should not think it would be of much use as a medicine, because the essential part (whatever it may be) may be absent in nine specimens out of ten. The "L. D.'s" letter may explain why so many people "peg out" under the hands of doctors, chemists, and quacks—especially the latter. ABERTIFY.

[71989.]—**Marine Boiler.**—A copper boiler, 11in. long, 7in. wide, and 6in. deep, with internal furnace, will be suitable. J. A.

[72021.]—**Telescope.**—The following method of finding the magnifying power or a telescope is quoted by Dr. Kitchen from the *Nautical Almanac* of 1787, in his "Economy of the Eyes," Vol. II.:—At the distance of one or two hundred yards from the telescope, put up a small circle of paper of any determined diameter, an inch, for instance, upon a card, or any piece of strong paper, through which the light cannot be easily transmitted; draw two black parallel lines, whose distance from each other is exactly equal to the diameter of the small circle, adjust the telescope to distinct vision, and through it view the aforesaid small circle with one eye, and with the other eye, open also, view at the same time the two parallel lines. Let the two parallel lines be then moved nearer to, or further from, your eye, till you see them appear exactly to cover the small circle viewed in the telescope; measure now the distance of the small circle, and also of the parallel lines from your eye. Divide then the distance of the former by that of the latter, and you will have the magnifying power of the telescope required. T. D.

[72026.]—**Prurigo.**—To "INNOMINATE.—"Curability of Cataract with (internal) Medicines," by Jas. Compton Burnett, M.D., F.R.C.S. (Gould, 59, Moorgate-street, E.C.), price 3s. 6d., contains numerous instances of radical cure, not by his own skill only, but by other homœopathic M.D.'s, and—shall I say it?—his Chapter IV. gives "Cases of Cataract cured with Revulsives, &c., by Allopaths." Therefore allopaths have proved the curability of cataract without operation. If Dr. Burnett is, well—untruthful, then Mr. "Innominate" has a means available to his for demolishing that hydra Homœopathy which is giving orthodox physic far more dis-ease than did the seven-headed monster to Hercules himself—thanks to, amongst other agencies, the League tracts, and I think to the "E. M." also.

THE LYDNEY DISPENSER.

[72026.]—**Prurigo—Arsenic, in re "Foto Fils."—Best Remedies.—A Caution.**—A near and very dear relative of mine was a sufferer from Psoriasis in an inveterate form, itching (during the earlier stage) being a leading symptom. In or about 1857 she was placed under the care and the treatment of the great skin specialist, Sir Erasmus Wilson, his prescription being 5 drops of Fowler's arsenical solution, *plus* tincture of iron, three times daily after meals. At first the medicine apparently removed the disease, but eventually the condition became inveterate, the whole of the surface of legs and abdomen being one thick crust, under which the colour of the skin was a dark angry red. Some few days after her (first) accouchement, when she had used Dr. Wilson's prescription off and on some ten years, all skin symptoms suddenly vanished, and death followed on the 21st day after her delivery. That Dr. Wilson's treatment really tended to cause this fatal issue is still the opinion of

THE LYDNEY DISPENSER.

[72060.]—**Celluloid.**—I have waited expecting that some of "ours" would give more information than that conveyed by "Sm." in issue of 15th ult. Celluloid was patented 30 or 40 years ago by the late Mr. A. Parkes, the inventor of it, and I cannot see how there is any patent for it now. All particulars of its manufacture must have got into scientific books long ago. I don't expect to get much information on any such subject from the "general public"; and as "Sm." does not know, I hope some of our scientific readers will be able to give full particulars. M. C. I.

[72069.]—**Beef.**—I asked the question, expecting to have several interesting replies; but instead thereof, I am questioned. I cannot offer any evidence other than my own experience. I don't suppose nine out of ten butchers would notice it. My opinion is that beef killed in the afternoon, being much warmer than in the evening, keeps the pores open, and so allows the heat to escape; while the cooler air closes them, and confines the heat. Do you think this is probable?

BUTCHER.

[72084.]—**Music for the Deaf.**—With reference to the audiphone, I may mention that about 11 years ago we made some of these. Unfortunately, the lady for whom one was particularly intended could hear nothing with it, owing, as we believed, to her teeth not being her own—a fact we were not aware of at the time. I did, however, know of a gentleman who could hear with an audiphone. They were then, I was told, selling in America at 10s. each—a dozen could be made for that sum. I find we have still a good blade left, and if "Afflicted One" likes to write to me I will send it to him, with pleasure, with handle and ratchet attached. A black cord and tassel is worked through the ratchet (see Address column).

A. E. B. M.

[72091.]—**Ear-Piercing.**—Surely the querist does not imagine all the holes he refers to are made at once! No woman could possibly bear so much pain. They are made at intervals of at least a month. This permits the inflammation set up by the insertion of each ring to subside somewhat before the next is put in. As to Indian operators giving wrinkles to English jewellers, I fail to see where much can be learnt—all that is necessary for nose-piercing is a strong nerve; because the moment the piercer passes through, a rush of blood follows that would quite unnerve anyone not used to it. Frequently the actual cautery has to be applied—and it is well to have it ready, for the loss of so much blood is very weakening. It is not usual to pierce the left nostril—generally the right one. Not long ago two young ladies could be seen on the lawn of a noted M.P. of the Midlands; the one wearing a diamond and large emerald in the right nostril; her sister wore a sapphire and topaz in the same place. These rings worn in the nostril do not look nearly so pretty, in my opinion, as when hanging from the centre of the nose (similar to those worn in Asia Minor and the surrounding countries). But the insertion of these is evidently painful, judging from the following extract from "Indian Resident." He says: "In India and many places in the East the nose is pierced both in the centre and the nostril. The passing of the curved steel instrument is very painful, and the operation is borne much better by native ladies than by Europeans. With the latter the hole is a long time healing, caused, probably, by irritation set up by the ring having to be moved each time food is taken. Besides, the membrane of the nose is well-supplied with blood, and much is lost during piercing." I await with much interest the reply of "Constance" to query 72211 in this week's issue; its original heading was "Wounds."

LEAMINGTON JEWELLER.

[72111.]—**L.C. and D. and L. and S.W.R. Locos.**—Numbers of the ten-wheeled tanks are as follows:—By Bryer, Peacock, and Co., 1879: 374 to 379, 383 to 389; in 1882: 412 to 426. By Stephenson in 1883: 45 to 57; in 1885: 77, 78, 8 104, 124 to 126, and 129. By Neilson in 1885: 4 to 489 inclusive. By Dubs in 1884: 169 to 173 inclusive, and 490 to 495 inclusive; in 1885: 517 to 525 inclusive. The front coupled bogie tanks were built at the Nine Elms works in 1889-90 by the S.W.R. Co.; I have not the numbers.

NORTH-WESTERN.

[72123.]—**Compound Marine Engine.**—I should make a single boiler, say, 14in. diameter by 18in. long, with a single furnace only in a ᗜ-shape firebox, and let tubes run through to back end, where they can be easily got at to tighten if a loose uptake is fitted. Copper $\frac{3}{16}$in. thick for shell and box and ends. You must well stay these, and do not use less than 1in. tubes. You can make bottom of firebox circular and 8in. long, so as to burn coal or coke. You had better fit a drain-cock or two.

Bristol. T. C.

[72134.]—**Homœopathy and the Poisons.**—The old "forest fox," the erudite philosopher, engaged in ruminating on the contortions of a poor cat's face thinking about being sick, is profoundly touching. There is material here for another Æsop's fable. But without answering the querist's pertinent inquiries, the "old fox" manages to advertise these half-crown tracts—a truly foxy proceeding. I feel bound to say, "Well done, Old Fox!" "A. W. S." seems to have puzzled the "Lydney Dispenser" greatly. Of course his query is unanswerable from the "like-cures-like" point of view. Nearly all the antidotes have precisely the opposite physiological effect, or are given with a view of neutralising the poison chemically.

INNOMINATE.

[72138.]—**Gunpowder.**—In the *Ency. Brit.*, "Gunnery," by Capt. Noble, there are tables for all these questions. Taking the absolute density of powder cubes there given = 15·7cub.in. per lb. Then $\frac{\text{density of water}}{\text{density powder}} = \frac{27{\cdot}7}{15{\cdot}7} = 1{\cdot}75$ times density of water; and 34cub.in. per lb. gives 26·6 tons press. per square inch, by tables. Supposing an 80-ton gun, charge 425lb. of 1½in. cubic powder, chamber 18in. diameter, weight shot 1,700lb. content bore 60,400cub.in., space behind shot 14,400cub.in. Then, volume of charge = 425 × 27·7 = 11,773cub.in.; number of expansions = $\frac{60{,}40}{11{,}77}$ = 5·13 expansions. But work in foot-tons, as p his table, = 92·4ft.-tons per lb.; space left aft charge is burned = 425 × 34 = 14,450cub.in.; energy due to this space = $\frac{14{,}450}{11{,}773} = 1{\cdot}227$; 1·227, by his table, represents 17·7ft.-tons per so 92·4 − 17·7 = 74·7ft.-tons nett. 92 per to 95 per cent. of this is realised. 74·7 at 92 cent. = 68·725 × 425lb. = 29,210ft.-tons; at 9 cent. = 70·965 × 425lb. = 30,160ft.-tons; and corresponding muzzle velocities of which by his ta are 1581ft.-seconds and 1600ft.-seconds, respecti This can also be proved independently by trea the powder-gas pressure by Mariotte's law, wh the question resolves itself into: 1lb. powder 34cub.in. density, giving a pressure of 26·6 tons square inch; this pressure is reduced by motion

:le to 19 tons per square inch—i.e., the
:on in the gun cylinder.

$$\frac{\text{:e + chamber}}{\text{ume of charge}} = \frac{74850}{11773}$$
= ratio of expansion 6·36.

:re during expansion

$$\frac{\text{p. log. ratio}}{\text{ratio} - 1} = \frac{1·84784}{5·36} = ·345.$$

s × ·345 = 6·555 tons per square inch,
:re. But mean pressure × area bore
re in feet × 95 per cent. = foot-tons.
201 × 25·04 × 0·95 = 31,340 foot-tons.
nary formula—

$$\frac{\text{40} \times 2g}{\text{t. shot tons)}} = \text{1,630ft. per sec. muzzle velocity.}$$

y near approximation to Captain Noble's
orked independently from an indicator
v. But your correspondent should read
ited: the tables given and the explana-
o lengthy for insertion here. Perhaps
now rather out of date; but it is well
ng for all that. W. S.
, Aug. 27.

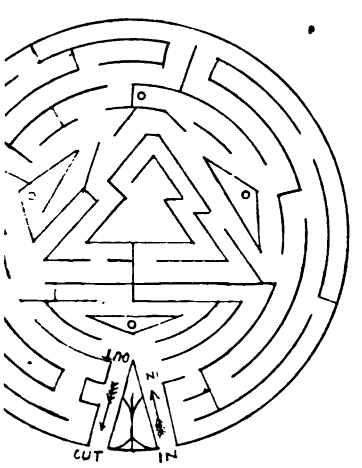
-**American Organ and Concert**
must be tuned. You can do it if you
Scratch with a penknife the end of the
reed can easily be drawn; that will
tone. Don't scratch much off.
G. H.

-**Magic Squares.**—It is, I think, best
nasik square as suggested in the question
is a magic square that has all its
" magic, thus distinguishing it from a
quare, which has generally only the two
magic. With regard to normal paths
rows, columns, and diagonals, none of
e made magic unless the root of the
eater than 5. The maximum number of
ional magic paths in nasik squares of
varies, being greater in proportion for
han for odd. Thus, the roots being 6,
11, the maximum number of additional
is, respectively for each, 3, 2, 4, 4, 7, 6.
enæum Club. T. S. Barrett.

-**Polishing Copper Plates, &c.**—As
has got on to them, it is doubtful
u will do anything with them now.
Jack of All Trades.

-**Maze.**—Many designs for mazes will
n the *Boy's Own Paper* for 1883, and
our purpose. It may interest you to
nost of the ancient mazes, except that
in Crete, which, by the way, was a
ze, not made by the hand of man, were
rve as processional exercises for monks
and not for any purpose of bewilder-
S. Bottone.

-**Maze.**—Perhaps the following sketch
u. It is rather larger than you stated,
or 64ft., and scale $\frac{1}{16}$in. to the foot.



for poles and flags for advertisement,
rgreens, or the centre, or all may be
untains, or the centre one scent fountain,
supply. Jack of All Trades.

—**Regular Polygons.**—At the end of
*itiones Arithmeticæ*, in 1801, Gauss gave
ery, and the solution $x^{17} - 1 = 0$, whose
ational roots, involving the sines of all
les of $\frac{\pi}{17}$, he carries to ten figures by
equations alone. For the impossibility
ng the equation with any other known
x than 2, 3, 5, 17, 257, or 65537, or with
r of any of these odd numbers, there
e only his word. Poullet de Lisle made a French translation of that great work in 1807; and in the *Théorie des Nombres*, Legendre, a year later, repeated the algebraic proof; as did Peter Barlow, in his English work of similar title, in 1811. None of them give a graphic construction, but I have worked it with ruler and compasses, and you should with compasses alone, and let us see with how small a number you can. With the three openings, 1, $\sqrt{3}$, and $\sqrt{2}$, you can get $\frac{1}{2}\sqrt{17}$. Now call $\frac{1}{2}\sqrt{17} - \frac{1}{2} = a$. Then find $\frac{1}{2}a + \sqrt{(\frac{1}{4}a^2 + 1)}$, and call this $b$. Then $\frac{1}{2}(a + 1)\sqrt{(\frac{1}{4}a^2 + 1)} - \frac{1}{2}(a + 1)$, and call that $c$. Lastly, in a circle of radius 1, the side of the 34-sided polygon, or chord of $\frac{\pi}{17}$ or $2 \sin. \frac{\pi}{17} = \frac{1}{2}b - \sqrt{(\frac{1}{4}b^2 - c)}$. Use the fewest openings possible, and let no arcs intersect at angles acuter than 60°. E. L. G.

[72152.]—**Cog-Wheels.**—The statement of the requirements of "W. S." appears rather involved. I presume he wants to make B and C turn at equal rates in opposite directions. Let the pair of bevel wheels E (p. 562) be named $e$ and $f$. $f$ the one keyed to shaft F, $e$ the one keyed to worm D.

Let G have $p$ teeth.
If C turns $n$ times having 84 teeth,
G turns $\frac{84}{p} n$ times,
∴ F and $f$ each turn $\frac{84}{p} n$ times,
But B turns $n$ times also,
∴ D turns 34 $n$ times (from the nature of the worm gear)
∴ $e$ turns 34 $n$ times.

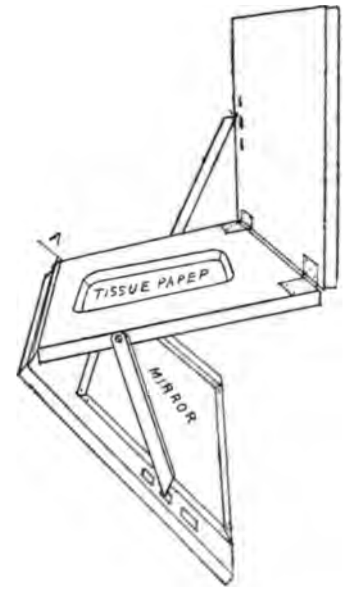
Now $f$ and $e$ are to gear, and whilst $f$ goes $\frac{84}{p} n$ times, $e$ goes 34 $n$ times.

$$\therefore \text{ ratio of } \frac{e}{f} = \frac{\frac{84}{p} n}{34 n} \quad \therefore \frac{e}{f} = \frac{42}{17 p}.$$

This gives us a ratio between G and the pair of bevel wheels. G may be chosen arbitrarily, and the other calculated from it; e.g., suppose G has 10 teeth, $p = 10$, and $\frac{e}{f} = \frac{42}{170} = \frac{21}{85}$, $e$ would have 21 teeth, and $f$ would have 85 teeth. In the sketch the worm appears right-handed. It should be left-handed if the shaft of D is to the left of B when looked at from the left. W. E. H.

[72156.]—**Kauri Gum.**—What is it soluble in? If oil, spirit, turps, beeswax. Then put it into hot water to soften, and press it into a mould.
Jack of All Trades.

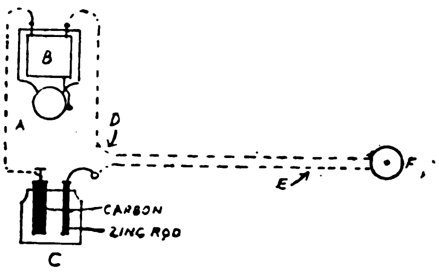
[72159.]—**Retouching.**—The negative is generally prepared by a medium, or it is slightly rubbed on the surface with powdered rosin over the places that require operation. There is a special pencil to be obtained, which should be very finely pointed by means of emery cloth. The desk is generally constructed in the way shown in the sketch; the quarter-plates are fitted in the opening; the half and whole-plates are placed on the rim A. The pencil should be held loosely, and worked lightly in a circular movement over the light spots, streaks, &c., on the negative that are to be worked down to make an evenly toned surface. Retouching requires a good amount of careful manipulation and practice. The unnatural effects seen on many portraits are due to bad work; the result of the proper method being carefully practised is the means by which well-worked portraits are rendered more life-like than otherwise. For instance, light red or orange-coloured spots on the face are apparently much darker in the print than they are in reality, for which the best remedy is retouching.
F. C. V.



[72159.]—**Retouching.**—The first thing necessary is to make a retouching desk. Woodcuts of this may be seen in most dealer's price lists, and it is not difficult. The object to be attained is that all light coming into the room comes through the negative. Then it is necessary to make the surface "bite" the pencil; several media are sold for this purpose, but the simplest thing is to rub a piece of rosin with the middle finger until the finger is covered with fine rosin powder, then to rub this on the negative with a fine circular motion. The pencil most used is Hardmuth's H H H H, and the first thing to do is to dot out or fill up the transparent little holes caused by faults in the negative and by freckles. Then all the abrupt transitions between lights and shadows are rounded off. For further work to be done, see the able articles by Redmond Barrett in the *British Journal of Photography* for the last few weeks. The touch of the pencil should never be seen—only the effect of the aggregate touches.
Plymouth. B.Sc.

[72160.]—**Troublesome Feet.**—Try sea-water baths. G. H.

[72168.]—**Electric Bell and Battery.**—It *does* matter at what terminals of an electric bell the battery wire and line wires are connected. If you will make all your connections to sketch, you cannot be wrong. B, on sketch, is the bell, C the battery, and F the push or press button, and A, D, and E are the wires. Wire A is connected from the bell to the carbon in battery exactly as shown.



Wire D is connected from the other terminal of the bell to the plate in bottom of the button, and wire E to be connected from the zinc rod of battery to the top plate in button. The bell must work if connected as shown on sketch. A. B. T.

[72173.]—**Portrait Lens.**—Yes, the Petzval type is the best. For a "garden" studio I would prefer a Rapid Rectilinear or a single lens; but then the focus should be five or six times that of the Petzval to produce the same size of portrait—for instance, a single lens of, say, 30in. focus would take a beautiful cabinet head of 1in. to 1½in.
Plymouth. B.Sc.

[72174.]—**Tattoo Marks.**—Have heard that if done over again with milk they will disappear, but doubt it. I suppose nothing but cutting them out would be effectual. Caldemone.

[72176.]—**Integral Calculus.**—In my answer in last week's "E. M." (p. 19), there is a printer's error in the last line but one of the analysis, where the symbol = has been put in place of + before the quantity $\frac{a^3}{3}$. J. R. C

[72177.] — **Agglomerate Leclanche.**—The $MnO_2$ in the blocks. Sm.

[72181.]—**Ghost in American Organ.**—On taking off the keyboard you will find a row of small rods, which communicate with the valves. You will probably find that the rod of the note which sounds continually is stiff, and does not rise after being pressed down. The remedy is to rub it carefully with blacklead. B. Sc., Plymouth.

[72192.]—**Clock-Mending.**—In reply to F. J. Garrood, the exact length of pendulum from pivot to bottom of ball is 3⅜in.; diameter of ball, ⅜in. (nearly). In reply to "A. J. W.," I do not know how to calculate the numbers; but should much like to know. The following are the numbers at present: escape-wheel 30, pinion 7; next wheel 56, pinion 7; next, 63, pinion 8; centre, no pinion, 24; carries hands with common pinion.
Amateur Clocker.

[72193.]—**Oboe for Chamber Music.**—I hardly think Mr. Doery would find the oboe, solo, or accompanied by the pianoforte, suitable for chamber music, though it would be effective in a small chamber orchestra of a quartette of strings, with flute and clarionet. As a solo instrument, it is really adapted to little more than melody, and that very limited in character. Rapid passages and arpeggios can be executed easily, but, to use the words of Berlioz, "they only produce an ungraceful and almost ridiculous effect." The chamber soloist needs a little scope for his efforts. A pastoral melody is very agreeable now and then; but I doubt if Mr. Doery would care to be for ever expressing "candour, artless grace, soft joy, or the grief of a fragile being," with the risk of becoming grotesque if he ventured on a little animation! And yet that would be his position, after much patient practice. The special difficulties of the instrument are the management of the breath, and of the pressure of the lips on the reed. The oboe is more difficult, in both these respects, than the other wood wind instruments. It is fatiguing to play, and frequent intervals of rest are necessary. The age to which playing the oboe can be continued must be a question of individual constitution. I believe that the constant holding of the breath does in some cases prove to be too great a strain on the lungs, and people with weak lungs would probably do better to leave wood wind alone. With strong lungs, "use" becomes "second nature," and there seems no reason why playing should not be continued to advanced age. But that is a medical question. C. J. Tahourdin.

[72194.]—**Arc Lamps.**—The Brockie-Pell and Siemens work with either continuous or alternating currents; the Brush with continuous only; but I am not sure of the Pilsen. F. C. Allsop.

[72194.]—**Arc Lamps.**—The lamps named are constructed to work with continuous, *ed est* unidirection currents. They will also work, though not regulate so well, with alternating currents.

S. Bottone.

[72196.]—**To Mr. Bottone.**—The copper plate should be buried in a sack or two of coke, well rammed down in a hole carried deep enough to reach moist earth. To test the conductivity of the rod, attach a wire to the point, and another to the base of the copper plate. Now connect one wire to one terminal of an ordinary detector galvanometer, and the other to a terminal of a Leclanché cell. Lastly, connect up the other terminal of the detector to the free pole of Leclanché. If the connections are good, the needle will deflect. S. Bottone.

[72197.]—**Joining Malleable Iron to Steel.**—Some malleable iron will weld and forge almost as well as wrought does. I have seen a wrought-iron bar welded to a malleable eye, but I don't think cast steel and malleable iron can be so united.

A. F. Shakespear.

[72200.]—**Cutting Discs.**—You had better use a fly-press—plenty to be got secondhand. Of course, you can use a toggle-joint, but it will be much slower.

Bristol. T. C.

[72201.]—**Flywheel.**—Your friend is right, and you, of course, are wrong, as you can never get all the power put into the engine, and the flywheel has nothing to do with that. What deceives you is that 3, 4, or 5H.P. may be got out of a so-called 2-horse engine; the latter merely indicates a trade size.

Bristol. T. C.

[72201.]—**Storage in Flywheel.**—Your friend is quite right. In the trials of agricultural engines at Newcastle in 1887, the power got out of the engines was from ·724 to ·943 of that put into them, most of the engines giving about 85 per cent. of the indicated horse-power. In the Society of Arts trials of motors in 1889, the Paxman engine was found to give out from ·792 to ·879 of the indicated horse-power, or about the same as those mentioned above. The flywheel don't increase the power—it only keeps the engine steady, so that it don't jerk in running. Your engine of 2I.H.P. would deliver, if well made, 2 × ·85 = 1·7H.P. to the belt on the pulley, or less than 1¾H.P. Glatton.

[72201.]—**Storage in Flywheel.**—Your friend is quite right; it is impossible to get so much power out of an engine as is put into it. Besides this, the function of flywheel is not to increase the power of the engine, but simply to equalise it. The heavy wheel actually consumes power to drive it, but when once in motion its momentum (dead weight in motion) checks any perceptible increase in velocity if the power be momentarily increased, and in like manner carries it over any momentary obstacle without perceptibly decreasing in speed. Any lasting increase in power, or taking off of load, will even with the flywheel increase the speed of rotation; so likewise any increase of load, or decrease of power, will slacken the speed. And since H.P. means weight moved in a certain time to a certain distance, it is evident that the flywheel does not increase the actual power of engine, but rather decreases it. S. Bottone.

[72202.]—**Dynamo.**—To suit the amount of wire given—viz., 6lb. No. 22—you should have an H armature about 2½in. diameter, 5in. long, wound with 1lb. No. 20. The field magnets could then be made of cast annealed iron ¾in. thick, 5in. wide, 5in. long, exclusive of pole pieces. S. Bottone.

[72203.]—**Harmless Smoking.**—A 10 per cent. pyro solution such as you require is compounded by diluting 1 part of pyro with 10 parts of water. Yes, allow the cotton to get dry, or nearly so, as the nicotine will keep it moist afterwards. Before finishing with your query, I beg to make a suggestion. Would not a tuft of asbestos fibre improve the working arrangements, and do away with the cotton-wool? It could be easily cleaned by being held in the flame of a candle or gas-jet.

J. Pawsey.

[72204.]—**Star-Maps.**—Lubbock's are the best maps I know. They are out of print; but you will probably get a copy from a dealer in scientific books—such as Clay, of Edinburgh—for about 25s.

Sm.

[72204.]—**Star-Maps.**—There are so many good star atlases published nowadays of so many different styles, and on so many different principles, that in order to select one it is absolutely necessary to know the precise way in which the querist wishes to use it. If he merely desires to become acquainted with the configurations of the constellations, the map selected should be as free from names, designs, and letters as possible. Gall and Inglis published two such, a shilling each, one ("An Easy Guide to the Constellations") having small separate maps for each constellation, and the other containing the whole of the heavens in four maps. Neither of these give the Greek letters of the stars; but for the purpose I have mentioned these would only be in the way. Director, R.R.L.

[72204.]—**Star-Maps.**—I do not think your correspondent can do better than obtain a set of "Charts of the Constellations," by Arthur Cottam, F.R.A.S., published by Stanford. These consist of a separate map to each constellation (with the exception of some of the smaller ones, where two are included in one map), and have the additional advantage of having the naked-eye stars in the surrounding constellations given for purposes of identification. They include all the stars contained in Lord Crawford's "Summary of the Dorpat Catalogue," all the Pulkowa stars, and a large selection from Burnham's lists, the principal nebulæ of Messier and the two Herschels, and all the variable stars mentioned in "Celestial Objects." Being drawn to a large scale, they are very plain and easy to use, and I have found them most valuable accessories to my micrometrical work.

Kenneth J. Tarrant.

Bushey Heath, Aug. 29.

[72204.] — **Star - Maps.** — Perhaps if Harris Tothill wants to learn the constellations from the grotesque forms of men and beasts, which they are supposed to represent, and which are in many cases of great assistance, Middleton's "Celestial Atlas, with Corresponding Blank Maps of the Stars only," would suit him. These show all the stars visible to the naked eye in Great Britain—that is, from the 1st to the 6th mag., and many nebulæ. They consist of one map of the North circumpolar stars, and four for the seasons—all rectangular. Opposite to each is a map showing the stars on the same scale, white on a black ground, without any outlines, letters, or figures—in fact, as they appear to the eye in the heavens. The R.A. and Dec. are for 1840. The price is 12s. 6d. plain, 15s. coloured, published by Whittaker and Co. and Jarrold and Sons. A companion to the same, describing each constellation, is to be had for a small sum. There is also an easy "Guide to the Constellations," published by Gall and Inglis, price 1s., which might be of some help; but it is not nearly so complete as the former. G. G. B.

[72205.]—**Astronomical.**—You will find all about it in any small primer of the science—say "Elementary Lessons in Astronomy," by Lockyer, published by Macmillan, price 3s. 6d. Sm.

[72207.]—**Arc Lamps.**—There are the Brush, Thomson-Houston, Brockie-Pell, Siemens, Pilsen, Planet, and a whole host of others, that work with continuous currents. The Brockie-Pell and Siemens will work with alternating currents. Those that work with alternating currents generally work with both. F. C. Allsop.

[72208.]—**Harmless Smoking?**—What can Mr. W. E. Smith mean? Three grains of pyrogallic acid would be a certainly fatal dose for the strongest man, as no antidote is known. This is hardly the substance to try such experiments with. As this poison has much the same action on the heart, &c., as phosphorus has, it is not likely that the fumes could be harmless. D. P. G.

[72209.]—**Marking Sheets.**—How will a stencil plate and tar-brush suit you? Sm.

[72210.]—**Noise in Telephone.**—You do not say what sort of telephone yours is. If you have a microphone the noise is probably caused by excess of battery power. Too much battery power will often cause a microphone to sing. Very often a microphone will sing from apparently no cause whatever, and when this is the case a tap on the diaphragm of the microphone will cause it to stop.

165, Queen Victoria-street. F. C. Allsop.

[72210.]—**Noise in Telephone.**—To Mr. Bottone.—The following are among the probable causes of the "sizzling" noise in your telephones: —battery current too strong; adjustment-screw too loose; adjustment-screw too tight; roughness or rust on the diaphragm opposite the magnet; dust between the carbon and platinum—this can be removed by drawing a piece of smooth writing paper between these two. Faults in soldering fine wire connections will sometimes give rise to "sizzling," so will also currents flowing in an adjacent wire. S. Bottone.

[72212.]—**Scroll Chucks.**—Scroll chucks are far inferior to key chucks in holding power, in fact the grip is feeble. But even a key chuck will not hold a cylinder whilst it is being bored, you must bolt it to a face place. I have found no want of accuracy in American chucks, and I have used them from 2½in. up to 18in. diameter. Sm.

[72212.]—**American Scroll Chucks.**—Having used these chucks for model, cycle, and general engineering work, I have come to the conclusion that their self-centring qualities are not to be relied on. Last year I turned a large number of ball cones for cycle-hubs, but I always had to mark the work so as to insure its going back into its original position if, after taking it out of the chuck, it should require returning. For boring model cylinders up to ¾in. bore, ¾in. stroke, they do very well, but on larger cylinders they lack rigidity and holding power. For such things as cylinder covers, loco. wheels, pistons, pulleys, and cycle-hub flanges, they are first-rate. They are also very handy when fitted with a double set of jaws, i.e. inside and outside, because with the inside or drill jaws you can turn up boiler fittings, nuts, bolts, and rivets for models, etc. For turning cylinders of 1½in. stroke and upwards, also eccentrics, I prefer an independent four-jawed chuck, these being very rigid and hold very firmly. If you must have a self-centring chuck, get a combination one, like the "Horton" or the "Skinner,"—these are both self-centring and independent. The lever scroll chuck holds considerably better and firmer than those with the key, when one has learnt the knack of working it; but when one has not done so there is no other chuck that can give so much trouble and annoyance.

A. F. Shakespear.

[72213.]—**Flow of Water.**—The size you name will give 3,375,000c.ft. of water, equal to 5,625c.ft. per minute for 10 hours. If used in a hydraulic engine at the pressure you name, each cubic foot per minute would give 2,240 × 144 ÷ 33,000 = $\frac{9}{10}$ theoretical horse-power, or an actual of probably $\frac{6}{10}$. You would consequently require 1,000 ÷ $\frac{6}{10}$ = 1,666c.ft. per minute for the 1,000H.P. But how are you going to obtain the pressure?

Bristol. T. C.

[72214.]—**Preserving Decoctions of Herbs.** —If you won't use spirit, try carbolic acid 1 per 1,000; besides this, bottle immediately after boiling and keep well corked. B. Sc.

Plymouth.

[72214.]—**Preserving Decoctions of Herbs.**—Salicylic acid, used in very small quantity, would probably have a beneficial effect. It costs about 1s. an oz., but is extremely light, so that 1oz. means a good-sized bottle full. Director R.R.L.

[72214.] — **Herbs.**—Thoroughly cleanse the bottles with boiling water, and having put in your boiled infusion, raise the temperature again till nearly boiling, keep thus for ten minutes, and cork tightly. The corks must have been well boiled, and covered with parchment paper. Sm.

[72216.]—**Lubricating Pistons of Cornet.**—Use no lubricant except that supplied by nature from the mouth. Simple.

[72216.]—**Lubricating Pistons of Cornet.**—Get an old silk pocket-handkerchief, rub off every vestige of grease from your pistons, dip them in clean cold water (or, this failing, in hot water), replace the piston dripping with water, and play away as fast as you please. Do it again and again, and you will succeed fully. Grease is the enemy you have to fight, deposited about the pistons from the breath. Wm. Hosken.

[72216.]—**Cornet.**—Do not lubricate the pistons. Keep them clean. Brass work should not be oiled unless you get an oil absolutely free from acid. Even then there is no necessity for its use. Sm.

[72217.]—**Publishing Mechanical Drawir** —"Giovi" does not give sufficient informati He should say how many copies he requires of e drawing. Most probably the cheapest way wo be to have them photographed and lithograph but if he requires them to be printed in a let press machine, the zinc "process" block will be best as well as the cheapest. A "process" bl 12 by 6½in. would probably cost about 30s.

*Advertiser* Office, Ulverston. Photo

[72220.]—**Eyesight.**—In any circumstances y ought to get glasses of different focal lengths.

Plymouth. B. Sc.

[72220.]—**Eyesight.** —If the patient lived

London, I should advise him, if it is too expensive for him to consult a specialist privately, to go to Moorfields, or Royal Westminster Ophthalmic Hospital, where he would have his retina examined and his vision thoroughly tested, which does not seem to have been done. The affection would certainly be capable of explanation after proper examination of the media and retina. INNOMINATE.

[72220.]—**Eyesight.**—This query concerns a subject of importance, I believe, to many of your readers. My own sight is almost identical in its defects with those described by "E. M." A friend of mine is afflicted in the same way. An eminent oculist prescribed glasses which have enabled him to see very well, but he finds the short sight of one eye is nevertheless increasing. The longer-sighted eye, both in his case and mine, is also astigmatic to a serious extent. The important question with sufferers from this affection of the sight is how to prevent it from increasing. In my own case the astigmatism of the eye is, to a great extent, controllable at will; but whenever one eye is in use the other is out of focus, and at no time can I get the two images to coincide. A. W. DOBBY.

[72221.]—**Specks Before the Eyes.**—"Bad Sight" had better not worry about the specks, unless there is some other symptom. Muscæ volitantes are very troublesome, though as a rule they do not indicate any serious mischief.
INNOMINATE.

[72225.]—**Trisecting an Angle.**—There are two ways of trisecting an angle, described in the first volume of *Knowledge*—one in the No. for Dec. 9, 1881, and the other in that for Dec. 23 the same year. X. Y. Z.

[72227.]—**Imitation Rock or Coral.**—Red sealing-wax dissolved in alcohol. SM.

[72227.]—**Imitation Rock or Coral.**—Arrange some cinders into the shape of rocks, &c., fixing them into place by means of glue; then give them a coating of coral varnish, made by dissolving sealing-wax in spirits of wine by means of a gentle heat. J. PAWSEY.

[72227.]—**Imitation Rock or Coral.**—Powdered sealing-wax of the required colour, allowed to dissolve in spirits of wine till it forms a thick paint, and then laid on in successive coats with a brush, makes the best imitation with which I am acquainted. The basis of the "rock" should be rough pieces of hard coke, the "coral" stout branchy twigs; they can be attached to the woodwork by strong glue or fine wire. If the last coating on the rock be lightly sprinkled with silver sand from a pepper caster, the effect is increased.
B. HARCOURT.

[72228.]—**Logarithms.**—Mr. Webb puts rather a severe test on a table of six-figure logarithms when he uses them to obtain the eighth power of 88. Still, even then surely there is a "real advantage" in using them when the enormous labour required in performing the operation by ordinary arithmetic is considered. In the majority of cases of ordinary occurrence, $3{\cdot}5963474 \times 10^{15}$ is quite near enough when dealing with such large numbers. The error is 1 in 1⅔ million—a very small percentage. I should advise him to expend 4s. 6d. in the new edition of Chambers' seven-figure logarithms, if he has much occasion to use them.
DIRECTOR, R.R.L.

[72228.]—**Logarithms.**—The number you say they give you is within 2½ millionths of the truth; and this is actually nearer than you have, on the average, a right to expect from six-figure ones.

| | |
|---|---|
| Log. gives .. .. | 3596,3636,0000,0000 |
| True number .. | 3596,3452,4805,5296 |
| Difference .. .. | 83,5194,4704 |

Generally, where the number begins with lower figures than 43, you may expect as many figures correct as the logarithm has decimal places, but one figure less when it begins above 43. Though you have here but five figures true, the error really begins only in the seventh. E. L. G.

[72228.]—**Logarithms.**—There is no table of logarithms in existence that would enable one to find the 8th power of 88 correct to every figure. Tables of logarithms are invaluable for facilitating and performing calculations when greater exactitude than the correctness of the first five or six significant figures is not required. To find the 8th power of 88 correct to every figure would require a table of 16-figure logarithms instead of six-figure merely; and even then there is a doubt that there would be absolute correctness, unless the numbers themselves (or the anti-logarithms) were of corresponding length. It must be recollected that a six-figure table merely contains the nearest approach to correctness that can be conveyed in six-figures; consequently, there is always a slight error. In the instance quoted by Mr. Webb there is an error if we take the final figure of the logarithm as correct. A 7-fig. table gives ·9444827 as the log. of 88, whilst a 6-fig. table necessarily gives the last figure as 3. Now, in multiplying by 8, in order to get the 8th power, this error is made 8 times greater, and an additional figure made unreliable. Consequently a 6-figure table of logarithms will only enable us to find the first five figures of the 8th power of 88. If, instead of the 8th power, Mr. Webb had tried for the 80th power, he would have got only four figures correct; 800th power, only three figures correct: and so on. T. S. B.

[72230.]—**Cataract: Eserin Lotion.**—Very probably the oculist discovered symptoms of that terrible affection of the eyeball called glaucoma. Eserin is given to cause contraction of the pupil, and so to allow the watery humours of the eye to escape through their proper channels. If for any reason they did not become absorbed quickly enough, the eye would be hopelessly lost—in some cases in a few hours. The only chance of saving it under these circumstances is to have the operation of iridectomy performed. INNOMINATE.

[72230.]—**Cataract.—Eserine Lotion.**—Eserine is the alkaloid of calabar bean, and the effect, dropped into the eye, is antimydriatic, or to contract the pupil. If it is the case that your wife has cataract, why should she object to the usual operation? Let her ask anyone who has undergone it, and she will be told that it is a mere nothing at all. She must be very nervous and foolish also to prefer blindness to that. B. Sc.
Plymouth.

[72230.]—**Eserine.**—Eserine is a remedy for enlargement of the pupil, and prevents suppuration of the cornea. It is used in presbyopia, ocular neuralgia, and corneal ulcers. Also in glaucoma and staphyloma, I hope you will now feel easier in your mind. SM.

[72231.]—**Machinery.**—Use plenty of flat timber packing, and then jack boiler up or down. Leave shear legs alone, and you will soon jack the things into place.
Bristol. T. C.

[72233.]—**Tisane.**—There is a French tisane composed of sulphate of sodium, senna, coriander, aniseed, and citron—an infusion and probably the one alluded to by "Sutarg." SOLANUM.

[72233.]—**Tisane.**—Tisane aux quatre herbes is an infusion of 12 parts of the following to 1,000 of boiling water, adding 60 parts syrup, if desired. Fleurs de mauve, pied de chat, pas d'ane, petales de coquelicot, fleurs de bouillon blanc, guimaure, violettes, *a, a*.
Plymouth. B.Sc.

[72234.]—**Electro-Motor.**—If the current can pass when one of the brushes is removed, it is a sure sign that there is electrical leakage somewhere—that is, if the two electro-magnets are properly connected up—viz., from one battery terminal to one wire of fixed magnet, then from second wire of fixed magnet to first brush, from first brush to first wire of rotating magnet, from second wire of movable magnet to second brush, and lastly, from second brush to second battery terminal.
S. BOTTONE.

[72235.]—**Boiler.**—The cheapest and easiest way is to buy parts of one of the model makers who advertise in the "E. M." They will cost about fourteen shillings, fittings will cost another twenty-five, pressure gauge another twenty. The ready-made article will cost from sixty to sixty-five shillings with pressure gauge. A. F. SHAKESPEAR.

[72235.]—**Boiler.**—Make a vertical copper boiler, 20in. high, and 10in. diam.; put in one flue 2¾in. diam., set the grate at a distance of about 3¼in. from the floor, with wide firebars—say about 1¼in. apart. Braze all the seams, and the boiler will burn coal, and raise sufficient steam to drive an engine well. At least, I have a boiler nearly this size, which burns coal and steams well. Further particulars can be given if desired. J. A.

[72238.]—**Cleaning Daniell Batteries.**—Make a little mop of flannel tied on the end of a stick with copper wire. Dip this in strong oil of vitriol, rub over the corroded and greened coppers, then wash in running water; lastly, sandpaper up. The E.M.F. of the Daniell is rather more than 1 volt, so that, theoretically, the six cells should light a 6-volt lamp. But the internal resistance of these cells is very great, so that you will probably not be able to light a lamp having greater voltage than 3 or at most 4 volts. S. BOTTONE.

[72239.]—**Strain.**—The strain on spokes is tension only, and you can safely reckon on ¼ the spokes (after deducting the holes for rivets or bolts). This would be $5 \times (1\frac{3}{4} - \text{say}, \frac{1}{2}) \times \frac{3}{8} = 2\frac{1}{3}$sq.in., at 5 tons per inch $= 11\frac{2}{3}$ tons. Speed will not affect it.
Bristol. T. C.

[72240.]—**Writing with the Foot.**—Fit a thimble to the toe, and solder a penholder to it in a convenient position. GLATTON.

[72240.]—**Writing with Foot.**—Hold the pen or pencil between first and second toe. I can write with a pencil whilst sitting in a chair, but it wants practice to make small letters. SM.

[72241.]—**Magnolia Metal.**—Your correspondent "Eos" would do well to put himself in communication. We are the only makers of magnolia metal, and could better verbally give him all the information he requires rather than through the post. We have good reason to believe "magnolia" would be suitable for the purpose mentioned by your correspondent.
W. E. WATSON, Sec.
The Magnolia Anti-Friction Metal Co. of
Great Britain.

[72242.]—**Photographs on Tin.**—Merly the old wet positive collodion process on ferrotype plates. How do you find dry-plate methods expensive? I was under the impression that it was the other way about—no nitrate of silver or collodion to buy.
SM.

[72242.]—**Photographs on Tin.**—"Dry Plate" evidently means the old ferrotype process, and will require both developing and fixing solutions, all of which he can easily make himself. If he will publish his address, I will send him all the particulars. It would take up too much valuable space to describe otherwise. SIMPLE.

[72242.]—**Photographs on Tin.**—The so-called "tintypes," or ferrotypes, as they are called in England, are thin iron plates, sold already enamelled with a deep brown or black japan. To take a picture on these requires a considerable knowledge of the wet collodion process. The plate is first covered with iodised collodion by holding in the left hand by one corner and pouring a pool of collodion from a bottle in the right hand; the excess is poured back into the bottle and drained off at the lower corners. When the collodion has set along the lower edge of plate the plate is immersed (in the dark room) into a bath of nitrate of silver in water, 7 per cent., until all oil streaks disappear. The plate is then placed in camera and exposed; and then, on returning to dark room, developed with a developing solution made of sulphate of iron, 120gr.; water, 4oz.; acetic, 2dr.; alcohol, 2dr. After being developed and washed the picture is fixed with hyposulphite, and well washed with water. As collodion, though very tender to the finger, is very resistent to heat, the picture can be rapidly dried by holding before the fire. It is now ready for mounting in frame, which is usually a glazed "preserver." S. BOTTONE.

[72243.]—**Candle-Power.**—The spot can be conveniently viewed at an angle of about 45°. The ordinary fish-tail burner, consuming 5c.ft. of gas per hour, gives about 13 candle-power. The actual light varies with the quality of the gas. Your opinion of the flame of candle as compared to gas is correct in the ordinary form of burner, where there is insufficient supply of air-centre of flame to insure sufficient combustion; but by inserting certain bodies in the flame, and properly feeding the flame with oxygen, the gas flame may be made to give as compact a light as a candle—nay, even more. The wavering and flickering of gas flame, by shifting the shadows and apparently displacing the images, tires the eyes by the constant and wearisome efforts they make to catch the moving images. The electric light, especially the arc light, affects some people, producing headache; but this occurs mostly with *malades imaginaires*. S. BOTTONE.

[72244.]—**L. and N.W. Locos.**—I suppose "Locomotive" must mean Ramsbottom's six-coupled saddle tank shunting engines (1750 class), diam. of wheels, 4ft. 3in.; cylinders, 17in. by 24in.; or else Webb's 689 class, same as above, but with cylinders 17in. by 20in. Both classes have a few engines built with very low funnels and domes, to enable them to enter low-roofed goods stations, otherwise they are the same as the rest of the two classes. There is also a class (2453) used in Crewe Works yard with dome and chimney combined. Diam. of wheels (four, all coupled), 2ft. 6in.; cylinders, 9in. by 12in. NORTH-WESTERN.

[72246.]—**Solenoid.**—To make such a solenoid to work with as little battery power as possible, I should use a hollow soft iron cylinder for a core, about 2in. internal diam., and 10in. long. If this were wound with 4lb. No. 15, and actuated with 5 pints chromic-acid cells, you will do what you require. S. BOTTONE.

[72248.]—**Prehistoric Man.**—If "Geologist" is agreeable, I do not suppose that the editor could find the necessary space. Get Lyell's "Antiquity of Man." It is a standard work, to be found in most libraries. SM.

[72249.]—**Coil.**—Iron wire bundle, 3in. long, ⅜in. diam., size of head 1¾in. diam., primary, two layers No. 20, silk covered; secondary, ¼lb. No. 38; condenser, 25 sheets tinfoil, 2½ × 2.
S. BOTTONE.

[72250.]—**Old Batteries.**—The carbons and zincs must be dismounted. The former should be allowed to steep in plain water for a week, changing water every day, and lastly dried off by baking in an oven. The zinc should be washed with an old brush dipped in dilute sulphuric acid (1 of acid to 12 of water), and then reamalgamated by rubbing over with mercury, and lastly washed, and reared up, to dry.

S. Bottone.

[72250.]—**Old Batteries.**—I have found that zinc plates, such as you speak of, are best scraped until they present a uniform silvered appearance. The carbons can be well washed in hot soda-water, care being taken not to let them fall or knock against one another, or else they will, in 99 times out of every 100, break. Do not forget to amalgamate the zincs before replacing them in the cells.

J. Pawsey.

[72251.]—**Noisy Tap.**—The pressure in the pipes forcing the water through an aperture sets up vibration of some movable part. Sm.

[72251.]—**Noisy Water-Tap.** — The rubber washer is probably split; if not, reverse it, or put in a new one.

Bristol. T. C.

[72253.]—**Chemical Action in Battery.**—The elements are zinc, carbon, sodium chloride, and water, which become zinc chloride, carbon, sodium hydrate, and hydrogen, through a preliminary change of hydrochloric acid; thus—

$Zn + C + 2NaCl + 2H_2O = Zn + C + 2NaOH + 2HCl.$

Then— $Zn + 2HCl = ZnCl_2 + H_2.$ Sm.

[72254.]—**Springs of Yellow Metal.**—Brass, or even copper, makes good springs, when hammered, rolled, or drawn hard. It is not so stiff as steel, however. Glatton.

[72254.]—**Springs of Yellow Metal.**—Perhaps "Delta" metal would do. I have had no experience with it; but it contains iron. I think it is made by Wood, of Bermondsey. Sm.

[72254.]—**Springs of Yellow Metal.**—Both good tough yellow metal wire and phosphor bronze wire can be drawn very hard, and stand well for springs if kept out of the way of gas, acid vapours, and heat, but must be coiled up as drawn. I have drawn it so hard that it has been equal to steel otherwise. The gold springs for dentists' work are drawn very hard, and stand well.

Jack of All Trades.

[72255.]—**Zinc in Powder.**—Ignite zinc oxide in a current of hydrogen. Sm.

[72259.]—**Viol d'Amour.**—The viol d'amour is practically obsolete. Berlioz, however, in his book on "Instrumentation," treats of it, and says that "it would really be a great pity to allow this choice instrument to become lost; upon which any violinist might learn to play, by a few weeks' practice. I believe there has recently been in musical circles some talk of reviving it. It was somewhat larger than the viola, and had seven gut strings, the three lowest being wired. In unison with these respectively were seven metal strings, below the neck and passing underneath the bridge, which strings, by sympathetic vibration, produced resonances of a very agreeable character. It was not tuned invariably in the same way; but Berlioz gives the "most simple and most rational way." Its compass was at least three octaves and a half, and was written, like the viola, on the Do and Sol clefs. It was peculiarly adapted to chord and arpeggio playing, and was rich in harmonics—those of the arpeggio on the open strings being of great beauty.

C. J. Tahourdin.

[72261.]—**Rectification of Elliptic Orbits.**—In binary star orbits the elements of the real ellipse may be derived from the apparent ellipse either by the graphical method, or by an analytical process (of which there are several). The graphical method is fully described—with an example worked out—in the "Handbook of Double Stars," by Messrs. Crossley, Gledhill, and Wilson. It is a very convenient method, but requires some careful drawing, and is, perhaps, only well suited for those who have had the training and experience of a draughtsman. The most convenient analytical process I know of is that devised by Prof. Glasenapp, the distinguished director of the Imperial Observatory at St. Petersburg. This method (which will be found fully described in the *Monthly Notices* of the R.A.S. for March, 1889) depends upon the determination of the numerical values of the co-efficients in the general equation of the second degree

$$a x + b y + c x^2 + d x y + e y^2 + 1 = 0 \text{ ........ } (1)$$

where $x$ and $y$ are the rectangular co-ordinates of the companion star with reference to the principal star which coincides with the origin of co-ordinates. Putting $y = o$ in this equation, we have the quadratic

$$a x + c x^2 + 1 = 0 \text{ ................ } (2)$$

Now the roots of this equation are the co-ordinates of the two points where the apparent ellipse intersects the axis of $x$. Measuring these by scale on the drawings of the apparent ellipse, we obtain numerical values of $a$ and $c$ from equation (2). Again, putting $x = 0$ in equation (1), we have the quadratic

$$b y + e y^2 + 1 = 0$$

for which we may similarly obtain values for $b$ and $e$. The values thus found for $a$, $b$, $c$, and $e$, being substituted in the original equation (1), we obtain the value $d$ (by taking the co-ordinates of a fifth point on the curve). The relations between these co-efficients and the elements of the true orbit are then given by very elegant formulæ due to the late Russian astronomer, M. Kowalsky. (These I will be happy to give "W. S." should he care for them.) In both the graphical and analytical methods the first—and indeed the most important—thing to be done is to draw the most probable apparent ellipse as accurately as possible. This is done by Sir John Herschel's method of plotting the measures of position angle and the epochs on paper ruled in fine squares, and drawing an interpolating curve through them. From this curve we obtain the radius vector for a series of position angles differing by 10°, on the principle that equal areas are described in equal times, a law which holds good for the apparent as well as the real ellipse. This part of the process—the drawing of the apparent ellipse—is perhaps the most difficult, and requires much skill, patience, and experience. When I first commenced the computation of binary star orbits I employed the graphical method, but have now discarded it for Prof. Glasenapp's method, which is less troublesome and much more rapid. The points of nearest approach and furthest recession can only lie in the same straight line when the plane of the orbit is at right angles to the line of sight (that is, when the apparent and real orbits coincide)—a case of very rare occurrence. These points in the visible ellipse are, of course, merely apparent, not real.

J. E. Gore.

# UNANSWERED QUERIES.

*The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.*

Since our last A. F. Shakespear has replied to 71705; "Glatton," 71729, 71735, 71738, 71753, 71772, 71781, 71860, 71864, 71902.

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| 01971. | Fan, 475. |

The average consumption of meat in Australia by each inhabitant is equal to 276lb. per annum, or over ¾lb. of meat every day of the year by each man, woman, and child.

There are, it seems, 16 merchant steamers having a speed of 19 knots and above. Of these 12 are under the British flag, one under the French, the *Calais Douvres* belonging to the London, Chatham, and Dover Railway Company, and three under the German. There were built in the whole world in 1889, 1,090 vessels, having a tonnage of 1,502,629. Of this total 656, with a tonnage of 1,180,346, were built in Great Britain.

The *Journal* of the Chemical Society for August gives an abstract of a paper on the "Chemistry of Storage Batteries," by E. Frankland. The author describes some experiments undertaken with a view to ascertain what lead compounds actually take part in the chemical reactions on charging and discharging secondary batteries. The experiments seem to explain the practical observation that only half as much active material is required on negative as on positive plates.

**Hop Tea.**—The new industry just introduced into Kent for the curing of hops by a special process with a view to their admixture with tea, has during the past week attracted a great amount of attention, and the works at Maidstone have been visited by large numbers of persons interested in the hop and tea industries, including Mr. Alderman C. Whitehead, agricultural adviser to the Privy Council. It is stated that an infusion of dried hops with the Ceylon and Indian teas would counteract their irritant tendency, while the characteristics of taste, smell, and flavour would remain.

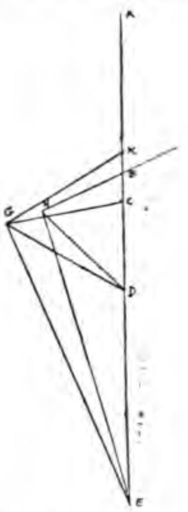
# QUERIES.

[72262.]—**Guinea Fowls.**—Would some me what is the matter with my Guinea fowls' are very scurvy and sore. The fowls eat we can hardly walk. Have kept them on dry not in the damp. Give them wheat and mi turkeys. Have lost a good many with it. thankful to know what it is, and the cause there is anything I can do for it.—Thankful.

[72263.]—**Japanned Wire.**—Can any of y inform me how to japan iron wire?—same a and quite as fine finish. In using a brush, it wire streaky and in patches.—A. A. A.

[72264.]—**Gramme Dynamo.**—To Mr. I am making a Gramme dynamo of 150 c.p. 59-volt lamps. According to my calculation require 1¾lb. No. 20 B.W.G. wire on the arn 13lb. No. 24 B.W.G. on the poles. Will you form me if this will answer in practice with machine?—Gramo.

[72265.] — **Geometrical Demonstra** should be much obliged if some reader could with a geometrical demonstration (by means propositions and postulates) of the following



G K D is an equilateral triangle, K C is one- D; join G C. Produce D K to A, so that A D. Produce A D to E, and draw G E, makin triangle C G E. Let H be a point, so that H E or C E. Through the three points A, H, and circle, of which F is the centre. Join H F, c at B. Prove that H D equals B D.—Theorem.

[72266.]—**Battery Solutions.**—I have a is very low in S.G. 1160; the plates being g What detriment is there in having a cell or cell a low S.G.?—Wireman.

[72267.]—**Chemistry.**—Can any reader te book on the chemical action of electric currents substances?—H.

[72268.]—**Turning Spirals in Wood.** much like to know how the single and double wood are turned? Some, I notice, you can s between the spirals. A description of the appliances used would oblige.—Carino.

[72269.]—**Donkey Pump.**—Would Mr. S kindly give in the "E. M." a sketch show would arrange his donkey pump, so as to be self A sketch of the "Dreadnought" class of eng L.N. and W. would oblige.—W. B.

[72270.]—**Calculating Brake H.P.**—I sh if anyone can give me a simple formulæ for the brake H.P. (of any engine), which does not the rigging up of friction blocks, as with the Pro I believe there is a simple method of just pas piece of belting over a flywheel, and weights on to one end of the belt, while the other end to a spring balance which is fixed to the floor.—

[72271.]—**Tempering Drills.**—Would kindly give instructions how to temper drills fo jobbing-work?—Amateur.

[72272.]—**Tool-Cutting.**—Wishing to fill time of an evening at bookbinder's tool-cutti any kind reader tell me the tools that are requi is there any book that I could get some informa —D. W.

[72273.]—**Corrosion in Water Pipes.** any way to clear water pipes that are badly We have some 3in. pipes that have barely through, owing to the corrosion. Is it possibl them with any chemical that will have the de of removing the rust? I have tried filling one ash and find it ineffective. Can any of your form me of any composition, chemical or appliance that will get us out of the difficulty? thankful for hints from any of your numerous to the best method to adopt.—J. D.

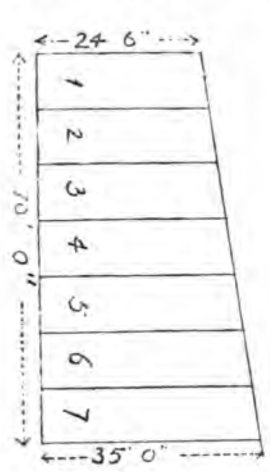
[72274.]—**Intermittent Streams in En** Could any of your kind readers give me informa the intermittent streams of England or elsewhe is a stream near Tenby, I believe, which flow years, and also one at Croydon. I should like ledge about them. I presume their cause o similar to the annual flooding which take quarries in the old green sandstone, because months to soak through the ground in that fo Geo. Hygiene.

.]—**Photo. Micrography.**—Having made fair as an amateur photographer, I should like to try l at the above. Will someone please advise me llowing? What kind of object lens and condenser ed for getting photos. of liquid specimens (milk, &c.)? Having a very limited purse, I should only e lenses, and fit the remainder up myself. Is ns only required for the microscope? How are kept on the slide when the microscope is in a al position? Any elementary information will -G. T. B.

.]—**Battery Life.**—I am a medical man, and t bell is worked by four Leclanché cells. How know when the cells require attention? It would awkward if the bell ceased to ring upon the f an important message. I use lithanode cells ing purposes, and am charmed with them. I use and a graduated resistance of platinoid wire. uses the following phenomena? About a minute or less—after the lamp is properly lighted the y suddenly decreases, and a short time afterwards t will brighten up again, and perhaps exceed its brilliancy.—CHIRURGO.

.]—**Grandfather's Clock.**—I have a very old l would feel obliged if any reader can tell me the eaning of the two pointers there are in front of ed part showing phases of the moon? They are y connected with the works. I have asked one watchmakers, but they could not tell me.—

.]—**Division of Land.**—How can I divide e of land into seven plots, as shown, so that each



s the same number of superficial feet?—TEE

.]—**Finder.**—Will any reader give diameter and ngths of lenses for finder for telescope of 2·75in. e, also size and position of diaphragms?—W. IEN.

.]—**Acute Rhinitis.**—Attention being called cure of bronchial catarrh, those readers may be give me some assistance in my almost similar . I have had it now on and off for two years, it g only to a long sea voyage. That remedy being ent impossible. I should be glad of any method ment likely to effect a cure. The symptoms are al sneezing, a discharge of warm, clear water from ad, and extreme exhaustion. Have consulted l men and attended a hospital, but have found enefit, and great expense. Will gladly give further lars if necessary.—ATHLETE.

1.]—**Moulding and Casting.**—Is there any-ong "our" readers who can inform me how to mould st small fine work in brass or bronze, so that the s come out of the mould clean and sharp, almost tamped? I can manage any rough sort of casting, annot make a success of the small fine work in n. The sand does not take the impression of the details. I shall be much obliged for any really al information, and will obtain any book, or ise address, or, in fact, do anything that may be ary to enable me to obtain the information asked hich would be of great service to me.—AJAX.

82.]—**Home-Brewed Beer.**—Will anyone give tructions how to brew 18 galls. good beer?—the quan- f malt and hops, how long to boil, and the most mical utensils for the same? Or refer me to back ers, or give me the name of a pamphlet on the sub- —E. A. THOMAS.

83.]—**Salt-Pans.**—Can any reader oblige me with ription of the iron pans used, I believe, at Saltcoats, otland, and probably elsewhere, for obtaining salt e evaporation of sea-water? I should like to learn apparatus I would require to turn out, say, 1 ton of er diem., with wood as a fuel?—HERMIT.

84.]—**Cement-Kiln.**—Can any reader favour me the dimensions of a kiln to burn cement, with wood fuel? I am told such a kiln would require to be d differently from the ordinary ones which burn I wish to build a kiln to turn out 5 to 10 tons of t, where coal is an expensive article, and wood very .—HERMIT.

85.]—**Galvanised Iron Water Cisterns.**— galvanised iron cisterns unwholesome for drinking r? Mr. Hellyer so states in his work, and I have l others hold the same opinion. Dr. Sedgwick ders says: "In H.M. Navy, the water-tanks are not nised, it having been found that with galvanised s the water becomes impregnated with zinc." And galvanised cisterns are in very general use for the ge of drinking water, and many people suppose them to be harmless. Any information from those who have a special knowledge of such matters would greatly oblige. —J. A. D.

[72286.]—**Electro-Coppering.**—Will any of "ours" furnish me with any particulars as to electro-coppering a surface of cast-iron, some 4 or 5sq.ft. in area? What would be the cost, power, &c.? The cast iron would previously be ground, and copper surface require to be 1-16in. thick.—W. STRAFFORD.

[72287.]—**Fiddle of Neil Gow's.**—Can any of "ours" inform me as to the value of a fiddle which belonged to Neil Gow, and which bears the inscription, "This fiddle belonged to Neil Gow," and upon which he played before the Duke and Duchess of Athol and Robert Burns? It is in good order, and has a splendid tone.—W. STRAFFORD.

[72288.]—**Sugar-Coating Sweets.**—Will any kind reader tell me how to sugar-coat medicated sweets?—MAUD.

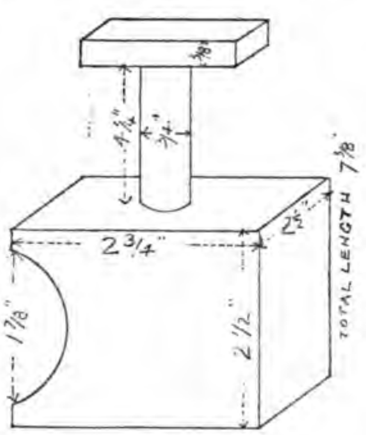
[72289.]—**Troughton's Reflecting Circle.**—I understand that Troughton's reflecting circle has been improved by, I believe, Mendoza y Rios. Would anyone state what these improvements are? I might say that I have a knowledge of Troughton's reflecting circle.—C. SHORTEN.

[72290.]—**Pressure.**—I have a cylinder of cast-steel 6in. high, and 6in. internal diameter, ½in. thick, fitted with steam-tight piston. At what pressure would it be safe to work it constantly?—LE VIGNE.

[72291.]—**Electroline.**—Can any of "ours" tell me the nature and use of electroline, introduced by Prof. Marx in 1889?—LE VIGNE.

[72292.]—**Accumulators.**—To MR. BOTTONE.—Will you kindly say if anything else is added to the red lead, sulphuric acid, and water to form a paste for the above plates? Some of our paste falls out of the grids after charging in the shape of dust; also the paste, when mixed, commences to work, and increases in bulk. I should like the formulæ, mode of applying, and after-treatment of a paste which you have found give good results on old plates.—J. S.

[72293.]—**Electrical.**—I have a small set of castings, size as per sketch. Would Mr. Bottone be kind enough to tell me the size and quantity of wire for field-magnets? And what size wire for armature—Siemens H? And what candle-power incandescent lamp would this light driven at 2,000 revs.? And how should the same size castings be wound for shocking purposes?—B. W. B.



[72294.]—**Algebra.**—Will any reader of "E. M." tell me the quickest way of working out the following:—Sum to 12 terms $x^2 + (x - 1)^2 + (x - 2)^2 + \dots\dots$? The books I have do not show the way of working such problems.—NO SIG.

[72295.]—**Menthol.**—Can any correspondent give me the formula of menthol, and its source?—R. W. B.

[72296.]—**Direct-Vision Prism.**—I should be much obliged if "Prismatique" or some other optical correspondent could inform me of an arrangement to use a small direct-vision prism on a reflecting telescope?—the necessary lenses with their foci, and distances between them. Also where I could obtain a cylindrical lens for use with stars.—R. W. B.

[72297.]—**Horses Running Away.**—To "Eos."—When a horse runs away (the driver being in his place with a hold of the reins) on being startled or frightened, is it, as a rule, want of strength to pull hard enough on the reins that prevents him being able to stop the horse? Or would the horse still be able to continue its career, although half-a-dozen men were on the box pulling at the reins, seeing that all the men are aboard the vehicle? A reply would extremely oblige.—NO HORSEMAN.

[72298.]—**Gearing Safeties.**—I have a safety bicycle, and would like to know what it is geared to. Could any reader give me a rule to calculate the same?—IGNORAMUS.

[72299.]—**G.W.R. Locomotives.**—Would some reader give me full dimensions (with sketch, if possible) of the 500 class of goods engines, as rebuilt by Mr. Dean, Mr. Dean's 2348 (goods) class? Also his four-coupled outside framed passenger engines 1889.—NORTH WESTERN.

[72300.]—**Steam Coil for Dryers.**—I want to erect drying closet for laundry. I have tried ordinary 4in. cast-iron hot water pipe, socket joint, made with cast-iron borings, at a pressure of 25lb., but the sockets split. Could any kind reader tell me the cause, and what thickness of pipe and sockets I should require to stand the expansion and pressure of 25lb. steam?—ANXIOUS.

[72301.]—**Papermaking.**—Will any reader kindly say best plan for keeping clean the surface of cylinder of a single-cylinder papermaking machine? The cylinder gets dirty at several places, with a white substance sticking to it when in contact with the pulp. Any information will greatly oblige.—MACHINEMAN.

[72302.]—**Observing Chair.**—Would any correspondent favour me with a design for an adjustable observing seat, to be used out of doors with a refractor?—T. D.

[72303.]—**Kitchener's Pancratic Eyepiece.**—In Chapter XIII. of Kitchener's "Economy of the Eye," Vol. II., there is a description of "The pancratic eyetube, invented by W. Kitchener, M.D., applicable to achromatic and reflecting telescope, and also to microscopes." After giving instructions how to use the instrument, Dr. Kitchener goes on to say, "The pancratic eyetube, I think, gives a better defined image of a fixed star, and shows double stars decidedly more distinct (especially in achromatic, which are a little over-corrected) and perfectly separated than any other eyetube, and I hope will enable us to determine the distances of these objects from each other in a more perfect manner than has been possible heretofore. This eyetube applied to an achromatic of 44in. focus, produces, in the most perfect manner, every intermediate degree of magnifying power between 100 and 400, either for celestial or terrestrial uses, the field of vision continuing uniformly distinct. Therefore, it is presumed that the advantage of my pancratic eyetube over the usual common eyetube in variety of magnifying power—convenience, cheapness, and portability, is as 300 to 1." I beg to ask whether the above statements have been borne out by the testimony of other observers? Also in what respects does this eyepiece differ from the ordinary pancratic or terrestrial eyepiece of the present day?—T. D.

[72304.]—**Vine.**—Would some of "ours" kindly say if the vine is cultivated, and fruit (grapes) ripens out of doors, and where, in England? I do not suppose that wine is made from the grapes, nor is this the question, but only if for table use. Is it true that there is a large grape-bearing vine in Hampton Court Palace garden, and which in the open yields large quantities of ripe fruit?—X.

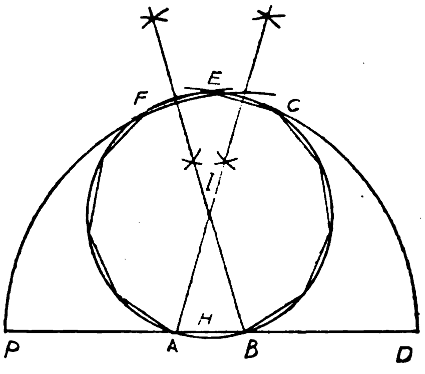
[72305.]—**Moulding and Casting in Metal.**—I should be glad of practical information and instruction in moulding and casting small, fine work (in brass or similar metal). I want the castings to turn out of the mould clean and sharp—almost as if stamped. The chief difficulty I find is in getting the sand to take the impression of small, fine details. My address is advertised in "Address" column.—AJAX.

[72306.]—**Carbonic-Acid Gas.**—What pressure is necessary to compress this gas, as it exhales from the earth, into fluid and into solid carbonic acid? And what are the relative volumes in these three states? What process is employed for compressing, and what are its uses as a gas, a fluid, and a solid? In what way is it retained in the state of a fluid and a solid? I have read that in its solid state it has the appearance of snow, and that Faraday succeeded in producing it in this form; also that it slowly evaporates in the open air, giving out a pressure of 38½ atmospheres at 0 deg. temp., from which quality it was at one time proposed as a means for producing locomotion. I presume its great cost excluded this, for, although exhaling freely in some places as a gas from the earth, its reduction to a solid, or even a fluid state, must necessarily be very expensive.—M.

[72307.]—**Wimshurst Machine.**—Can any reader tell me where there is a failure in the following? The machine is of window-glass 16in. diameter, and made according to instructions and drawings given by Mr. Wimshurst, some years ago, with the exception that originally the plates had 16 sectors of thin brass, 4in. long. It has four Leyden jars 10in. high (bought, as recommended, at Whitefriars Works), filled 4in. inside with brass dust, and coated 3in. outside with tinfoil; neutralising brushes and rods properly arranged, and in good condition; conductors and combs mounted on glass pillars. The whole machine—jars, and all wood-work (which is good mahogany), was well varnished with shellac. As originally made, on turning the handle the machine started immediately in all weathers, and would give great quantities of sparks from either or both conductors an inch long without Leyden jars. On connecting the jars, the machine could not be induced to go beyond a 3in. spark, which, however, was very dense, and gave a loud snap. And if the discharge was taken through the body (as I did once, accidentally), it was something to remember. The sectors were then reduced to 8 in number, and also shortened to 2½in. in length, still keeping them the same distance from hedge of plates (about ½in). The machine will not start itself now, but commences immediately on holding an ebonite penholder (previously rubbed on the coat-sleeve) to one of the brushes. The sparks are now slightly increased in length—about ½in.; but occur by no means so often. Neither does the machine give the same quantity of electricity, though that was only to be expected. What I want to know is, why shouldn't I get a 6 or 7in. spark? The machine has been well-made, and there is no leakage seen in the dark. Are the discharging balls too small? The positive one is ¾in., and the negative 1in. If these are reversed, the machine will not even give 1in. spark.—H. M. S. L.

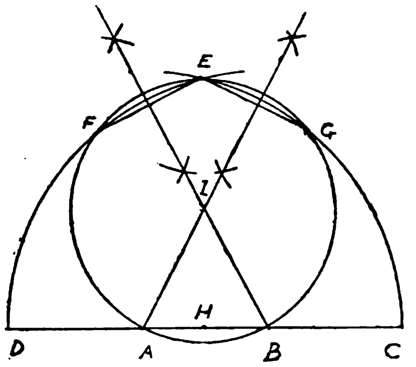
[72308.]—**Dynamo Governors.**—We are about to have a new engine fitted with Hartnell's governors. I wish to know if the magnetic cut-out (Elwell and Parker's) we have in use between dynamo and accumulators will be of any good with this new engine, seeing that it is fitted with delicate governors? Do you think if the governors were arranged to make the engine run, say, at 700 revolutions, and after running the dynamo for a minute or two, to get up magnetism (that is if I could get any at all, seeing that there is no resistance in circuit, if I was to take the magnetic cut-out from circuit), I could with perfect safety switch 53 cells on? Is it possible for the governors to act in time to prevent E.M.F. from cells getting above that being generated from dynamo, and, therefore, converting it into a motor? If you think it a very uncertain thing as regards the above acting, will you kindly explain how it could be worked with magnetic cut-out in circuit and governors speeded to allow engine to run at 700 revolutions per minute? I would rather have the cut-out in circuit, but it won't close without engine running up to 900 revolutions an hour? Is it possible for engine to go at that speed with governors speeded for 700 revolutions?—WIREMAN.

[72309.]—**Septagons, &c.**—Will any of your mathematical readers say if the methods below of drawing septagon and andecagon are theoretically correct? Some textbooks say that polygons the number of whose sides



$$\left.\begin{matrix}H-C\\H-D\end{matrix}\right\} = 3AB \text{ rad. } EF = AB$$

are prime cannot be exactly drawn by compasses, others that "Gauss has shown," &c.; which is correct? Are the two examples according to Gauss's method? What length is A C with regard to base A B for polygons of



$$\left.\begin{matrix}A-C\\B-D\end{matrix}\right\} = 5HB;\ \text{Rad. } EF = AB;\ \text{Biscet } AF, BG$$

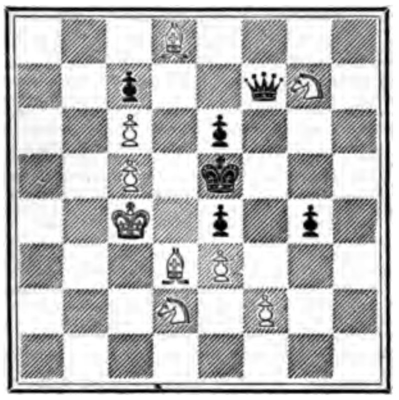
17, 19, 23, &c., sides? I should also be glad to know the approx. diameter for a circle of 360°, the given chord for the same being ¼in. What is the correction for the compass for lat. of London this year, as I want to fix a small sundial true N. and S.?—Ch. J. D.

## CHESS.

All communications for this department must be addressed to "J. Pierce, Knollside, Yawl, Lyme Regis, Dorset."

### PROBLEM MCCXVIII.—By T. A. Pringle.

*Black.*



*White.* [9 + 6

**White to play and mate in three moves.**

Solution to 1216.

| *White.* | *Black.* |
|---|---|
| 1. Kt-Kt sq | 1. P takes Kt (*a*). |
| 2. B-B 4 (ch). | 2. K moves. |
| 3. R or Kt mates. | |
| | (*a*) 1. K takes B (*b*). |
| 2. R-Q 5 (ch), &c. | |
| | (*b*) 1. P moves. |
| 2. P-K 4, &c. | |

A service of carrier pigeons between Zanzibar and the more important posts of the interior is being organised. Preliminary trials have given every satisfaction, and it is intended to establish a chain of posts 30 miles apart between Lake Nyassa and the coast. It is estimated that a pigeon will cover the whole distance in six hours.

## ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

### HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Sept. 3, and unacknowledged elsewhere:—

F. M. Rogers.—One in a Fog.—Greenock.—Carolus.—A. B. C.—Intending Patentee.—A. E. Ball.—J. Webb.—The Fife Adamson.—W. S.—M. C.—Wings.—Scotus.—Ulsterman.—W. A. L.—Director, R.R.L.—Caldemone.—J. W. Beauchamp.—J. A.—Labby.

G. Paul. (You must say what you mean by "invalid tricycles"; but you will find all sorts of patterns in back volumes, including designs for use by men without legs.)—A. R. (How can we advise, or anybody else, without knowing what is the nature of the invention for "protecting ships from running on rocks, sandbanks, &c."? Take out what is called "provisional protection" at the Patent Office, and then send particulars to the Secretary of the Admiralty, Whitehall. Any of the patent agents advertising in our columns will give you full information as to what to do in the case of other countries.)—G. F. Y. (If you address the letter "The Secretary, Royal Geographical Society, Savile-row, London, W., no doubt it will find him.)—A. W. (Please see indices. Unless made on a rather large scale, it is cheaper to buy varnishes, and you should procure the best pale copal or amber varnish.)—Laxt. (Do not understand what you mean by the first query, and, as to the second, try a solution of alum to harden the skin. But see indices of back volumes. Any druggist could make up something suitable.)—H. E. W. (Have not many designs for portable forges been given? Give some idea of the size you want and we may be able to help you. You do not seem to have any idea of what "civil engineer" means, and your "chanches" of success in that profession are very small indeed. You should have been articled to a civil engineer years ago.)—Doctor Med. (Probably you will find something about it in this number or the next.)—G. Thomas. (There is the Finsbury Technical College, Leonard-street, E.C.; but see advertisements in electrical papers.)—S. U. A. (What do you mean? Hardening and tempering can be learned only by practice; but we have given many articles on the subject, and have no room just now to repeat such information. Briefly, the metal is heated to a red (as it looks in the dark) and then quenched in water—that is hardening. Then it is heated again on a hot plate, and when the oil with which it should have been smeared blazes, the steel is "tempered" for certain purposes. See "Hints" above.)—Fountain. (We really cannot say. Perhaps the connections are not air-tight, and pressure of air is essential in that type of fountain.)—Ernest S. Grist. (The information you ask for has been given over and over again in recent volumes - even in recent numbers; but unless you are prepared to pay for the electric light you will be wise to let it alone.)—Roslin. (Do you mean "hammering circular saws," or merely straightening or flattening plates? The latter is done by a planishing hammer. The subject has a place in a sheet metal workers' notebook, but his business is principally in working out the forms to which he cuts his sheets.)—London A. L. I. (We really do not know of a work which will instruct any one in "charge of machine shop" how to "understand drawings.")—Anxious One. (Write to the Secretary of the Plumbers' Company, Adelaide-place, London Bridge, and you will get all information.)

**Every Man and Woman** wishing to be permanently strong and well should wear one of Harness' Electropathic Belts. They are delightfully comfortable to wear, and speedily invigorate and exhilarate the entire frame, completely exterminating disease from the system. Thousands of testimonials prove their remarkable curative value in nervous and rheumatic affections, liver, kidney, and other organic disorders, &c. Pamphlet and consultation free. Those who cannot call should write at once to the Medical Battery Co. (Ltd.), 52, Oxford-street, London, W. (the largest and only complete Electro-Medical Institute in the world).—[Advt.]

The following is given in the *Archiv für Eisenbahnwesen* as the railway mileage at the beginning of 1889:—Europe, 133,900; America, 190,000; Asia, 17,800; Africa, 5,200; Australia, 10,500; total, 357,400, as compared with 293,000 in 1884. Of the increase of 64,000 miles during the four years, 40,000 is in America, and 30,000 in the United States alone; 11,000 miles were opened in 1885, 17,000 in 1886, 23,000 in 1887, and 13,000 in 1888.

**Holloway's Ointment.**—This cooling Ointment perseveringly rubbed upon the skin, is the most reliable remedy for overcoming all diseases of the throat and chest. Quinsy, relaxed tonsils, sore throat, swollen glands, ordinary catarrh, and bronchitis may be arrested as soon as discovered, and every symptom banished by Holloway's simple and effective treatment.

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Indexes for Vols. VI. and VII., 2d. each. Post free 2½d. each. Indexes to Vol. XL., and to subsequent vols., 3d. each, or post free 3½d. Cases for binding, 1s. 6d. each.

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7ft. 8in. **Iron Lathe,** 8½ centre, back-gear, slide-rest, hand-rest, &c. Will exchange for good Safety or 50in. Ordinary.—R. Owen, 8, Vincent-street, Butts, Coventry.

Tyson Vase **Steam Engine** (no boiler required), drive sewing machine cost ten guineas. Exchange Lathe, Iron Drill, Eidograph, &c.—B., Whams-house, Lees, Manchester.

Two pair **Circular Rails** for locomotive, 3ft. diameter, 3½in. gauge, cost 15s.; take 5s. for the two.—G., 118, Broad-street, Reading.

**Hand Grindstone,** with trough, 8in. diameter; circular saw, 4in. diameter, with pulley wheel, on spindle, 5s. the two.—G., 118, Broad street, Reading.

Large **Compound Slide-Rest** for fixing to bench, and hand-power arrangement, with adjustable feed and three wheel cutters for cutting across or recessing metal plates, either flat or half-round, cost £7. Offers.—G., 118, Broad-street, Reading.

**Engine,** horizontal, 2½ by 3in. bore, with governor, pump, &c.; boiler, vertical, 1 by 2ft., nearly new, with fittings. Exchange for smaller and cash, or small gas engine.—A. Ley, Moor-street, Earlsdon, Coventry.

A very good **Printing Press,** and two cases of type. Exchange for Camera and lens; must be good.—Arthur Thwaite, Crown-square, Penrith, Cumberland.

**Bicycle,** 52in., good order, worth £4 10s. Will exchange for good half-plate camera lens, &c., or violoncello.—J., East-street, Faversham.

Wanted, a 3½in. Slide-rest and Emery Wheel, spindle ½in. dia. Exchange.—D. T. Williams, Gwyn-street, Alltwe Pontardawe, near Swansea.

Silver **Lever Watch,** for back-gear Lathe or Slide-rest, or offers in machinery or tools.—Jaggs, 17, Boones-road, Le Kent.

**Apps' Patent Inductorium,** 8in. spark, divided condenser, connections for mercurial or hammer break, perfect condition, cost 30 guineas. Exchange for Dissolving View Apparatus and Slides.—Electrical, 72, Price-street, Birkenhead, Cheshire.

**Lathe,** 7in. centre, 6ft. bed, back-gear, face-plate, catch-plate, boring chuck. Will exchange for Drilling Machine, Tricycle, or sell £8 10s.—Cycle Works, Highbridge.

Wanted, a Dog Pup, Yorkshire or small **Irish Terrier.** Must be guaranteed good stock. Exchange or cash.—Welles House, Colchester.

Exchange **Safety Bicycle** for tools, anything useful, or cash.—Wm. Rossiter, Bridport, Dorset.

Electric Light Apparatus, Fittings, &c., also g modern Book wanted in exchange for high-class Dragoon Pigeons, la Magic Lantern and Slides.—Amateur, 18, Lowbaxter-street, Bu Suffolk.

Autograph Letters of Celebrated Men wanted. E change useful Domestic and Mechanical Articles. Give particul and state wants to—Collector, 18, Lowbaxter-street, Bury, Suff

Magnificent Kimball **American Organ,** 13 st sub-bass, full organ, knee swell, over 6ft. high, inclosed book-c new, £15 cash and £10 exchange.—C. W. Searle, Sunninghill.

English Mechanic
WORLD OF SCIENCE AND ART.
RIDAY, *SEPTEMBER* 12, 1890.

# PHONES: THEIR CONSTRUC-ION AND FITTING.—VII.

By F. C. Allsop.

of "Practical Electric Bell Fitting," lectric Bell Construction," "Practical Electric Light Fitting," &c.

### Erecting Telephone Lines.

elephone line there are four different tions of the line to erect. There is, e "line" wire, which is the outside nnecting the two instruments, and is ier overhead or underground; second, eading in" wire, which connects the wires with those inside; the "join- " or inside wires, which are those ng from the instrument to the "lead- ' wire and to the battery; and, fourth, arth" wire, which wire runs from the ient down to to the earth connection. es where a return wire is used, the ire is not, of course, required.

### Line Wires.

overhead purposes, No. 16 B.W.G. awn copper wire should be employed, stronger wire is required, a stranded ch as is generally used by the tele- ompanies, consisting of three strands 18 hard-drawn copper should be used. ivate line work, however, No. 16 . will be found the most suitable, and, in cases, where the spans are short, t in an exposed position, No. 18 even e erected. Formerly, iron wire, r 11 B.W.G., was much used: but tle is ever erected now, a 3-18 copper, or, or silicum bronze having taken e. Iron wire, when used, requires to y well galvanised, or it soon rusts, towns is rapidly eaten away by the rous fumes from the chimneys. For ason an iron wire, where it passes chimney, or even copper wire if it very close, should be wrapped with r a yard or two, and the tape served coating of varnish.

inning the wires they must be fixed on insulators or shackles, insula- r preference, as they give a higher ion.

37*a* shows the Z-pattern insulator, g. 37*b* and *c*, which are sections, show fference between double and single- sulators. In the single shed insulator be seen there is only one recess, while louble shed there are two, thus giving insulation. In Fig. 38 is shown the shackle, while that in Fig. 39 is a shackle. The part (*a*) in Fig. 38 is ackle, made of glazed porcelain, and e shackle-strap of galvanised iron.

be seen that, owing to there being sulating parts, the double shackle much higher insulation than the White porcelain insulators or shackles best, but if they are placed in an d position where they are likely to be by stone throwing, the brown porce- hould be used, as offering a less g appearance. Shackles are generally t the ends of a line and the insulators rmediate supports, as shackles can lly be fixed so as to withstand a r strain than insulators. The Tele- Cos. use either insulators or double es, some having a preference for tors, while others will use nothing ouble shackles. The best insulation oubtedly obtained by using insulators, a very high insulation is desired, fluid tors, such as the Johnson, should be yed. Private line work, however, is different from exchange; what is sufficient for the former being often quite inadmissible in the latter. In exchange work, each wire, owing to its close proximity to others, and very often electric light wires carrying high-tension currents, requires to be very well insulated, while a private line wire, which, in nine cases out of ten, is of no great length, is generally in private ground, and thus removed from external disturbances. For short lines in towns, therefore, it will usually be found quite sufficient to fix the wire to single shackles, the shackles being fastened to the chimney stacks by $\frac{1}{16}$ galvanised iron wire taken once right round the stack, or, if the strain is great, twice, each turn being so arranged as to pull against a different course of bricks. When it is desired to fix to a chimney stack, a wrought-iron bracket, as shown in Fig. 40, should be used, and an insulator, or shackle, fixed at the end. The wire is then fixed to the insulator, and should be so arranged that the only strain on the bracket is towards the chimney-stack. Wall brackets for supporting insulators take a variety of forms, and very often a bracket will have to be designed to meet special requirements. Where it is necessary to fix a pole, a cast-iron saddle (see Fig. 41) is employed to form a base for the pole, a ridge tile being taken off, and the saddle fixed in its place. The pole, which is made of iron gas-pipe 2 or 3in. in diameter, according to the strength required, is then erected, the lower end passing into the socket of the saddle, and the top end being supported by stays. In open spaces and in the country, wooden poles must be used let into the ground, the wires being supported on insulators, after the manner adopted for the telegraph wires.

In erecting overhead wires in towns, care must be taken to see that the wires are erected in a thoroughly substantial manner; otherwise serious accidents may result. All streets should be crossed as nearly at right angles as circumstances will permit, and the wires kept off the main thoroughfares as much as possible. If a wire must be stretched across a street nearly parallel with the direction in which the street runs, extra precautions should be taken to see that the fixings are thoroughly sound and the wire properly erected. If a wire crosses a street in this direction and breaks, then the wire will fall right into the street, coiling up and twisting as it falls in a manner that cannot but cause the most serious results should there be much traffic. In crossing electric light wires, it is best if there are a number of telephone wires to cross over the electric-light wires, for if the telephone wire were put underneath and the electric-light wire was to break, then it is probable that all the telephone wires would be damaged.

To fix overhead wires in a proper manner requires, at least, three men—four or five if in [illegible]wded thoroughfares. Before commencing to run the wires, the different points at which a fixing shall be taken must first be determined. This is best done by getting on the roof of the two buildings between which the wire is going to be run, and taking a survey, by which means it can generally be determined which are the most suitable places. The next thing is to get permission to take a fixing on the houses, or a "way-leave" as it is called, which must be obtained from the landlord. Very often this getting way-leave is the most difficult part of overhead wiring, many persons having (perhaps not unnaturally) a great dislike to wires on their roofs. In private line work, however, the wires are generally erected on houses belonging to owner of the telephones, and thus there are no way-leaves to be got; but, nevertheless, it frequently happens in towns that fixings have to be made on intermediate buildings where permission has to be obtained. Permission being obtained, the insulators or shackles should next be fixed at each place, and everything got ready for running the wire.

The wire should be commenced running from one end and worked towards the other. In running each span, one man goes on top of the building from which a start is made, taking with him the coil of line wire and a ball of stout string. Another man goes on top of the building where the next fixing is to be made, also taking with him a ball of string. This string is first got through between these two points, which is done by working the string from each of the fixings, and then joining the two ends together and pulling the string up taut, when it will generally rise clear of everything; if not, it must be manipulated till it does. In crossing a street the ends of the string must first be brought to the house on each side, and the two ends thrown down at the same time into the street, one of the men remaining in the road to tie the ends together, when the string must be quickly pulled up taut. After the string has been got through between two points, the man having the coil of wire ties one end of the coil to the string and pays it out to the other man, who draws the wire across, and when he gets the end makes it fast to the insulator. The other man then proceeds to draw back the slack, after which he cuts the wire, draws it up tight with the draw-vice, and makes it fast to his insulator. In the same way the other spans are run until the line is complete. If the lines end at each insulator, a small piece of wire must be soldered to the end of each span, so as to bridge over the insulator and make a good connection right through. Each span should be erected, if possible, without joins, but if joining is necessary, the joint must be well soldered, which should be done at as low a heat as possible to avoid softening the wire.

### Humming of Wires.

A great trouble that often arises with suspended wires is the humming produced in the wire near its supports. This is caused by the wind passing across the wire and setting it in vibration, the support acting as a sounding-board. On wooden poles in the country, when the wind is strong, the sound is very loud, but it is in town chiefly where the greatest inconvenience arises. The noise is very disagreeable to the inhabitants of the house to which the wire happens to be attached, preventing many persons from sleeping at all on windy nights. Unfortunately, it is the bedrooms that are generally nearest to the wire, and this, coupled with the silence prevailing during the night, increases what is perhaps hardly heard in the day ten or twenty-fold at night. The trouble, however, can easily be got over by using a little judgment in selecting a fixing and by using special supports. Make your spans as short as possible, the noise is always worst on houses at the end of long spans, especially if the spans are in exposed positions. If the chimney, &c., is an intermediate support, terminate each span on the opposite side of the chimney, using separate bands (kept as far away from one another as possible) round the chimney for each support, and connect across with guttapercha covered wire. If this is not sufficient, bind round the insulator or shackle a piece of india-rubber about $\frac{1}{4}$in. thick, fastening the wire outside the rubber. The noise can often be stopped by clamping two strips of wood about 18in. long, 2in. wide, and 1in. thick on the wire close by the insulator, the proper distance of this "damper" from the support being ascertained by sliding it along the wire.

### Underground Wires.

Where wires are run underground, No. 16 B.W.G., guttapercha covered, and taped or braided, must be used. Braided wire is more expensive than taped; but is to be preferred, owing to its not unravelling so easily, and also because it will draw better into pipes.

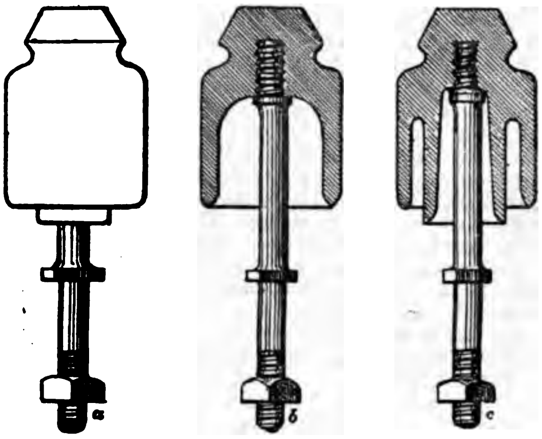


Fig. 37.

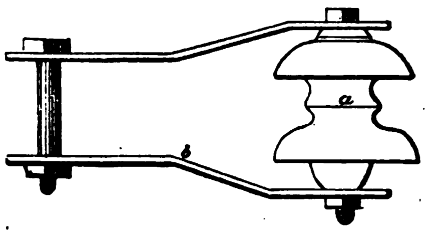


Fig. 38.

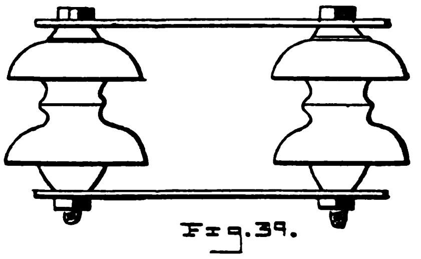


Fig. 39.

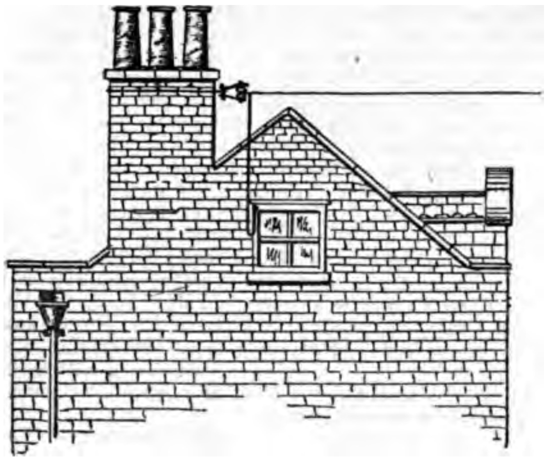


Fig. 42.

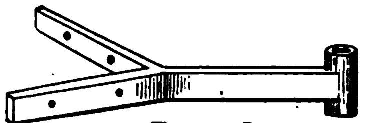


Fig. 40.

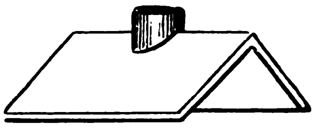


Fig. 41.

The wire should have been well served with Stockholm tar, which preserves it from decay, though it somewhat lowers its insulation. Bitumen-covered wires, either taped or braided, are also considerably used for underground purposes. It is considerably more expensive to place telephone wires underground than overhead; but the unsightliness and danger of overhead wires is done away with, and the expense of repairing them when broken by snowstorms, &c. Underground wires should be laid in iron pipes, the pipes being laid about 12in. below the surface of the ground. When the pipes are being laid, a naked wire is drawn through, by means of which the covered wires are afterwards drawn in. A method which allows of the wires being accessible at all parts is to lay the wires in small creosoted wood troughing, fitted with a loose lid, the troughing being buried, like the iron pipes, 12in. beneath the surface. Thus, if at any time the insulation of the wire should break down at any point, the earth can be removed from above the casing, and the wire inspected at the point where it is believed the fault lies. With iron pipes, nothing can be done save pulling out the faulty wire and drawing in a good one by means of it. The method adopted by the Post Office with their underground wires in towns is that of iron pipes with junction-boxes at certain distances. These pipes are laid underneath the pavements and roads, and into them is drawn a cable containing a number of wires. If a fault occurs in one or two of the wires, the whole cable between the two junction-boxes is drawn out and a new cable drawn in by means of it, the old cable being sent to the works for repairs, and when repaired is used at some future time.

If there are many wires in the same pipe or troughing, it will be found best to use a separate return-wire for each instrument, owing to the trouble arising from induction if an earth is used. The method adopted by the writer with underground wires is to lay them in wood troughing and twist each pair of wires together throughout the entire distance. This method not only prevents trouble arising from induction, but also allows (if each pair is neatly laid side by side) each circuit being readily identified should it be necessary to test or repair the wires at any place.

### The Leading-in Wires.

For the leading-in wires No. 18 B.W.G. copper wire, guttapercha covered, to No. 9 B.W.G., wound with tape and well covered with Stockholm tar, should be used. In places not much exposed to the weather No. 20 to 12 may be employed; but in most cases No. 18 will be found the most durable, which should also be double taped if likely to be subjected to any mechanical strain. The leading-in wire is joined to the line-wire close to the last shackle or insulator, the joint being carefully soldered. The wire is best brought into the building through the window frame, a hole being bored in the frame for this purpose, though if there is no window near, other means must be resorted to. The leading-in wire, before it enters the wall or window-frame, should make a short dip below and then rise to the hole where it enters, as shown in Fig. 42, so that rain may run down and drip off at the bend instead of running into the building. As there is in wet weather considerable leakage from the line wire to earth by means of the outside covering of the leading-in wire being wet and forming a conducting film, a porcelain cup is often used fixed just above the joint between the line-wire and leading-in wire. This, by keeping the upper part of the leading wire dry for a space of 3 or 4in., makes a break in the conducting film, and preserves the insulation of the line. In brin
wire down the side of a building, it
if possible, be tied to the rain-water
pipe; but if neither of these is pr
the wire must be fixed by big staple
to pipe hooks driven into the wall
care is necessary in driving these s
see that the staple is not driven qui
which would injure the insulatio
wire. Where the wire passes over
of the roof or the corner of a chimn
a short piece of the wire should b
round where it touches the brickwor
vent the insulation being frayed of
wind blowing the wire about.

### Inside or Joining-up Wire

If the telephone instrument is
place where the leading-in wire e
building, it is best to continue th
percha wire right to the instrume
if the distance is far, the leading
should be stopped just inside the
and the continuation made to the
ment with less expensive and more
wire. For inside wiring plain gutt
covered wires are unsuitable, as
situations the insulation cracks off
The best wire for inside wiring an
up the battery is No. 20 B.W.G
with a layer of rubber, then doubl
covered and paraffined. This wir
obtained in almost any colour to
decoration; but a drab or neutral t
least noticeable. These wires shoul
along the skirting-board and up th
the wall, the wires being fastened b
Never, however, place two wires u
staple, or let two staples touch one
as if this is done a short-circuit i
certain to be caused sooner or lat
different wires should be so arr
always to retain the same positio
to one another, as this greatly f

a fault. If the wires are likely to
rfered with they should be either
so as to be out of reach or else
n wooden casing, such as is used for
light wires. In passing from room
the best plan is to bore a hole in one
of the woodwork above the door; if
e a number of wires the holes being
that the wires retain their relative
to one another. If there are electric-
res in the same building, these must
as far away from as possible. If
phone-wires are obliged to be put
e electric-light wires, under no cir-
ices should they run parallel to
owing to the disturbances arising
iduction. It is best also to avoid
too near gas-pipes, especially if
only "compo." as in the case of
g striking the outside wire, it is
o "jump" from the inside wire to
ghbouring conductor in connection
earth, and if this took place the
e would probably fuse the pipe and
o the gas. If a joint has to be made
be carefully soldered (rosin being
a flux), after which the joint must
ated with Chatterton's compound or
uttapercha, and wound with tape.
judgment is necessary in seeing that
ts do not come in inconvenient or
tions, and also that the most suitable
or the wire is taken.

**h Wires and Earth Connections.**

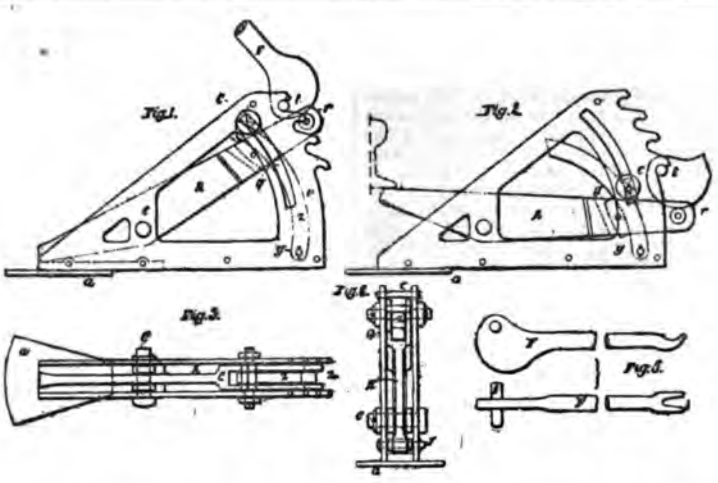
mportance of a "good" earth is
tly underrated by many persons in
a telephone line, though they are
careful when a return wire is used in
hat a good connection right through
ied. Since, when an earth return is
he ground takes the place of the
vire, it is obviously very important
good connection to the ground is
l at both ends of the line.

in water pipe makes the best earth
on; but if this is not obtainable, the
re may be attached to the gas-pipe.
ist be taken, however, to see that the
pe is really a main, and not a cistern
if this latter is the case, there will
bad earth," caused by the break in
ty at the ball-cock in the cistern.
e gas-pipe also connection must be
the street side of the meter, owing
d lead used in the joints being a bad
or. If connection is made on the
de, the meter must be bridged over
iece of wire; but even this is liable
terfered with by the gas inspector.
h wire should never be connected to
sition gas-pipe, owing to its liability
fused should the line be struck by
g. Should neither a water nor gas-
obtainable, a pump pipe leading to a
kes a good "earth"; but if this is
e had, an artificial earth must be re-
. A good artificial earth is made as
—Suspend 5ft. or 6ft. of sheet-lead
e in the centre of a hole about 4ft.
hen ram in with ordinary gas-coke
in 6in. of the surface, when fill in
il. The earth wire must then be
to the projecting end of the lead.
ould be taken to obtain as moist a
for the hole as possible. Never
the earth wire on a gas-pipe at one
a water-pipe at the other, as perma-
rents are thereby often set up which
certain cases give rise to noises in the
e. In country places, where an
earth has often to be resorted to,
ould be taken to see that the same
is used for the earth plate at each
he same line. For instance, sheet-
uld not be used at one end and an
te at the other, or permanent earth
will be the result.

e earth wire, No. 18 B.W.G. copper
ttapercha-covered, taped, and tarred,
is advised for the leading-in wires, should be used; but if this is objected to on the score of economy, No. 18 naked copper or 3-18 galvanised iron can be employed. If a naked wire is used, No. 18 copper is to be preferred, but it is never advisable to use the cotton-covered and paraffined, such as advised for inside wires, as, in all probability, in getting to the water-main the wire has to pass through places where it will be liable to injury from dampness and other causes. If obliged to use paraffin wire, a short length of stout wire should be soldered to the water-pipe, and the other wire soldered to the projecting end. Care must be taken to see that a really good soldered connection is made to the pipe, otherwise the joint soon oxidises, and a bad "earth" is caused. If it can be managed, it is best to let the water out of the pipe while the joint is being soldered. In making the connection, the pipe must be scraped clean with a knife for the length of about 3in., and the cleaned copper wire twisted tightly round it, the joint being soldered with resin as a flux, though in the case of gas-pipes it will be necessary to use "spirits." It is generally sufficient if the stout earth wire starts from the zinc of the battery, the connection from the zinc to the instument being made with the small wire as used for inside wiring.

(*To be continued.*)

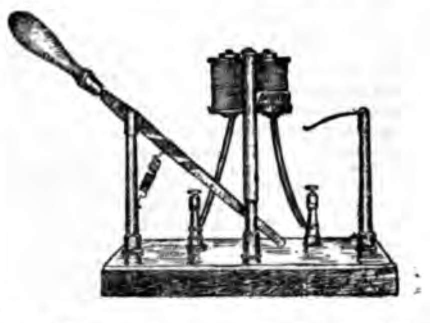
## IMPROVED LIFTING JACK.



THE patented lifting jack, devised by M. J. Cito, of Pétange, and M. P. Funck, of Luxemburg, which they have protected in this country, is characterised essentially by the fact that in a suitable frame is supported a lifting lever having a roller upon which acts the eccentric cam of a hand-lever placed in different notches in the frame according to the height to which the weight is to be lifted. A wedge is adapted to slide in a curved slit formed in the frame. At the lower part of the latter is provided a bent locking arm which is pivoted eccentrically to the fulcrum of the lifting lever, and always bears upon a tongue arranged in the fork of the lifting lever and adapted to turn upon its axis. The weight is kept raised by the wedge being clamped between the locking arm and the frame, thus preventing the back movement of the locking arm and also of the lifting lever. Figs. 1 and 2 show side elevations of the lifting jack or apparatus. Fig. 3 is a plan of the same. Fig. 4 is an end view, and Fig. 5 a detail of the hand-lever. The lifting lever R to be applied to the weight which is to be raised, for example a railway rail, has its fulcrum in the frame at C. The frame is made of sheet steel provided with openings. At its outer periphery, which is approximately concentric with the fulcrum C, the said frame has a number of notches wherein the hand-lever F is placed. The rear arm of the lifting lever R is forked, and carries at its end a roller, *r*, upon which acts the eccentric cam of the hand-lever F. This carries a cross-piece *t*, which is placed eccentrically to the cam, and can be placed below the hooks formed by the notches in the frame, whilst the cam itself bears upon the roller *r*, so that by means of the hand-lever and its eccentric cam acting upon the roller of the lifting lever the rail or the like can be lifted. For locking the lifting lever a wedge, *e*, is adapted to slide in a curved slit or incision formed in the frame, so that in the movement of the hand-lever F it can slide down between the frame and a bent locking arm, *z*, pivoted at *y*, which arm is carried upwards by the fork of the lifting lever R and bears upon a tongue, *q*, placed concentrically with the aforesaid locking arm, this tongue being fixed in the fork of the lifting lever and arranged to turn upon its bolt. The wedge *e* effects its locking action in such a manner that after the weight has been lifted a certain distance the hand-lever F will be liberated, and that, by the pressure exerted by the tongue *q* of the lifting lever R upon the arm *z* placed eccentrically to the fulcrum C, the wedge *e* is clamped between this arm and the frame, so that the weight is under any circumstances kept at the height to which it has been raised. When the weight is to be raised further the pin *t* of the hand-lever F is placed in a notch below the same, and this is repeated until the weight has been lifted to the desired height. After the weight has been lifted the apparatus is liberated by placing the upper forked end of the hand-lever F (Fig. 5) between the wedge *e* and the lifting lever R and then forcing the same upwards. In this manner the apparatus is set free without shifting the weight from its position. At the front part of the frame and on the bottom thereof is arranged a plate, *a*, of any suitable dimensions, for the purpose of preventing the apparatus from penetrating too deep into the ground.

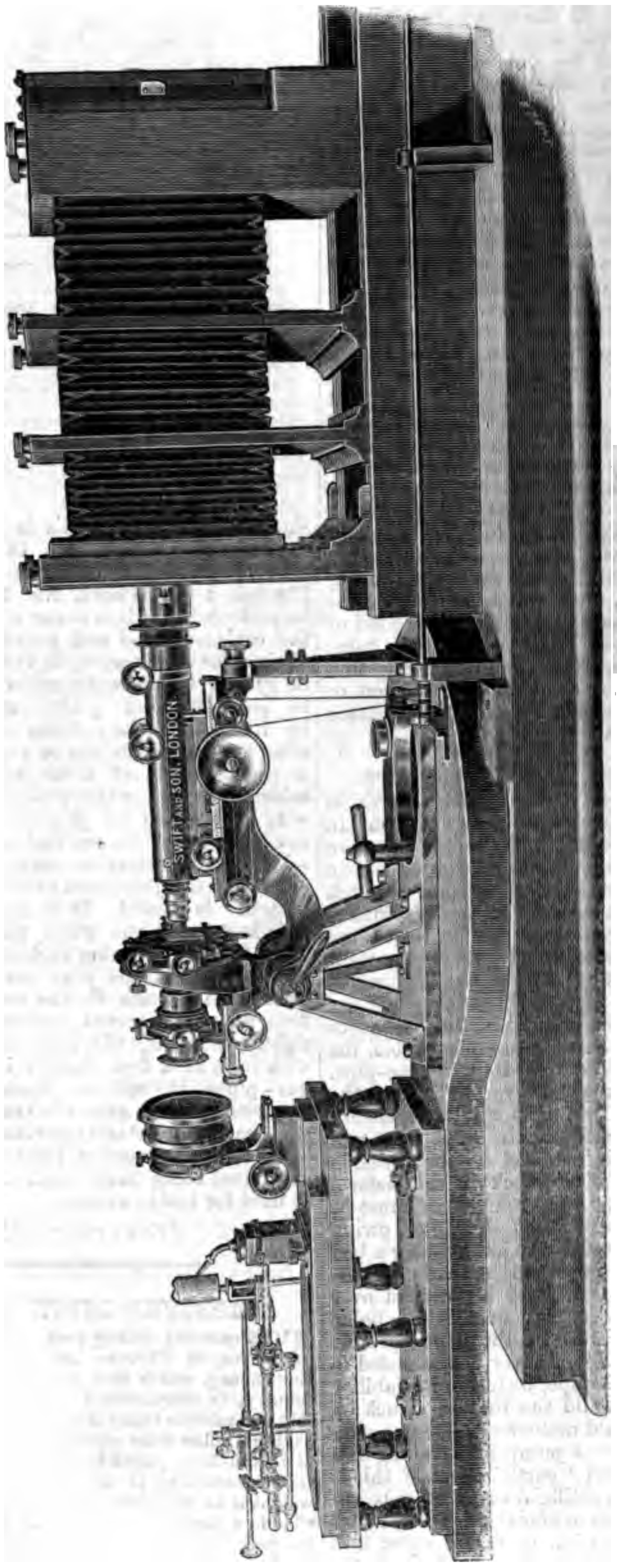
## DENISON'S SAFETY CUT-OUT.

THE accompanying cut shows a safety cut-out for dynamos. It is taken from a photograph of one of a pair of similar instruments which have been used—on a couple of Weston dynamos in New Haven—for some three years past. The arrangement is simple enough. The two outside posts were in series with the shunt coils and the field magnets.



When the lever was pressed in contact with the spring, the dynamo started into action and held the lever in position so long as the circuit was complete; but, of course, if for any cause the circuit was broken the machine would be instantly thrown out of action and remain harmless until such time as the lever was again raised. The instrument shown was installed by Mr. J. F. Denison, and has been in steady service.

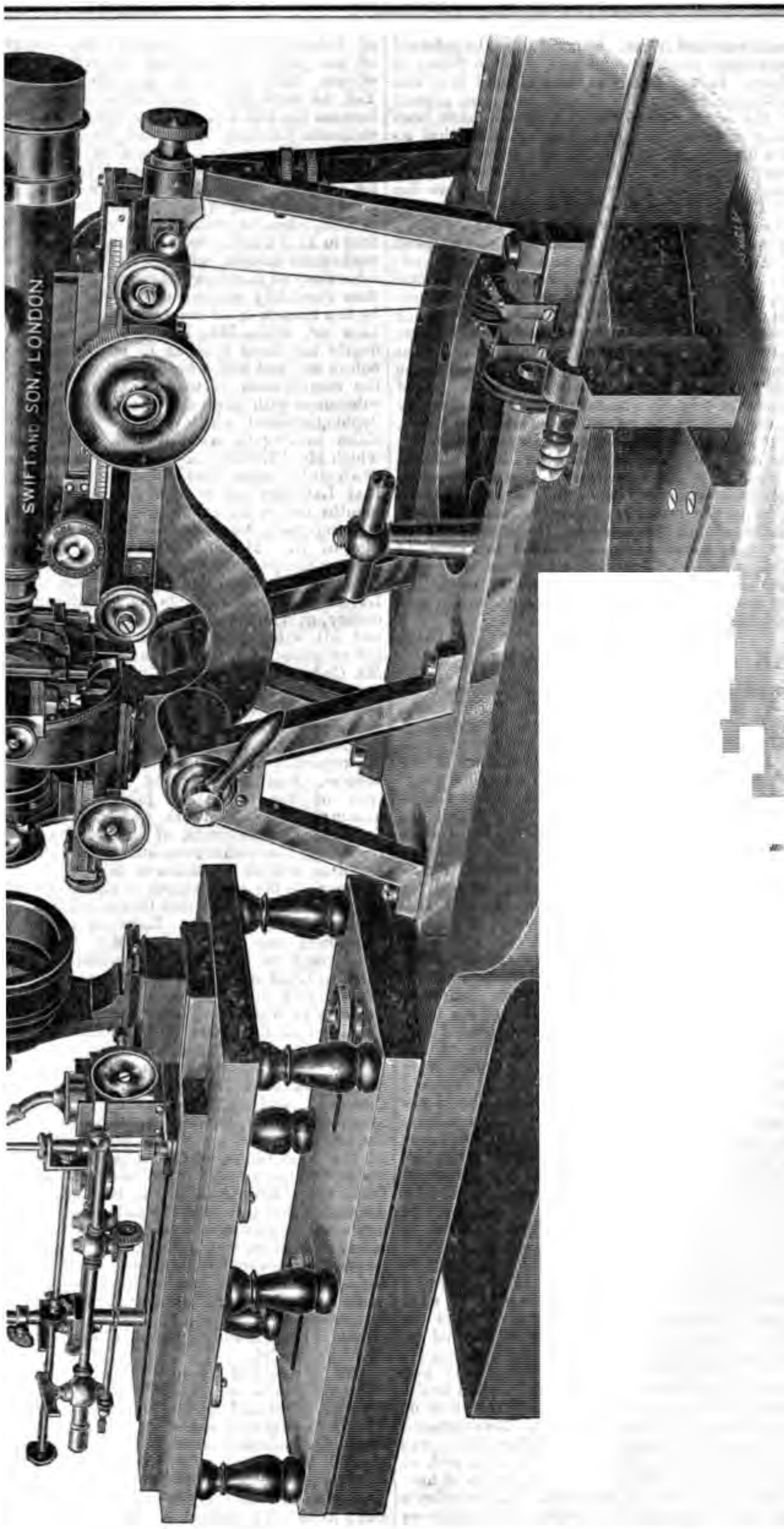
The protective principle involved is really a very serviceable one, and might be advantageously employed on very many arc circuits. The object of such a contrivance is to prevent accidents happening from broken lines; if, for example, a line wire snaps and grounds itself or falls across another conductor, the result is an enormous rush of current, which in many cases may destroy the dynamo or produce serious results by crossing with some innocent wire leading to a distant point. If such an accident happens where the safety cut-out is used, the dynamo will be cut out before the fallen end of the wire can strike the ground or cross another wire, avoiding all danger of damage to the machine or of accident through fire or shocks.—*Electrical World*, N. Y.



PRINGLE'S PHOTO-MICROGRAPHIC APPARATUS.—FIG. 1.

## MIMICRY.

THE Friday evening discourse during the meeting of the British Association was delivered by Mr. E. B. Poulton, M.A., F.R.S., who took for his subject "Mimicry." The great principle of mimicry, said Mr. Poulton, was first enunciated by Bates in 1862, as the result of his observations in the Valley of the Amazon; it was confirmed and extended by Wallace in the Malay Archipelago and India; by Roland Tusien in South Africa; by Fritz Müller in Brazil; by Belt in Nicaragua; and by Meldola in England. This great principle had taken its place in the solid framework of biological science, and was now well known and generally accepted. The object of the lecture was to consider the relationship between mimicry and the other uses of colour in the animal kingdom, and to devote especial attention to any cases which throw light upon the evolution of mimetic resemblance. The illustrations used were, as far as possible, new, although most of them have been described before; all had been prepared specially for this occasion. The object of the first and principal use of colour was concealment. These colours were, therefore, called Cryptic, including two subdivisions—(1) Procriptic, when concealment is a defence against enemies; (2) Anticryptic, when it is a means of capturing prey. The meaning of a Cryptic appearance is often unintelligible until we see the organism in its natural surroundings. Thus a green pipefish was seen to be conspicuous except when surrounded by the leaves of the Zostera, which it always frequents; while a brown moth was only concealed when placed among the brown leaves which it resembled. These were examples of procryptic colours. Anticryptic colours were illustrated by a Brazilian frog, which buries itself almost completely in the earth, so that its prey approach without suspicion. Concealment might also be effected by the use of foreign objects, and examples of such allocryptic colours might be seen in certain small English crabs which deck themselves in pieces of seaweed. Mimicry was closely related to this division of the subject, but differed, because the animal resembled something which was repugnant or dangerous to its foes, or which attracted its prey, rather than an object which was of no interest to either. Mimicry was therefore deferred until after the description of the colours which served as models for it. The second great use of colour was to act as a signal or warning (sematic colours); repelling enemies by the indication of something unpleasant or dangerous (aposematic or warning colours); or signalling to other individuals of the same species, assisting them to escape from danger (episematic or recognition colours). Aposematic colours were illustrated by the conspicuous black and white skunks, with their well-known and nauseous properties, by the conspicuous appearance of certain unpalatable moths, and by an inedible chrysalis which has been recently shown by Porchiniski to possess an appearance suggesting that it has been pecked and abandoned by a bird. Episematic colours were illustrated by the white tail of the rabbit acting as a beacon to those behind. There are also very interesting allosematic colours, in which the conspicuous appearance and special defence of some other animal was made use of. Thus many crustacea associated with themselves other animals, such as sea-anemones, sponges, and ascidians, which were avoided by the enemies of the former, and there were even two species of crabs which invariably held a sea-anemone in each claw. Mimicry, the third use of colour, in reality closely related to the first use already described, might be defined as false warning and signalling colours (pseudo-sematic), repelling enemies by the deceptive suggestion of something unpleasant or dangerous (pseudapo-sematic), or attracting prey by the deceptive appearance of something attractive to them (pseudepi-sematic). To illustrate pseudapo-sematic colours (protective mimicry) there were exhibited numerous Indian and some African butterflies, which closely resembled other species possessing a nauseous taste and conspicuous appearance. The instances selected to show the various ways in which the resemblance occurs were—(1) male and female alike, and mimicking both sexes of some nauseous butterfly; (2) male and female different, and respectively mimicking the corresponding sexes of the nauseous form; (3) male and female mimicking different species; (4) the female exposed to more dangers and flying more slowly is mimetic, while the male is not; (5) such mimetic females resemble two or more different species; (6) when a species is mimetic on a continental area, a closely allied species is frequently non-mimetic on some adjacent island; (7) cases in which the mimicry is imperfect and probably recent, the resemblance being in the direction of the type of some group of nauseous butterflies rather than a faithful copy of any single species. Recent work also threw light upon the history of mimicry. Many moths had transparent, scaleless wings, and thus resenble stinging wasps, hornets, &c. It had been shown that the scales thinly covered the transparent part when the insect freshly emerged from the chrysalis, but that they were shaken off during the first flight. This loss was shown to be due to the rudimentary stalk at the base of the scale and the rudimentary socket in which it fitted. When the mimetic resemblance (for example, to a hornet) was very perfect and detailed, the scales were lost were extremely degenerate in but when it was less perfect, they re a more normal and complex shape. Curi enough, the degradation of the scales wa attended by any diminution in size, but r the reverse. Pseudepi-sematic colours (aggr mimicry) were illustrated by certain flies whic their eggs in the nests of bees, &c., and coloured like the latter, so that they could app with impunity. The examples of "alluring c ing" were also placed under this head, and illustrated by a lizard with pink flower-like tures at the corners of the mouth, probably s to attract insects; by a fresh-water turtle, opens its mouth and moves about two fila which look like worms, thus attracting its and by the lures of various fishes, which are phorescent in the case of certain deep-sea and allure the prey into close proximity mouth. The lecturer said it was very inte to observe that even the foreign objects com associated with a mimicked species might be



PRINGLE'S PHOTO-MICROGRAPHIC APPARATUS.—FIG. 2.

ıppearance of the mimicker, an example of eud-allo-sematic colours being afforded by a American insect, which had been shown by '. L. Sclater to resemble a common leaf-g ant, together with the leaf itself. The ʻas represented by the thin, green body of ect, which forms a jagged line along the oming to a sharp edge as thin as a leaf. It xplained by the lecturer that epigamic are those displayed in courtship. As in the ivisions of the subject, foreign objects might layed as well as personal adornments; and es of such allepigamic colours were seen in ntiful or curious objects collected by bower-

## SPINNING TOPS.

ı Saturday evening lecture to the working lasses, which is annually delivered during eeting of the British Association, was on ning Tops," a subject which Prof. Perry, F.R.S., knows so well how to treat. After a few preliminary remarks he gave an explanation of a rapidly-made series of experiments with spinning objects, some set in motion by the hands, but others, including tops and gyrostats, set in very rapid rotation by means of an electro-motor. The object of the lecture was to show that all the problems raised by these spinning objects had their analogy in the rotation of the earth, and that the fact that the earth is a spinning top is a great and persistent cause of many phenomena. It was probable that terrestrial magnetism was altogether due to it. The lecturer said that if more attention were paid to the spinning of tops much greater advances would be made in mechanical engineering and in industrial invention; geologists would not make so many mistakes of millions of years in their calculations; we should all have a much better knowledge of astronomy, of light, of magnetism, and of electro-magnetic subjects. The lecturer first of all illustrated the *quasi*-rigidity that rapid rotation gave to a flexible or fluid body. A thin sheet of paper assumed the rigidity of a board. A chain released from a hub rolled like a solid wheel. A fly-wheel inclosed in a brass box was made to revolve rapidly and the box did not tumble down, but maintained a vertical position, and offered resistance to any attempt to turn it round. If it were tilted it turned with what is called a precessional motion; and the nature of this motion was fully explained and illustrated. Every spinning body resists more or less a change of direction of its spinning axis. Rotating machines on board ship offer greater resistance to pitching and rolling. A top thrown up would fall down anyhow, thrown up spinning there was no doubt how it would come down, because the spinning axis keeps parallel to itself. The fall of a biscuit or of a hat was equally controlled by throwing either with a spinning motion. It was for this reason that the barrels of guns were rifled. It was this which explained the feats of jugglers with hats, hoops, plates, umbrellas, knives. To explain some curious motions of spinning bodies the effect of the pressure of air and of water was illustrated. It made a projectile turn itself broadside to the air. A disc of cardboard dropped edgewise soon set itself broadside, as did the silver coins thrown into the water at Aden for the diving boys. If artillerymen did not understand this the windage of a projectile would give them trouble. All that appeared incomprehensible in the curious motions of the gyrostat under various conditions lost its mystery when the motions were regarded as rotation about various axes; and this was the key to the explanation of what was called precession. The application of these experiments to the rotation of the earth was further illustrated by large diagrams and by the wobbling motion communicated by the hand to objects with three axes, which, spun first on the shortest axis, would of themselves rise to spin on the longest axis. A circular chain hanging vertically from a cord when made to revolve rapidly first wobbled, and ultimately became a horizontal ring. Explaining the effect of the earth's precessional movement, he said that in about 13,000 years the North Pole would be turned away from the sun, and the northern hemisphere would be much warmer in summer and much colder in winter. The axis of the earth described a wavy circle once in 25,866 years. In dealing with the question whether the earth was a shell filled with fluid, the professor gave a vibratory motion to vessels containing respectively sand, treacle, oil, and water. A boiled egg had a slower oscillation than an unboiled one. When the two eggs were rolled the unboiled one stopped sooner than the boiled one. The liquid inside went on moving and renewed the motion of the shell after it had been stopped by the finger. It was easy to spin a boiled egg, but not an unboiled one. If only they had studied the spinning of tops, Bulwer Lytton's "Coming Race," who lived underground, ought to have been able to prove, first, that they were living inside a rotating body, and the rate of the rotation; secondly, the direction of the true north; and, thirdly, their latitude. Prof. Perry frequently introduced the name of Sir William Thomson as his instructor in this subject, about which this lecture might be said to be the first connected publication.

## PRINGLE'S PHOTO-MICROGRAPHIC APPARATUS.

THIS apparatus is shown in Figs. 1 and 2. For description, see *Report* of the Proceedings of the Royal Microscopical Society, ENGLISH MECHANIC, June 27, pp. 375-6.

IN the ten years 1879-89 there was a fall in the number of first-class passengers in the United Kingdom from 39,000,000 to 30,000,000; and the number of second-class passengers from 63,431,000 to 62,878,000, a total decline of about 10,000,000; while the third-class passengers increased by the enormous number of 222,000,000.

IT is stated that Erastus Wiman's plan for constructing a double-line railway tunnel under New York bay, between Rosebank on Staten Island and Bay Ridge in Brooklyn, is favoured by New York capitalists and railway men. The entire cost is estimated at £1,200,000. Mr. Wiman is quoted as saying that the transportation of coal alone would make the investment a paying one.

**"Names We Love and Places We Know."**—The amateur photographer is *en evidence* everywhere nowadays, and to good purpose. Messrs. Hazell, Watson, and Viney, Limited, have just provided him with a delightful and desirable field for the display of his talents by the issue of a birthday textbook of literary gems under the above title, with pages left vacant for the insertion of local photographs. Thus may be gathered together autographs and pictures round which, in the days to come, may cluster sweet memories and tender regrets that shall invest the volume with an ineffable charm.

# BRITISH ASSOCIATION.

## THE ADDRESS IN MATHEMATICS AND PHYSICS.

THE address in Section A was delivered by Mr. J. W. L. Glaisher, D.Sc., F.R.S., the president, who referred to the wide range of subjects comprehended within its scope. The field extended from the most exact of all knowledge, the sciences of number, quantity, and position, to branches of inquiry in which the progress had been so slight that they still consisted of little more than collections of observed facts. It was unfortunate for his audience that his own subject should be at one extreme, not only of those dealt with by that section, but even of the still greater range covered by the Association. He would endeavour, however, to confine himself to a few general considerations relating to pure mathematics. By pure mathematics he did not mean the ordinary processes of algebra, differential and integral calculus, &c., which every worker in the so-called mathematical sciences should have at his command. He referred to the abstract sciences which did not rest upon experiment in the ordinary sense of the term, their fundamental principles being derived from observations so simple as to be more or less axiomatic. To that class belonged the theories of magnitude and position, the former including all that related to quantity, whether discrete or continuous, and the latter including all branches of geometry. The science of continuous magnitude was alone a vast region, containing many beautiful and extensive mathematical theories. Among the more important might be mentioned the theories of double and of multiple periodicity, the treatment of functions of complex variables, the transformation of algebraical expressions (modern algebra), and the higher treatment of algebraical and differential equations as distinguished from their mere solution. It was that kind of scientific exploration which fascinated and rewarded the pure mathematician, and upon which his best work was most profitably spent. He did not wish to underestimate the importance of such a subject as finite differences, in which a number of distinct problems were treated with more or less success by interesting methods specially adapted to their solution. Nor would he willingly undervalue the interest of those branches of mathematics which we owed to the mathematical necessities of physical inquiry. But it always appeared to him that there was a certain perfection, and also a certain luxuriance and exuberance, in the pure sciences which had resulted from the unaided, and, he might almost say, inspired genius of the greatest mathematicians which was conspicuously absent from most of the investigations which had had their origin in the attempt to forge the weapons required for research in the less abstract sciences. Passing to the consideration of pure mathematics itself—that was to say, of the abstract sciences, which could only be conquered and explored by mathematical methods—it was difficult not to feel somewhat appalled by the enormous development they had received in the last 50 years. The mass of investigation, as measured by pages in Transactions and Journals, which was annually added to the literature of the subject was so great that it was fast becoming bewildering from its mere magnitude and the extraordinary extent to which many special lines of study had been carried. To those who believed that mathematics existed for the sake of its applications to the concrete sciences, it must indeed seem that it had long since run wild, and expanded itself into a thousand useless extravagances. It seemed to him that if the extension of the pure sciences could only be justified by the value of their applications, it was very doubtful whether a satisfactory plea for any further developments could be sustained. It was daily becoming more and more difficult for a mathematician to keep himself acquainted, even in a general way, with the progress of any of the branches of mathematics except those which form the field of his own labours. He believed, however, that the increasing extent of the territory of mathematics would always be counteracted by increased facilities in the means of communication. Although it might not be possible to contemplate the actual position of pure mathematics in this country with any great amount of enthusiasm, we might yet feel some satisfaction in reflecting that there was more cause for congratulation at present than there had been at any time in the last 150 years, and that we were far removed from the state of affairs which existed before the days of Cayley and Sylvester. He certainly should not wish, even if it were possible, to obtain more recruits for the pure sciences at the expense of the applied, nor did he desire to see the system of instruction which had found favour in this country so modified that pure mathematics could be carried on by narrow specialists. Every person who proposed to engage in mathematical research should be equipped at starting upon his career with some knowledge of at least all the subjects included in the first part of the mathematical tripos. In conclusion, he referred in some detail to one special subject—the theory of numbers. It was much to be regretted that this great theory, perhaps the greatest and most perfect of all the mathematical theories, should have been so little cultivated in this country, and that no portion of it should ever have been included in an ordinary course of mathematical study. The chapters in the books upon algebra which bore the title "Theory of Numbers" gave a misleading idea of the nature of the subject, the results there given being mainly introductory lemmas of the simplest kind. The theory had nothing to do with arithmetic in the ordinary sense of the word, or numerical tables, or the representation of numbers by figures in the decimal system or otherwise. Many of the greatest masters of the mathematical sciences were first attracted to mathematical inquiry by problems relating to numbers, and no one could glance at the periodicals of the present day which contained questions for solution without noticing how singular a charm such problems still continued to exert. This interest in numbers seemed implanted in the human mind, and it was a pity that it should not have freer scope in this country. It was extremely desirable that some portion of the theory should be included in the ordinary course of mathematical instruction at our Universities. He hoped that the apathy of so many years might lead to a splendid awakening in this country, and that our past neglect of this most beautiful theory might be atoned for in the future by special devotion and appreciation.

## THE ADDRESS IN CHEMISTRY.

The address in Section B was delivered by Prof. T. E. Thorpe, B.Sc., Ph.D., F.R.S., who referred at length to the labours of Priestley, especially noticing the history or reviews of them given by M. Berthelot, perpetual secretary of the French Academy, in his "La Révolution Chimique," recently published. He said that Leeds had a notable association with chemistry, of which she was justly proud. In September, 1767, Dr. Joseph Priestley took up his abode in the town. He was the son of a clothdresser, and was born at Fieldhead, six miles from Leeds. He was trained for the ministry, and became minister of Mill Hill Chapel, Leeds. Living near a brewery, he studied the properties of "fixed air" or carbonic acid, which is formed in the process of fermentation, and was at that time the only gas whose separate and independent existence had been definitely established. From the happy accident of his location sprang the extraordinary succession of discoveries which earned for him the title of the Father of Pneumatic Chemistry, and which were destined to completely change the aspect of chemical theory and to give it a new and unexpected development. There had been a disposition to obscure his true relation to the marvellous development of chemical science which made the close of the last century memorable. M. Berthelot, the Perpetual Secretary of the French Academy, had published a remarkable book, "La Révolution Chimique," in which he claimed for Lavoisier a participation in discoveries which were counted among the chief scientific glories of this country. One need not be unduly influenced by the "bias of patriotism" in asking how far these claims could be substantiated. These claims, explicitly made by Lavoisier himself, were uniformly disallowed by his contemporaries. M. Berthelot sought to support them by additional evidence. The claims had reference to Lavoisier's position in relation to the discovery of oxygen gas, and the determination of the non-elementary nature of water. The substance we call oxygen—a name we owe to Lavoisier—was discovered by Priestley on August 1, 1774, and, as is well known, he obtained it by the action of heat upon the red oxide of mercury. In Priestley's account of the origin of his discovery Berthelot sees the evidence of empirical work. Priestley, he said, drew no general conclusions from his beautiful discoveries. The implication thus conveyed was opposed to the real spirit of Priestley's work. He wrote that it was always his endeavour, after making experiments, to generalise the conclusions to be drawn from them. The fact that Priestley was the first to consciously isolate oxygen was not contested; but M. Berthelot demands that Lavoisier be regarded as an independent discoverer of the gas. He further asserts that Lavoisier was the first to recognise the true character of air, and believes it probable that he would have succeeded in isolating its constituents if the path of inquiry had been left to him alone. But there was nothing to show that Lavoisier had made any advance beyond the position of Hooke and Mayow. The chemists of the 17th century understood the true nature of combustion in air much better than their brethren of the last quarter of the 18th century. Examining closely Lavoisier's claims in the light of M. Berthelot's book, it was difficult to assign impartially to each person his share in a rapid succession of discoveries between Lavoisier's first memoir "On the Calcination of Tin" in 1774, and its revised and completed form in 1777. Lavoisier was aware of Priestley's great discovery of oxygen and of his previous work on the other constituent of air, but he made no allusion to either. Yet he must have been influenced by the work because the full and clear recognition of the non-elementary nature of air which he eventually made was based upon it. In none of the memoirs of Lavoisier after that of Easter, 1775, was the claim for participation in the discovery more than implied; and it was explicitly made for the first time in 1782, when he wrote: "It will be remembered that in 1775 I announced the discovery which I had made some months before with M. Trudaine in the laboratory at Montigny of a new kind of air up to then absolutely unknown, and which we obtained by the reduction of mercurius precipitatus *per se*. This air, which Mr. Priestley discovered at very nearly the same time as I, and I believe even before me, and which he had procured mainly from the combination of minium and of several other substances with nitric acid, has been named by him dephlogisticated air." In another treatise the claim was again made in these words: "This air which Mr. Priestley, Mr. Scheele, and I discovered at about the same time." There was no question that Lavoisier knew of the existence of oxygen months before he made the experiment with the burning-glass, because Priestley had already told him of it. Having become the librarian and literary companion of Lord Shelburne in October, 1774, he had visited Paris and had been the guest of Lavoisier, at whose table he mentioned the discovery, at which the company, including the host and his wife, expressed great surprise. He also got an ounce of mercurius calcinatus prepared by Mr. Cadet, and frequently mentioned his surprise at the kind of air which he had got from it to M. Lavoisier, M. le Roy, and several others. Further evidence that Lavoisier was not the true and first discoverer of oxygen, and that he had no claim to be regarded as a later and independent discoverer, was supplied by M. Berthelot's analysis of the laboratory journals of Lavoisier. The memoir by Cavendish was published in 1774, and before it was struck off an addition was made recording the communication by a "friend" to Lavoisier and his repetition of the experiment. A reference to the manuscripts in the archives of the Royal Society showed that this addition was in the handwriting of Blagden. Lavoisier's later memoir mentioned the presence of Mr. Blagden, who "informed us that Mr. Cavendish had already tried, in London, to burn inflammable air in closed vessels, and that he obtained a very sensible quantity of water." Thereupon Blagden wrote a narrative of the facts to the *Chemische Annalen*, in which he stated that Lavoisier had concealed part of the truth, which was that days before the final experiment he had been told of those of Cavendish, and that the water obtained was not a sensible quantity, but was equal to the weight of the two airs added together. Blagden also told him of the conclusions of Cavendish and Watt, that water, and not an acid or any other substance, arose from the combination of the two airs. Blagden concluded that Lavoisier "was induced to institute again such experiments solely by the account he received from me of our English experiments; and he really discovered nothing but what had before been pointed out to him to have been previously made out and demonstrated in England." To this Lavoisier made no reply, and the Academicians offered no explanation; and this letter was ignored by M. Berthelot.

The President of the section having gone over the different points of the evidence, concluded by saying:—It would be heaping Ossa on Pelion to adduce further evidence from letters of the time of what Lavoisier's contemporaries thought of his claims. *De mortuis nil nisi bonum.* I would much more willingly have dwelt upon the virtues of Lavoisier, and have let his faults lie gently on him; but I have felt it incumbent on me on this occasion to make some public answer to M. Berthelot's book, and in no place could that answer be more fittingly given than in this town, which saw the dawn of that work out of which these grand discoveries arose. It may be that much of what I have had to say is as a twice-told tale to many of you. I trust I need make no apology on that account. The honour of our ancestors is in our keeping, and we should be unworthy of our heritage and false to our trust if we were slow to resent or slack to repel any attempt to rob them of that glory which is their just right and our proud boast.

## THE ADDRESS IN GEOLOGY.

The address in Section C was delivered by the President, Mr. A. H. Green, F.R.S., professor of geology in the University of Oxford, who stated that nearly all his time during the last fifteen years had been taken up in teaching. That had led him to think a good deal about the value of geology as an educational instrument, and how its study compared with that of other branches of learning in its capability of giving sinew and fibre to the mind. At a gathering, where several of the best English geologists were present, the question of the cause of

climate was under discussion. The
which found most favour was a change
ion of the axis of rotation within the
and that, it was suggested, might have
t about by the upheaval of great bodies
al and mountainous land where none
, and an accompanying depression of the
tinents or parts of them. That such a
n of the heavier material of the earth
; in some shifting of the axis of rotation
no doubt. The important question was,
? What degree of rearrangement of
would be needed to produce a shift of
required? It was purely a question of
the necessary calculations could be
y a mathematician. The bulk of those
ed quite content with the vague feeling
g could be done in the way suggested,
as a general air of indifference as to
hypothesis would stand the test of
erification or not. He could adduce
similar instances; but it would be more
uire what it was that had led to a fail-
f it really existed, must be a source of
whole brotherhood of "hammerers."
as not far to seek. The imperfection
ical record was a phrase as true as it
yed. No more striking instance of its
ould be found than that furnished by
wn mammalian jaws from the Stones-
The first of those was unearthed about
to the number of some nine, between
18. The rock in which those precious
beginning of mammalian life occurred
arried without intermission ever since;
ransacked by geologists and collectors
ber; many of the quarrymen knew a
ey first saw it, and were keenly alive
ket value of a specimen; but not
se prized and eagerly-sought-after
turned up during the last 70 years.
, how many of the geological facts
m observation admitted of diverse ex-
Take the case of *Eozoon Canadense*.
structures which some of the highest
n the Foraminifera assure us are the
an organism belonging to that order;
lists, equally entitled to a hearing,
it that those structures were purely
regates simulating organic forms. And
the question whether the limestones
e problematical fossil occurred were
rmed in some other and perhaps scarcely
ay. And that, after all, was only one
tless uncertainties that crowded the
ct of invertebrate palæontology. In
e light had we constantly to grope our
we attempted the naming of fossil
r instance. The two species, *Gryphæa*
*Gryphæa bilobata*, furnished an illus-
rked forms were clearly separable, but
obtain a suite of specimens, even from
of which the second species was said
lly characteristic, showing a gradual
one form into the other. And over
in the distinctions relied upon for the
n of species must be pronounced far-
d shadowy, and were, it was to be
n based upon points which were of
e for classificatory purposes. In the
plants the last statement was notori-
nd yet we were continually supplied
s of species which every botanist knew
and nothing more, and zonal divisions
pon those bogus species and conclusions
them. It was from data such as had
d, scrappy to the last degree, or from
of being interpreted in more than one
determinations shrouded in mist and
at geologists had in a large number of
conclusions. Inferences based on such
d shaky foundations must necessarily
ely hypothetical. That that was the
a great portion of the conclusions of
ere ready enough to allow. But it
question whether that homage at the
c was in many cases anything better
ice. One way to make a geologist
ch him any geology at all to begin
d him first into a laboratory, give
d long spell at observations and
s requiring the minutest accu-
so saturate his mind with the
f exactness that nothing shall ever
rive it out. It was easy to pick out
practical work as would not only
ntal habits aimed at, but would also
good stead when he went on to his
t. The uncertainties with which the
eologist are so thickly strewn have an
cational value, if only we are on our
t taking them for anything better than
e. A man who is ever dealing with
idence and geological conclusions, and
o estimate these at their real value,
th him, when he comes to handle the
lems of morals, politics, and religion,
with which his geological experience
him. There are immense advantages which the science may claim as an educational instrument. In its power of cultivating keenness of eye it is unrivalled, for it demands both microscopic accuracy and comprehensive vision. Its calls upon the chastened imagination are no less urgent, for imagination alone is competent to devise a scheme which shall link together the mass of isolated observations which field work supplies; and if, as often happens, the fertile brain devises several possible schemes, it is only where the imaginative faculty has been kept in check by logic that the one scheme that best fits each case will be selected for final adoption. But, above all, geology has its home—not in the laboratory or study—but beneath the open sky; and its pursuit is inseparably bound up with a love of nature, and the healthy tone which that love brings alike to body and mind. Geology should be taught in schools, and for more prosaic reasons, of which the two following are perhaps the most important. Geography is essentially a school subject, and the basis of all geographical teaching is physical geography. This cannot be understood without constant reference to certain branches of geology. Again, how many are the points of contact between the history of nations, the distribution and migrations of peoples, and the geological structures of the lands they have dwelt in or marched over. But geology is not an easy subject to teach in schools. The geology of the ordinary text-book does not commend itself to the boy-mind. The most neatly-drawn sections, nay, even the most graphic representations of gigantic and uncouth extinct animals come home to the boy but little, because they are pictures and not things. He wants something that he can handle and pull about; he does not refuse to use his head, but he likes to have also something that will employ his hands at the same time. The kind of geology that boys would take to is outdoor work; and, of course, where it can be had, nothing better could be given them. A difficulty is that field work takes time, and filches away a good deal of the intervals that are devoted to games. Still, cross-country rambles and scrambling about quarries and cliffs are not so very different from a paper-chase; and if the teacher will only infuse into the work enough of the fun and heartiness which comes so naturally in the open air, he need not despair of luring even the most high-spirited boy, every now and then, away from cricket and football. But there are localities not a few—the Fen country for instance—where it is scarcely possible to find within manageable distance of the school, the kind of field geology which is within the grasp of a beginner. But even here the teaching need not be wholly from books. The best that can be done in such cases is to make object lessons indoors its basis. For instance, give a lad a lump of coarsish sandstone; let him pound it and separate by elutriation the sand grains from the clay; boil both in acid, and dissolve off the rusty coating that colours them; ascertain by the microscope that the sand grains are chips and not rounded pellets, and so on. All such points he will delight to worry out for himself; and, when he has done that, an explanation of the way in which the rock was formed will come home to him. Or it is easy to rig up contrivances innumerable for illustrating the work of denudation. A heap of mixed sand and powdered clay does for the rock denuded; a watering-can supplies rain; a trough, deeper at one end than the other, stands for the basin that receives sediment. By such rough apparatus many of the results of denudation and deposition may be closely imitated, and the process is near enough to the making of mud pies to command the admiration of every boy. It is by means like these that even indoor teaching of geology may be made lifelike. The great facts of physical geology which have so important a bearing on geography and history often admit of experimental illustration, such, for instance, as the well-known methods of imitating the rock folding caused by earth movements. During the first year the lectures and bookwork should deal with physical geology. In the laboratory the student should first make the acquaintance of the commoner rock-forming minerals, the means of recognising them by physical characters, blowpipe tests, and the simpler methods of qualitative analysis, and may then go on to work at the commoner kinds of rocks and the elements of microscopic petrography. During the summer months take him into the field, but do no more than impress upon him some of the broader aspects of outdoor work, such as the connection between physical feature and geological structure. During a second year stratigraphical geology should be lectured upon and studied from books, and so much of animal morphology as may be necessary for palæontological purposes should be mastered. The practical work would lie mainly among fossils, with a turn every now and again at mineralogy and petrology to keep these subjects going. Out of doors let not yet the student attempt geological mapping, but put into his hands a geological map and descriptions of the geology of his neighbourhood, and he would be called upon to examine in minute detail all accessible sections, collect and determine fossils, and generally see how far he can verify by his own work the observations of those who have gone before him. Indoor work during the third year would be devoted to strengthening and widening the knowledge already gained. Out of doors the student should attempt the mapping of a district by himself. It will be well, if there is any choice in the matter, to select one in which the physical features are strongly marked.

## THE ADDRESS IN BIOLOGY.

The address in Section D was delivered by Professor A. Milnes Marshall, M.A., M.D., D.Sc., F.R.S., whose discourse was devoted mainly to the subject of the development of animals, because, as he said, in addressing those specially interested in and conversant with biological study, their president acted wisely in selecting as the subject-matter of his discourse some branch with which his own studies and inclinations had brought him into close relation. Embryology, referred to by the greatest naturalists as "one of the most important subjects in the whole round of natural history," was still in its youth, but had of late years thriven so mightily that fear had been expressed lest it should absorb unduly the attention of zoologists, or even check the progress of science by diverting interest from other and equally important branches. Nor was the reason of that phenomenal success hard to find. The actual study of the processes of development; the gradual building up of the embryo, and then of the young animal within the egg; the fashioning of its various parts and organs; the devices for supplying it with food, and for insuring that the respiratory and other interchanges were duly performed at all stages—all these were matters of absorbing interest. Add to these the extraordinary changes which might take place after leaving the egg, the conversion, for instance, of the aquatic gill-breathing tadpole—a true fish as regarded all essential points of its anatomy—into a four-legged frog, devoid of tail, and breathing by lungs: or the history of the metamorphosis by which the sea-urchin was gradually built up within the body of its pelagic larva, or the butterfly derived from its grub. Add to these again the far wider interest aroused by comparing the life-histories of allied animals, or by tracing the mode of development of a complicated organ—*e.g.*, the eye, or the brain—in the various animal groups, from its simplest commencement, through gradually increasing grades of efficiency, up to its most perfect form as seen in the highest animals, and it became easy to understand the fascination which embryology exercised over those who studied it. But all this was of trifling moment compared with the great generalisation which told us that the development of animals had a far higher meaning; that the several embryological stages and the order of their occurrence were no mere accidents, but were forced on an animal in accordance with the law, the determination of which ranked as one of the greatest achievements of biological science. The doctrine of descent, or of evolution, taught us that as individual animals arose, not spontaneously, but by direct descent from pre-existing animals, so also was it with species, with families, and with larger groups of animals, and so also had it been for all time; that as the animals of succeeding generations were related together, so also were those of successive geologic periods; that all animals, living, or that had lived, were united together by blood relationship of varying nearness or remoteness; and that every animal now in existence had a pedigree stretching back, not merely for ten or a hundred generations, but through all geologic time since the dawn of life on this globe. The study of development, in its turn, had revealed to us that each animal bore the mark of its ancestry, and was compelled to discover its parentage in its own development; that the phases through which an animal passed in its progress from the egg to the adult were no accidental freaks, no mere matters of developmental convenience, but represented more or less closely, in more or less modified manner, the successive ancestral stages through which the present condition had been acquired. Evolution told us that each animal had had a pedigree in the past. Embryology revealed to us this ancestry, because every animal in its own development repeated this history, climbed up its own genealogical tree. Such was the recapitulation theory, hinted at by Agassiz, and suggested more directly in the writings of Von Baer, but first clearly enunciated by Fritz Müller, and since elaborated by many, notably by Balfour and by Ernst Haeckel. Natural selection explained the preservation of useful variations, but would not account for the formation and perpetuation of useless organs; but recapitulation solved the problem at once, showing that those organs, though now useless, must have been of functional value to the ancestors of their present possessors, and that their appearance in the ontogeny of existing forms was due to repetition of ancestral characters. Such rudimentary organs were, as Darwin pointed out, of larger relative or even absolute size in the embryo than in the adult, because the embryo represented the stage in the pedigree in which they were functionally active. Rudimentary organs were extremely common, especially among the higher groups of animals, and their presence and significance were now well understood. Man himself afforded numerous and excellent examples, not merely in his bodily structure, but by his speech, dress, and customs. For the silent letter *b* in the word doubt, or the *w* of answer, or the buttons on his elastic-side boots were as true examples of rudiments, unintelligible but for their past history, as were the ear-muscles he possessed but could not use, or the gill-clefts which were functional in fishes and tadpoles, and were present, though useless, in the embryos of all higher vertebrates, which in their earlier stages the hare and the tortoise alike possessed, and which were shared with them by cats and by kings. Another consideration of the greatest importance arose from the study of the fossil remains of the animals that formerly inhabited the earth. It was the elder Agassiz who first directed attention to the remarkable agreement between the embryonic growth of animals and their palæontological history. He pointed out the resemblance between certain stages in the growth of young fish and their fossil representatives, and attempted to establish, with regard to fish, a correspondence between their palæontological sequence and the successive stages of embryonic development. He then extended his observations to other groups, and stated his conclusions in these words:—"It may therefore be considered as a general fact, very likely to be more fully illustrated as investigations cover a wider ground, that the phases of development of all living animals correspond to the order of succession of their extinct representatives in past geological times." This point of view was of the utmost importance. If the development of an animal was really a repetition of its ancestral history, then it was clear that the agreement or parallelism which Agassiz insisted on between the embryological and palæontological records must hold good. Owing to the attitude which Agassiz subsequently adopted with regard to the theory of natural selection, there was some fear of his services in that respect failing to receive full recognition, and it must not be forgotten that the sentence he had quoted was written prior to the clear enunciation of the recapitulation theory by Fritz Müller. The imperfection of the geological record had been often referred to and lamented. It was very true that our museums afforded us but fragmentary pictures of life in past ages; that the earliest volumes of the history were lost, and that of others but a few torn pages remained to us; but the later records were in far more satisfactory condition. Although it was undoubtedly true that development was to be regarded as a recapitulation of ancestral phrses and that the embryonic history of an animal presented a record of the race history, yet it was also an undoubted fact, recognised by all writers on embryology, that the record so obtained was neither a complete nor a straightforward one. It was indeed a history, but a history of which entire chapters were lost, while in those that remain many pages were misplaced, and others were so blurred as to be illegible; words, sentences, or entire paragraphs were omitted, and, worse still, alterations or spurious additions had been freely introduced by later hands, and at times so cunningly as to defy detection. A matter which at present was attracting much attention was the question of degeneration. Natural selection, though consistent with and capable of leading to steady upward progress and improvement, by no means involved such progress as a necessary consequence. All it said was that those animals would, in each generation, have the best chance of survival which were most in harmony with their environment, and such animals would not necessarily be those which were ideally the best or most perfect. Embryology, however, was not to be regarded as a master-key that was to open the gates of knowledge and remove all obstacles from our path without further trouble on our part; it was rather to be viewed and treated as a delicate and complicated instrument, the proper handling of which required the utmost nicety of balance and adjustment, and which, unless employed with the greatest skill and judgment, might yield false instead of true results. Embryology was indeed a most powerful and efficient aid, but it would not, and could not, provide us with an immediate or complete answer to the great riddle of life. Complications, distortions, innumerable and bewildering, confronted us at every step, and the progress of knowledge had so far served rather to increase the number and magnitude of these pitfalls than to teach us how to avoid them.

## THE ADDRESS IN GEOGRAPHY.

The address in Section E was delivered by Sir R. Lambert Playfair, K.C.M.G., F.R.G.S., president, who said that for nearly a quarter of a century he had held an official position in Algeria, and it had been his constant delight to make himself acquainted with the islands and shores of the Mediterranean in the hope of being able to facilitate the travels of his countrymen in that part of the world. What he had to say might be to some a twice-told tale; but still he should like to speak in a familiar way of the "great sea," as it was called in Scripture. It was a well-defined region of many parts, all intimately connected by geographical character, geology, flora, fauna, and the physiognomy of the people. To the general statement there were two exceptions—Palestine and the Sahara. The Mediterranean region was the emblem of fertility and the cradle of civilisation. The sea, a mere gulf, now bridged by steam, rather united than separated the two shores, modifying their climate and forming a junction between three continents. The Atlas range was a mere continuation of the South of Europe. It was a long strip of mountain land, about 200 miles broad, covered with splendid forests, fertile valleys, and in some places arid steppes. In the east of the range the flora and fauna do not essentially differ from those of Italy; in the west they resemble those of Spain. A conifer (*Abies pinsapo*) and alfa grass or esparto grow in both the Atlas and South Europe. Of the 3,000 plants found in Algeria, the greater number are natives of southern Europe, and less than 100 were peculiar to the Sahara. The commonest plant on the south shores, the dwarf palm, grows spontaneously on the north shores, but does not occur in Palestine, Egypt, or the Sahara. There are mammalia, fish, reptiles, and insects common to both sides of the sea. Some of the larger animals, such as the lion, panther, jackal, &c., have disappeared before civilisation in Europe, but lingered through Mahomedan barbarism in Africa. There was abundant evidence of the former existence of these and other large mammals of tropical Africa in France, Germany, and Greece. It was probable they only migrated to tropical Africa after the upheaval of the great sea which in Eocene times stretched from the Atlantic to the Indian Ocean, making Southern Africa an island. The original fauna of Africa, of which the lemur was the distinctive type, was still preserved in Madagascar, which once formed part of Africa. The trout was found in all the snow-fed rivers which fell into the sea, but not in Palestine south of the Lebanon, or in Egypt, or the Sahara. The fresh-water salmonoid was a European type often found in the Atlas. There were newts and tailed batrachians in every country round the sea, again excepting Palestine, Egypt, and the Sahara. The zone of desert called the Sahara was popularly supposed to have been a vast inland sea, in very recent times; but the theory was supported by geological facts wrongly interpreted. It was abundantly proved by the researches of travellers and geologists that such a sea was neither the cause nor the origin of the desert. Rainless and sterile regions occurred in two belts around the world about equal distances north and south of the Equator. These corresponded in locality to the great inland drainage areas from which no water can be discharged into the ocean and which occupy about one-fifth of the total land surface of the globe. Some parts of the Sahara (described in detail) are below the level of the sea, and here are formed open depressions without any outlets, inundated by torrents in winter and covered with a saline efflorescence in summer. The salt does not prove the former existence of an inland sea; it is produced by the concentration of the natural salts washed down by winter rains, with which the unevaporated residue of water becomes saturated.

## THE ADDRESS IN ECONOMIC SCIENCE AND STATISTICS.

The address in Section F was delivered by Prof. Marshall, M.A., F.S.S., president, the main point being "Competition," although he dealt only with some aspects of the subject. He said, for instance, though the absence of any proper industrial census in England prevents us from getting exact information on the subject, yet there seems no doubt that the increase in the average size of factories has gone on, not faster, but slower than was thought probable a generation or two ago. In many industries, of which the textile may be taken as a type, it has been found that a comparatively small capital will command all the economies that can be gained by production on a large scale; and it seems probable that in many industries in which the average size of business has been recently increasing fast, a similar position of maximum economy will shortly be attained without any much further increase in size. Those reductions in the expenses of production of commodities which have been claimed by the eulogists of trusts and other large combinations, as tending to show that their gains are not at the expense of the public, turn out generally to have been at least equalled by the reductions in the expenses of production in similar industries in which there was no combination. And this count in their eulogy, though it may truly stand for something, seems to have been much exaggerated. After all, what these very large public firms and combinations of firms have done has generally been only to turn to good account existing knowledge, and not to increase that knowledge. And this brings us to the main reason for regarding with some uneasiness any tendency there may be towards such consolidations of business. Observation seems to show, what might have been anticipated *à priori*, that though far superior to public departments, they are, in proportion to their size, no less inferior to private businesses of a moderate size in that energy and resource, that restlessness and inventive power, which lead to the striking out of new paths. And the benefits which the world reaps from this originality are apt to be underrated. For they do not come all at once like those gains which a large business reaps by utilising existing knowledge and well-proven economies; but they are cumulative, and not easily reckoned up. He who strikes out a new path by which the work of eight men is rendered as efficient as that of ten used to be, in an industry that employs 100,000 men, confers on the world a benefit equal to the labour of 20,000 men.

## THE ADDRESS IN MECHANICAL SCIENCE.

The address in Section G was delivered by the President, Capt. Noble, C.B., F.R.S. Shortly before the termination of the long period of peace which commenced in 1815, the attention of engineers and those conversant with mechanical and metallurgical science seems to have been strongly directed towards improvements in war material. It may easily be that the introduction of steam into the Navy may have had something to do with the beginning of this movement; but its further progress was undoubtedly greatly accelerated by the interest in the subject awakened by the disturbance of European peace which commenced in 1854. Since that date—whether we have regard to our vessels of war, the guns with which they and our fortresses are armed, the carriages upon which those guns are mounted, or the ammunition they employ—we shall find that changes so great and so important have been made that they amout to a complete revolution. I believe it would be more correct to say several complete revolutions. It is at least certain that the changes which were made within the period of ten years following 1854 were far more important and wide-spreading in their character than were all the improvements made during the whole of the great wars of the last and the commencement of the present century. Indeed, it has always struck me as most remarkable that during the long period of the Napoleonic and earlier wars, when the mind of this country must have been to so large an extent fixed on everything connected with our naval and military services, so little real progress was made. Our ships, no doubt, were the best of their class, although I believe we were indebted for many of our most renowned models to vessels captured from our neighbours. They were fitted for sea with all the resources and skill of the first seamen of the world, and when at sea were handled in a manner to command universal admiration. But their armaments were of a rude nature, and so far as I can see possessed little, if any, advantage over those of nearly a couple of centuries earlier. It is not improbable that the great success which attended our arms at sea may have contributed to this stagnation. The men who with such arms achieved such triumphs may well be forgiven for believing that further improvement was unnecessary, and it must be remembered that the practice of engaging at very close quarters minimised to a great extent the most striking deficiencies of the guns and their mountings. The President then went on to describe some of the more recent additions to the British Navy.

## THE ADDRESS IN ANTHROPOLOGY.

The address in Section H was read by Prof. F. W. Rudler in the unavoidable absence of the president, Dr. J. Evans, F.R.S. The president wrote: In the year 1870 I had the honour of presiding over what was then the Department of Ethnology in the Biological Section of the British Association at its meeting in Liverpool. Since that time twenty years have elapsed, during the greater portion of which period the subjects in which we are principally interested have been discussed in the department of anthropology forming part of the organisation of the Biological Section; although since 1883 there has been a new section of the Association—that of anthropology—which has thus been placed upon the same level as the various other sciences represented in this great parliament of knowledge. This gradual advance in its position among other branches of science proves, at all events, that, whatever may have been our actual increase in knowledge, anthropology has gained and not lost in public estimation, and the interest in all that relates to the history, physical characteristics, and progress of the human race is even more lively and more universal than it was twenty years ago. During those years much study has been devoted to anthropological questions by able investigators both in England and abroad; and there is at the present time hardly any civilised country in the world in which there has not been founded, under some form or another, an anthropological society, the publications of which are yearly adding a greater or less quota to our knowledge. One or two [illegible] jects, both theoretical and practical, are still under discussion by anthropologists, and as yet no general agreement has been arrived at by those who have most completely gone into the questions involved. One of these questions is—What is the antiquity of the human race, or rather, what is the antiquity of the earliest objects hitherto found which can with safety be assigned to the handiwork of man? This question is susceptible of being entirely separated from any speculations as to the genetic descent of mankind; and even were it satisfactorily answered to-day, new facts might to-morrow come to light that would again throw the question entirely open. On any view of probabilities, it is in the highest degree unlikely that we shall ever discover the exact cradle of our race, or be able to point to any object as the first product of the industry and intelligence of man. We may, however, I think, hope that from time to time fresh discoveries may be made of objects of human art, under such circumstances and conditions that we may infer with certainty that at some given point in the world's history mankind existed, and in sufficient numbers for the relics that attest this existence to show a correspondence among themselves, even when discovered at remote distances from each other. Of late years how little have we heard of any scruples in accepting as a recognised geological fact that, both on the Continent of Europe and in these islands, which were then more closely connected with that Continent, man existed during what is known as the quaternary period, and was a contemporary of the mammoth and hairy rhinoceros, and of other amimals, several of which are either entirely or locally extinct. The principal instances on which the believer in Tertiary man relies may be classified under three heads:—(1) The presumed discovery of parts of the human skeleton; (2) that of animal bones said to have been cut and worked by the hand of man; and (3) that of flints thought to be artificially fashioned. On the whole, therefore, it appears to me that the present verdict as to Tertiary man must be in the form of "Not proven." Another question of more general interest than that of the existence of Tertiary man is that of the origin and home of the Aryan family. The views upon this subject have undergone important modification during the last twenty years. The opinions based upon comparative philology alone have received a rude shock, and the highlands of Central Asia are no longer accepted without question as the cradle of the Aryan family, but it is suggested that their home is to be sought somewhere in Northern Europe. While the Germans contend that the primitive Aryans were the blue-eyed dolichocephalic race, of which the Scandinavians and North Germans are typical examples; the French are in favour of the view that the dark-haired brachicephalic race of Gauls, now well represented in the Auvergne, is that of the primitive Aryans. Looking at the changes that all languages undergo, even when they have the advantage of having been reduced into the written form, and bearing in mind the rapidity with which these changes are effected; bearing in mind, also, our extreme ignorance of the actual forms of language in use among prehistoric races unacquainted with the art of writing, I, for one, cannot wonder at something like a revolt having arisen against the dogmatic assertions of those who have, in their efforts to reconstruct early history, confined themselves to the comparative study of languages and grammar.

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## ABSTRACTS OF REPORTS, PAPERS, &c.

### Horned Dinosaurs.

In the Geological Section, Prof. Marsh (U.S.) gave an interesting account of his discoveries with regard to the gigantic Ceratopsidæ, or horned Dinosaurs. During the last two years, Prof. Marsh has been working in the far west of America, near the Rocky Mountains, at certain beds called Laranie. It was formerly doubted as to whether these beds were tertiary or cretaceous, and it has now been found, by examination of the flora, that the lower part is true cretaceous, and that the upper part is tertiary. In the true cretaceous these Saurian remains have been discovered. They are of great size, and the blocks in which they are imbedded sometimes weigh as much as two tons. Securing them has been a work of great difficulty, and has called for the exercise of much engineering skill. The remains, of which the professor exhibited diagrams, particularly of the skull, differ from those most familiar to European workers. The skull is of great size, and is characterised by two large horn cores near the eyes, and by one smaller horn core on the nose, like the rhinoceros, the latter extending a considerable way backwards, where it appears to be armed by rudimentary cores. The teeth also are peculiar in having two fangs implanted crosswise. In the adult, the length of the skull is quite 6ft. The brain is relatively very small. To bear this enormous weight there are peculiar modifications of the neck vertebræ and of the four limbs. Prof. Marsh is disposed to refer this Ceratopsida to a distinct order of the Dinosaurs.

### Aluminium for Artillery Purposes.

Mr. H. J. Dagger contributed a paper on "The Use of Aluminium Bronze for Artillery and Small Arms." He said one reason for the employment of this metal was that in 1860 the price of the metal was 4s. 11d. per lb., whereas it was now obtainable in the market for 1s. 4d. per lb. His views on this subject were generally highly approved of by the president, with the reservation that perhaps this metal would be found more serviceable and reliable in the manufacture of small arms than of large field guns.

### Drugs Scientifically Examined.

In the Biological Section, Mr. W. Sharp described some experiments with drugs as a question of science. At the meeting held at Nottingham in 1866, a paper was read on "The Physiological Action of Medicines," the subject being the action of medicines when taken in health. Suggestions were made relative to further experiments, and they have been continued since. The primary object of these experiments is to answer this question of science. What is the action of substances called drugs on the living body of man? Experiments made in order to discover this action must be made on persons in health. This inquiry is comparatively a new one, and as yet little is known of it. The conclusions arrived at are the results of experiments with different quantities of the same drug. They are 14 in number, and include the following:—The smallest doses used in these experiments have power to act upon the living human body; the commonly received opinion that the actions of drugs are simply increased in degree and not altered in character by increasing the dose is an error; the actions of drugs are sufficiently distinct to admit of classification.

### The Human Lens.

In the same section, Dr. W. J. Collins offered some contributions to a knowledge of the composition of the human lens, especially in reference to the changes it undergoes with age and in cataract. This research was undertaken as being ancillary to the question of the propriety of extraction of immature cataracts. It was found that information on the subject of the varying composition of the human lens in regard to solids, water, &c., in relation to age was very meagre. The difficulty of obtaining clear, fresh, human lenses for analysis restricted the number of observations and extended the duration of the research; the value of the data obtained is enhanced by the identity of procedure in each case. Post-mortem material was not employed. Incidentally the research corroborated some previous work on the increased weight of the lens with advancing age. The weight, total solids, water, and ash, and the percentage proportion of the last three to the first were set forth in the case of 12 clear human lenses at ages four to 68 in a table. The researches of Becker, Deutschmann, Cohn, Loptschmiky, Priestley, Smith, and others are briefly reviewed. Due caution is observed in considering the results of above analyses as rather contributory and suggestive than final and conclusive. Attention is drawn to the increasing weight generally observed with age, and to the small range of the ratio of solids and water in healthy lenses, being fairly constant at all ages. Comparison is made with similar analyses of ten cataractous lenses, and conclusions drawn as to the nature of the change; and certain bearings of the facts ascertained upon the nature of presbyopia, hypermetropia acquisita, and glaucoma, and the operation for cataract are pointed out.

### Report on Naphthaline Colours.

In the Chemical Section, Prof. H. E. Armstrong, F.R.S., made a report on isomeric naphthaline derivatives. He said the committee had been enabled this year to complete a survey of the work which had been done in the field, and had fully revised all that had been stated. The vast majority of colours used in the present day were derived from naphthaline.

### The Simplex Brake.

In the Mechanical Section, Mr. W. B. Marshall described the "simplex" brake, the principal feature of which is that it can be applied or released from either side of the waggon; it is thus equivalent to an ordinary lever brake upon each side of the waggon, but with this important difference, that in the case of the ordinary lever brake it must be released or taken off on the same side on which it is applied or put on; the "simplex" can be taken off or put on at either side. The brake apparatus consists of a lever or actuating handle, pivoted at its centre, and working horizontally under the waggon. This lever is furnished with a toothed rack to hold it in any desired position, and is connected by two links or pull-rods to the ordinary brake apparatus. These links are furnished with slots, which engage with suitable pins upon the lever which they are connected to, and equi-distant from the central pivot. The normal position of the lever is at right-angles to the side of the waggon; if the end be either pulled towards or pushed from the headstock, the brake is applied by means of the slotted pull-rods, the lever acting in the first or second order according to the direction in which it is moved. The action is the same upon both sides of the waggon. This brake has been working for some time past with great success upon the London and South-Western, North-Eastern, Great Eastern, and Belfast and Northern Counties Railways. It can be applied to present vehicles at small cost, as the brake-riggings, such as shafts, hangers, levers, and brake-blocks, can be utilised.

### The Coal-Tar Industry.

Dr. W. H. Perkin, F.R.S., read a paper on the development of the coal-tar industry since 1880. He named various colouring matters which had been discovered since 1880, or which were steadily increasing, and illustrated his remarks by experiments with different colours. Germany was still holding the first position in the market, both as to quality and quantity; but the competition of Swiss, French, and English manufacturers with that country had been steadily increasing. Several years since he ventured to express his opinion as to the necessity of scientific research being made an important part of the training for chemical students in their school of chemistry, so that highly skilful chemical men imbued with a spirit of investigation might be produced, not only to fill chemical chairs, but also to occupy important positions in chemical works. Hitherto not so much progress had been made in this direction as could be desired, and he feared that this was to some extent due to their manufacturers not having as a body sufficiently realised the great importance of employing such men in their works. Thus, the demand being small, the supply necessarily corresponded; but surely the wonderful development of the coal-tar colour industry, which had been and still was being carried on in so thoroughly scientific a spirit, was an example which should not be forgotten, and it was to be hoped that its effect would be to stimulate their chemical manufacturers in a similar direction, and that they would find chemical works in this country provided with well-equipped laboratories and occupied by fully qualified men, so that their chemical industries might be raised to the highest possible state of perfection.

Sir Frederick Abel (President of the Association) said he had been struck with the concluding remarks made in reference to the reasons why they were to a great extent left behind in the development of that particular industry. There were now great works in Germany where chemical research was carried on as an elaborate business; where men even who had acquired University degrees and distinction were retained at liberal salaries to pursue simply the work of research. He knew of one establishment alone where there were as many as 50 well-trained chemists at work upon that particular class of research. If they could get a small army of men in England, headed by Dr. Armstrong, to systematically pursue the work, he felt they might hope soon to recover lost ground. In the first years of the coal-tar industry they claimed it as peculiarly their own, but now they could not do so in view of the competition of the French and Germans. The matter was one of great importance, especially to Leeds, and they owed a debt of gratitude to Dr. Perkin for his paper.

### Report on the Teaching of Chemistry.

Prof. W. R. Dunstan read the third report of the Committee on the Present Method of Teaching Chemistry. During the past year the committee had been principally engaged in collecting and comparing the regulations with respect to chemistry which were issued by the more important of the examining bodies in the kingdom, in order to discover how far their requirements were in harmony with such a course of instruction as that suggested by the committee in their second report, presented at the Newcastle-on-Tyne meeting. The committee considered it desirable to direct special attention to the following points:—It is of great importance that natural science should be sufficiently represented on the board which issues the regulations and is responsible for the proper conduct of the examination. It is remarkable that although chemistry is an important subject in the Oxford and Cambridge schools examination, no representative of this science is appointed by either University to act on the Examination Board, whilst Oxford does not appoint a representative of any one branch of natural science. The committee note with satisfaction that in these examinations, most of which are held to test proficiency in general education, chemistry is generally included, in addition to one or more branches of experimental physics, and that in many cases the examination is in part a practical one. As regards the status occupied by chemistry and experimental physics in public examinations, the position of these subjects is still lower than that of the other principal subjects of examination, and much yet remains to be done to secure the adequate recognition of the educational value of natural science. The committee are strongly of opinion that some attempt should be made to remedy a conspicuous deficiency in nearly all existing examinational regulations. It is virtually impossible to ascertain in the course of a single short examination, especially when the number of candidates is large, whether sufficient time has been devoted to the study of the elements of physical science to make it of permanent advantage to the student; neither is it possible to determine whether the character of the instruction has been in every respect satisfactory.

### Pulsations of a Rotating Bell.

In the Section of Mathematics, Mr. G. H. Bryan (Cambridge) read a paper descriptive of experiments conducted by him with regard to the pulsations of a rotating bell. He said it was well known that if a vibrating elastic rod of circular section be rotated upon its axis, the plane of vibration remains fixed in space instead of turning with the rod—an experiment frequently used to illustrate the corresponding property of polarised light. If, on the other hand, a tuning-fork be rotated, beats will be heard which indicate that the vibrations turn with the fork. The object of the paper was to show that when a vibrating ring, cylinder, bell, or other elastic shell in the form of a surface of revolution is rotating about its axis of figure, the nodes and points of maximum radical displacement will not remain fixed either in space or in the body, but will turn about the axis with angular velocity less than that of the body. He proved this first mathematically from a ring or cylinder, and found that the results of experiment agree pretty closely with theory.

## SCIENTIFIC NEWS.

It may be remembered that at the June meeting of the Royal Astronomical Society, Mr. Common, F.R.S., exhibited some photographs of the cluster 5 Messier taken by the aid of his five-foot reflector at Ealing on different dates. Considerable differences of magnitude were observed in many of the stars near the cluster; but Prof. Pickering says that an examination of the photographs taken at Harvard College proves beyond doubt that the star about 9″ or 10″ *s.p.* the cluster varies between 9·76 and 11·6 mag., while the south component of the wide pair following the cluster varies between 9·3 and 12·2 magnitude. Those who lay themselves out for watching "variations" may do good work by observing 5 Messier with reflectors as well as refractors.

Two more small planets have seemingly been discovered—one, mentioned last week, by Dr. Palisa, and now another by M. Charlois, of Nice, which will reckon as 296, on August 19. The asteroid discovered by M. Charlois is very near Hera (103), but the difference in magnitude suggests that it must be new. Hera was discovered by Prof. Watson of Ann Arbor, Michigan, 22 years ago.

The death is announced of Miss Marianne North, the accomplished artist, botanist, and traveller. She was born at Hastings in 1830, the eldest daughter of the late Mr. Frederick North, M.P. Miss North early developed a strong taste for natural history and a desire for travel, and in 1865 she went with her father to the East. For two years they resided in Egypt, Syria, and Palestine, and after Mr. North's death in 1869 his daughter devoted herself to painting as a profession. In 1869-70 she executed a large number of landscapes in Sicily, and in 1870 visited Canada, the United States, and Jamaica. Her sketches made in these places were the foundation of the present collection at Kew. She next went to Brazil to paint the flora of the country, and she was received with much distinction by the Emperor. Teneriffe, India, and Ceylon were then visited, the result being a splendid collection of studies. A selection from them was exhibited before the Royal Society. In November, 1877, Miss North went to India, and on her return two years later she offered her entire collection of pictures to the authorities at Kew, in trust for the nation, and she engaged to build at her own cost a gallery for their reception. The offer was accepted, the hanging of the paintings was superintended by the artist herself, and on July 8, 1882, the gallery was thrown open to the public. There are upwards of 700 paintings, and, according to the testimony of Sir J. D. Hooker, it would be impossible to overrate their usefulness and scientific importance. On August 4, 1882, Miss North left for the Cape, to study the vegetation of South Africa. Early in 1883 sixty new paintings were sent to Kew, and in June the collection had so increased that a new room was added to the building. On September 24, 1883, Miss North left London for Mahé, the principal island of the Seychelles group, where trees and flowers flourish which are unknown elsewhere. Here also she made many valuable sketches. She subsequently visited, in pursuit of her artistic and scientific objects, California, Borneo, Java, Australia, and New Zealand. A final journey undertaken to South America brought on a long and painful illness, from which Miss North never recovered, and she died a few days ago at her home in Gloucestershire, leaving a work which few can surpass.

In our "Scientific News" last week we, in a moment of forgetfulness, spoke of the friendly rivalry which might be set up by the publication of Mr. Higgs's photographs of the solar spectrum when compared with the drawings of M. Thollon. We forgot that M. Thollon had "joined the majority," but we have no doubt he would have enjoyed a view of Mr. Higgs's photographs.

Dr. James Matthew Duncan died recently at Baden-Baden, in the 64th year of his age. He was F.R.S., and a worthy representative of his native city, Aberdeen, where he was born in 1826.

Tardy news of the death of Prof. O. Silvestri, who held the chair of chemistry at Catania in 1863, but was subsequently invited to Turin, has been received. He made Mount Etna his especial study (just as Palmieri studies Vesuvius), and by his efforts an astronomical and meteorological observatory has been erected on Mount Etna at an altitude of 3,000 mètres.

The British Association meeting at Leeds has not been a success, so far as numbers are concerned, they being below the total of recent years. Next year the Association meets at Cardiff, and at the general committee meeting held on Monday, the secretary read a communication from the Lord Provost of Edinburgh, inviting the Association to hold its meeting in 1892 in that city. The invitation was supported by a deputation consisting of Baillie Colston, Dr. Russell, Prof. G. F. Armstrong, and Dr. J. B. Haycraft. Sir W. Thomson formally moved that the meeting of the Association in 1892 be held in Edinburgh. The motion was seconded by Prof. Fitzgerald, and on being submitted to the meeting was carried unanimously. Lord Rayleigh proposed that Dr. W. Huggins should be appointed President of the Cardiff meeting, remarking that that gentleman had a long-established reputation as a master of astronomy, especially with regard to the application of the spectroscope to astronomy, and that any address he might deliver on the occasion would be worthy of his subject. He added that some time had elapsed since an astronomer had been in the presidential chair. Mr. J. W. L. Glaisher seconded the resolution, and the President supported it, and agreed that, in electing Dr. Huggins, they would not only be doing honour to themselves, but would secure an excellent president to direct their work. The resolution was adopted. Lord Windsor, Lord-Lieutenant of Glamorganshire, the Marquis of Bute, Lord Rayleigh, Lord Tredegar, Lord Aberdare, Sir J. T. D. Llewellyn, Prof. Michael Foster, and Dr. A. Geikie were elected vice-presidents to assist Dr. Huggins. After some discussion as to the most suitable time, it was decided that the Cardiff meeting should commence on the 19th of August next year, and local officers were appointed. Prof. A. W. Williamson was re-elected general treasurer of the Association, Sir Douglas Galton and Mr. Vernon Harcourt were also chosen general secretaries, and Mr. G. Griffith was appointed assistant general secretary. The ordinary members of the council and the auditors were also adopted.

In connection with meteorological matters, Mr. A. L. Roch, of Boston, U.S.A., gave a description of an observatory which has recently been erected on Mont Blanc. Until recently, he said, the highest meteorological station in the world was in the United States, on Pike's Peak, at an elevation of 14,134ft. above the sea, and the highest station in Europe was on the Sonnenblick, in the Austrian Alps (10,170ft.). The French, who had done so much for high-level meteorology, could now claim the highest station in the world, M. Vallot having established a cabin provided with many registering instruments at the Rocher des Bosses, 1,460ft. below the summit of Mont Blanc, or 14,320ft. above the sea. It was hoped to maintain the instruments—which had to be attended to once in 15 days—in action during four months of the year. A series of intermediate stations was projected. Mr. J. G. Symons alluded to the expense of keeping up observatories where attendants had to be located, and said he was inclined to think that self-recording instruments would be successful. If they could be made to go for 15 days, they could be made to go for 31 days—indeed it was difficult to say where the limit would be. He did not suppose that tenths of degrees could be recorded by self-recording instruments, but tenths of degrees were not always of much consequence.

The Monday evening lecture was delivered by Prof. C. V. Boys, who showed his audience how he made his now celebrated "quartz fibres," and to what uses (or some of them) they could be applied. He exhibited their application as suspenders for extremely delicate apparatus. The fineness of the filaments was illustrated by showing, through the aid of the lantern on a screen, a living spider running over its web. The spider was then transferred to a web of the quartz fibre, which proved so delicate and smooth in comparison that the spider slipped at every attempt to climb the threads. The heat from a candle at the extreme end of the hall was sufficient to turn a mirror suspended by one of the fibres, the movement being made visible by the deflection of the spot of light on the screen. A musical note even had the same influence, and what is perhaps still more wonderful, the attraction of gravity of the 25-millionth part of a grain acting on a torsion balance made of the same fibre was also visible. Mr. Boys showed by means of a gold-leaf galvanometer that the fibre is also a perfect insulator.

The extraordinary rainfall of this year in New South Wales is shown by the following statement from the Sydney Observatory:—Average annual rainfall for 31 years, 49·226in.; average rainfall, from January 1 to June 30, for 32 years, 31·156in.; rainfall this year, from January 1 to July 21, 67·301in.

Prof. Möller, of Carlsruhe, has made some interesting observations on clouds. The highest clouds, cirrus and cirro-stratus, rise on an average to a height of nearly 30,000ft. The middle clouds keep at from about 10,000ft. to 23,000ft. in height; while the lower clouds reach to between 3,000ft. and 7,000ft. The cumulus clouds float with their lower surface at a height of from 4,000ft. to 5,000ft.; while their summits rise to 16,000ft. The tops of the Alps are often hidden by clouds of the third class, but the bottom of the clouds of the second class, and especially of the thunder clouds, often enfold them. The vertical dimensions of a cloud observed by Prof. Möller on the Netleberg was over 1,200ft.; he stepped out of it at a height of about 3,700ft., and high above the mountain floated clouds of the middle class, while veils of mist lay in the ravines and clefts. The upper clouds were growing thicker, while the lower ones were dissolving, and soon it began to rain and snow.

Experiments are being conducted in the Channel near Folkestone for the purpose of testing the geological structure of that portion of the sea-bed upon which it is proposed to constru a bridge across the Straits. The engineers in charge of the work are M. Georges Hersent and M. Renaud, marine hydrographic engineers. The examination of the French coast is finished, and so far as it has proceeded on the English side the Channel it has, it is stated, proved very satisfactory, the sea bottom being very solid and suitable for the proposed structure. There is comparatively very little variation in the depth except at the sand-banks, which would be bridg over.

**Thiol in Skin Diseases.**—Prof. Schwimm of Buda Pesth, has used thiol, a substance v similar to ichthyol, but free from unpleasant od and made by heating gas oil with sulphur, i large number of skin diseases with remarkable s cess. In herpes zoster, acne simplex, and rosac in moist eczema and in burns, he paints the affec parts with a solution in distilled water, of strength of one in four, twice a day, not wash the application off for two or three days. In s long standing cases the washing is still longer layed. In some cases an ointment (one three) was employed, and in some the dry pow itself.

# LETTERS TO THE EDITOR.

*[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]*

*All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

*All Cheques and Post-office Orders to be made payable to* J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

◆

## LUNAR SURFACING BY GLACIATION —EROSIVE AGE ON THE MOON— VOLCANIC ACTION WITHOUT WATER —RING FORMATION — MAGNETIC (OR ELECTRICAL) ACTION ON THE MOON.

[31556.]—MR. PEAL, in his letter on page 512 produces, as an argument in favour of lunar surfacing by glaciation, the fact that there is "no evidence of a long temperate era of erosion and sedimentary-rock formation" on the moon similar to that observed on our mother earth. Now, has it occurred to this worthy gentleman that an age of erosion and sedimentary-rock formation may actually have existed on our neighbour; but that all evidence, or nearly all evidence, of its existence was obliterated during the volcanic age, and not by a final glacial age?

I have sketched an imaginary section of the moon. We will take $a$ to be its surface during the erosive age, and $w$ its water. At $h$ we draw a limit, where we will suppose the heat of the interior during the early part of this age was sufficient to convert water into vapour—i.e., we will take it as that point below the moon's surface where the heat of the interior was sufficient to prevent further absorption of water from without. I am not overlooking the fact that "water can penetrate capillary passages, even into cavities filled with steam, and under-pressure may remain as water, even at a white heat. I only intend my line $h$ as an average limit. Now the interior goes on cooling, and the limit of absorption (or of great heat, if that suits better) gets nearer the centre of the globe, and arrives after ages, say, at $k$. This leaves the space between $h$ and $k$ capable of taking up moisture; and I conceive, considering the small proportion which the quantity of water on the moon must have borne to its total mass, that this is actually what took place on our satellite. That as the heat was dissipated, and the heated portion became less, more of the moon's substance was capable of taking up water, and this lessening of heat and extension of absorption continued until the whole of the water was absorbed, except that which the extreme cold towards the end of the erosive age converted into ice and snow.

At the end of the erosive age, then, I imagine the higher lands were covered with snow and ice, the lower lands were waterless and barren; although some ice which covered the frozen seas might have been left behind when the water beneath it was gone.

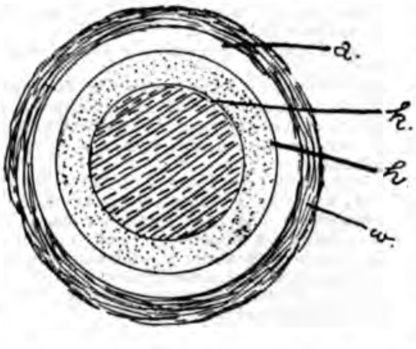
Now, having arrived at this semi-glaciated condition (we will assume with evidences of rivers and seas), what destroyed it all? I answer, Volcanic action. For, after the water was soaked up, the moon still continued to cool. The pressure upon the nucleus $k$, and the strain upon the crust $a$, must have increased as the contraction consequent on cooling continued. What then happened must have been the breaking up into cracks and fissures of the crust, and the escape by these paths of vast volcanic eruptions from the nucleus $k$; which, having been pent up under increasing pressure for ages, would send up such rushes of lava that we cannot find a terrestrial comparison, and which would have converted small ruptures in the crust into terrific gaping volcanic mouths.

I do not believe that all the absorbed water would be driven out by this process; but the molten lava would have converted the remaining ice and snow on the surface into vapour to be, after a considerable time, re-deposited as snow, as stated in my letter on p. 271.

"Without water there can be no volcano." I think Prof. Judd must be wrong. Highly-heated substances under very high pressure do not liquefy; but on pressure being removed, they become liquid. Now the heated nucleus $k$ may be perfectly solid under pressure, yet when contraction has sufficiently distorted the crust to relieve this pressure at any point, liquefaction and volcanic action can commence; and, when once commenced, where is the end?

Can we take Mars to prove anything as regards ring formation? The snow rings around his seas will vanish when the crust gives way, as I assume the moon's has done. The rings on the moon may be caused by the flowing up of sheets of lava over the old cliff lines of somewhat circular and departed seas, the middle of the seas subsiding as the lava cooled and the volcanic action ceased. Or, as Proctor stated, "by volcanic fires, upheaving a large region, and forming all round it a ring of raised rocky matter, while later the interior seems to have been invaded by liquid matter from without, carrying in and depositing substances of the same kind as those which form the surface of the so-called seas."

I do not quite understand Mr. Peal when he says "the moon has . . . . passed through the temperate era of erosion of *air*, rain, and river," when he later on states, "there is very little *evidence of* . . . . *air* in the moon," and he objects to the statement "hot air," when he admits air may have existed on the moon, and says that "our moon has yet a large store of initial heat which is slowly passing off."



Mr. Peal has brought my name into the last paragraph of letter 31443 in such a manner, that your readers will at first sight imagine that I believe the probable effect of "solar heat" is an objection to the theory of snow on the moon. My original letter does not express that; and I do not so believe.

After Mr. Peal's argument as to the improbability of snow becoming ice, and gliding off glacier-like to lower levels, and all that follows the statement in his letter of July 21st, down to the word "moon," I scarcely think he is in agreement with his own ideas, when he in his letter of the 6th July makes "avalanches" possible.

Admitted I am wrong as to the cause of the rays, and that I have wrongly used the word "ridges," I cannot see that Mr. Peal's account of the rays is any better. One thing his theory would account for, and one only—the brightness. But is the electrical action which occasions the removal of the meteoric dust according to his theory probable? "There seems no reason why, in giving it (i.e., the initial heat of the moon) off occasionally when there is an unusual discharge of aqueous vapour, it should not give rise to electrical phenomena." Quite so, but why always along the same rays? Would vapours always be given off at the same place, and the directive action of the currents of electricity (or of the discharges, if it is considered that electricity is stored, and finally discharged in the direction of the rays) always be the same? That is, would the exciting cause or causes of these electrical phenomena always be seated in the same portion of the interior of the moon? Would they not rather shift about, and consequently the rays change their direction if this were true?

I think we can fairly assume that the moon, if magnetic at all, is magnetic in the same sense that our earth is magnetic. Now the effect of the earth's magnetism is directive and not translative. That is, a magnetic body will arrange itself in a line, so as to point to the magnetic north and magnetic south, but if ever so free to act, will not approach one fraction nearer or depart one fraction further from the magnetic poles. In the case of an aurora, a magnetic needle floating in water will be deviated sometimes to more than a degree, but it does not float towards the cause of the deviation. When it is distinctly proven that the earth's magnetism is translative, then will I believe that vast paths of meteoric dust can by magnetic action be displaced on the moon, and not before.

Mr. Peal will not, we know, agree with me that the moon has been finally surfaced by volcanic action, because he has pointed out in letter 31154 that "our earth affords us a fairly clear demonstration that such could not be the case." But I contend the condition of our earth does not demonstrate this. I believe the moon was once very like what our own globe is at present, but being so much smaller has cooled so much more rapidly that she has passed through the various stages of planetary existence almost to the last stage, that last stage being when the remainder of her initial heat shall have been dissipated. And so surely as our earth goes on through the ages to come, do I believe that as it cools and contracts it will go through very similar stages to those experienced by our satellite. I mean that its waters will be absorbed, and a final volcanic upset, as previously explained in connection with the moon, will be the near finish of the piece; that in this final volcanic upset so much heat will be dissipated that another such a one would be impossible; and that then, if we could see it, we should arrive at a point where our earth would be slowly giving up her remaining initial heat, as the moon is now doing. In concluding this letter, I shake hands with Mr. Peal on the good humour of this correspondence.

**Henry Stooke.**

## METEORS.

[31557.]—IN reply to "R.R.L.'s" letter (31501), I much regret to say that I omitted to state the date I saw the apparently large meteor. It was on Sunday, August 17th, at 9.20 p.m., and therefore the one you mention is of no use. Do you not think there is a probable difficulty for two observers to know when they saw the same meteor, because of the possible difference in brightness due to their distance apart. Take, for instance, an observer at Yarmouth and another at Dublin. The former might observe a brilliant meteor in zenith, whereas the latter (360 miles west) might see the same meteor, but inferior in brightness—probably one-sixteenth. Under such circumstances, when the two observers compare notes, their observations would not appear to satisfactorily agree to definitely state that they both observed the same meteor.

**Heliostat.**

## A VISIT TO THE OBSERVATORY OF THE LATE ASTRONOMER, JAMES NASMYTH.

[31558.]—IT has been said, "The world soon forgets its great men." I am surprised at the small amount of interest created by the death of the astronomer, Mr. James Nasmyth, the inventor of the celebrated steam-hammer. The world is profiting by his great discovery, which he never patented. All his inventions in mechanical tools, and all the results of his arduous astronomical labours, he gave them freely to his fellow-man. At one time he entered into conversation with me upon this subject, and said, "It was all a work of love."

When Mr. Nasmyth retired from business in 1857, he had purchased the "Cottage in Kent," as he called it, and afterwards gave it the name of "Hammerfield." Hammerfield is near the village of Penshurst, Kent, and is close to Penshurst Castle, the residence of Viscount De L'Isle and Dudley.

I had the pleasure of being a near neighbour of Mr. Nasmyth for six years, and can bear testimony to his congenial disposition. To an astronomer, of course, the chief interest of Hammerfield lay in the large telescopes. There are three, two of which are reflectors, and were constructed by himself; the other is a refractor, by Cooke and Sons, of York.

The observatory is built on the west side of the residence, and contains the 8in. refractor, fixed upon a massive iron pillar. The dome of the building is fixed upon rollers, which a lad can easily rotate. The observatory is nicely fitted up. There is a cabinet containing choice geological specimens of rocks and fossils, some of which are from the coal measures. He exhibited to me a diagram, copies of which he had distributed amongst the geologists at a meeting of the British Association, showing a position of the Earth's curve to the scale of one-tenth of an inch to a mile. He set out the height of Mount Blanc, Etna, and also the depths of the deepest mine, as showing the almost incredible minimum of knowledge we possess about even the surface of the earth. This diagram conveyed a correct idea of the relative magnitude of geological phenomena in comparison with the earth itself.

The walls of the observatory were hung with astronomical subjects. One was a drawing of Jupiter's disc, 30in. in diameter, drawn by himself, showing the cloud-belts with their snowy white borders, also the large brick-red spot.

Another was a beautiful photograph of the full moon about 2ft. in diameter, which was presented to Mr. Nasmyth by Warren De La Rue, of Cranford Observatory, and was, he said, the first given to any friend. There was also a model in plaster of Paris, showing a section of the moon's surface, with its craters and wall-surrounded plains. He had sixteen models, showing the principal parts of the lunar surface.

On one occasion he saw me looking at a piece of mechanicism suspended by a fine wire from the dome of the observatory. He said, "When Sir John Herschel was here, he laughed heartily at my simple illustration, showing how large and small globes revolve around the centre of gravity." It was simply a small brass rod with a wood ball about 4in. in diam. fixed on one end, and a small one on the other. The fine wire from the dome was fastened round the brass rod, so that the small ball balanced the large one. These were made to revolve, and the centre of gravity was supposed to be where the fine wire was fastened around the rod.

The moon, as seen through his 8in. Cooke, was really grand. Some of the lunar craters appeared to be nearly filled to the brim with lava. The wide and apparently level tracts which have received the name of seas, appeared like deserts of sand, with small craters scattered over their surface. I observed two or three apparently filled with sand, with the rims of the craters protruding through. Mr. Nasmyth turned the telescope upon the walled-plain Plato, which is about 70 miles in diameter. The walls varied in height from 4,000ft. to 8,000ft. On the west and north walls were lofty peaks, which cast their black shadows across the plain, which look, said Mr. Nasmyth, "like the towers and spires of a great cathedral." I observed a landslip on the north-east of the circular wall, the bottom edge of the mass which had slipped down projecting in towards the centre of the plain.

The great alpine valley, which is about 80 miles long, and six wide at one end, lay to the west of Plato. The late Rev. T. Webb compared the shape of this remarkable valley to a "Florence oil flask." The valley connects the sea, or Mare Imbrium, and the Mare Frigoris.

I observed the isolated Mount Pico upon the dark grey Mare Imbrium, which rises to the height of 8,000ft. The summit of this striking mountain is divided into three peaks, which cast their shadows on the plain. I observed also at the base of the mountain several small craters.

At another time he showed me the lunar Apennine mountains, extending to a length of 450 miles. The summit of this mountain range is crowned with peaks, some of which rise to heights of nearly 20,000ft. In a line with the base of this mountain I observed two chasms; Mr. Nasmyth informed me that they were a mile wide. In the same field of view were three craters to the south of the Apennines—namely, Archimedes, Autolycus, and Aristillus. Archimedes is a fine object, with a terraced wall, crowned with many peaks, some of which rise to the height of 7,000ft. I observed two chasms, each a hundred miles long, proceeding from the opposite external sides of this crater. The black shadows of the Apennine and the Archimedes crater peaks presented a striking contrast to the bright lunar surface.

Mr. Nasmyth's two reflectors are fixed upon the lawn. One is a 13in. and the other a 20in. He gave me his opinion respecting reflectors. He said, "If I had my days over again, I should not go in for reflectors. When I was a young man I could run up a ladder; now I am older I find it very inconvenient. Besides, when I had everything ready for observation, I often found my 20in. speculum covered with dew, and the tube currents greatly interfered with good definition." In fact, Mr. Nasmyth never made any appointment for any friend to meet him for observation with his reflector. He used at such times his 8in. refractor.

Mr. Nasmyth entered into conversation with me respecting observatories. He said, "I received a letter a few days ago from a gentleman in Scotland, asking my advice respecting building an observatory. I wrote and told him to build a *hut* for his telescope, and when he required its use, to drive it out into the open air." Mr. Nasmyth informed me that the heat arising from the walls and dome of an observatory prevented good definition.

The tube of Nasmyth's 20in. reflector was made with trunnions, like a cannon; one of the trunnions was hollow, to admit of the eyepiece. The whole was mounted on a turn-table, having a seat opposite to the eyepiece. The observer, when seated, could direct the telescope to any part of the heavens without moving from his seat. He described the mechanism of this beautiful telescope to me, and showed how a little boy could move the instrument to any part of the heavens.

It was at Hammerfield, in June, 1860, that he discovered, with his large reflector, the "willow-leaf" objects on the surface of the sun, which has since been confirmed by the astronomers, Sir John Herschel, Warren De La Rue, Stone, Secchi, and others. I had a conversation with him in 1886 on the subject of the "willow-leaf" objects, when he said: "My large reflector is influenced greatly by atmospheric disturbance, owing to the end of the tube being open, so that I have seen them four times only since I discovered them in 1860."

There were times when he had a good night with his large reflector. Referring to these nights, he said: "When I turn the telescope to any position of the heavens, especially to any part of the Milky-way, the sight of myriads of stars brought into the field of view is overpoweringly sublime. Turn the telescope to any part of the heavens, it is the same."

In fact when sweeping the heavens with this telescope, the stream of stars which crossed the field of view was beyond all description. The grandeur of the magnificent scene impressed the mind with the great immensities of space in which the millions upon millions of suns were scattered.

Of late years Mr. Nasmyth has been little heard of, only among his friends. He died through decay of nature on the 18th of May last, aged 82 years. He leaves the bulk of £243,000 to eleven benevolent institutions, not forgetting the Society for the Prevention of Cruelty to Animals.

Sept. 2. I. Webb.

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## THE LAW OF PLANETARY ROTATION.

[31559.]—The desirableness of such a law is evident from the expression of the learned J. P. Nichol, LL.D., F.R.S.E., and late professor of astronomy in Glasgow University. See his "Phenomena of the Solar System." "Why do the planets rotate so variously? Where the relation of these varieties? That laws like these can result from chance is a supposition too monstrous for belief. The supposition obtrudes itself that some profound secret of nature is before us in dim shadow. But though the achievement be remote, the history of the final and certain evolution of truth forbids us to be so unphilosophical as to despair. Let us recall the sentiment of the old Greek, 'That the divinities do not act unexplicably,' and with stout heart push boldly but warily on."

The law I propose is the simple law of squares following.

The squares of the rotary periods of the planets are directly proportional to the inclination of their equators to that of the sun. Or, more simply, the rotary periods are as the square root of said inclinations.

So bulk, mass, density, and distance from the sun, etc., are entirely out of the question in the investigation of planetary rotation; or, if you prefer using axial velocity to rotary period, it is inversely as the square root of said inclination; so the more parallel a planet's equator be to that of the sun, the greater will be the velocity, but the shorter the rotary period.

I don't discuss the cause of the law in this paper: it can make no difference as regards the law; the revolutionary law of Kepler was accepted, though it received no explanation till the time of Newton. Yet, I have my theory.

A few examples will decide as to the merit of the above claim. The greatest difficulty is to ascertain the true value of the angles of inclination of the planets' equators to the equator of the sun; they are not given in any astronomical work that I have seen; but they can be calculated, and, I deem, sufficiently near to prove the law.

The inclination of the Ecliptic to the sun's equator, according to Herschel, is 7° 20′; Lockyer, Loomis, and others give it as 7° the mean is 7° 10′ this taken from the obliquity of the Ecliptic, 23° 27′ 24″ = 16° 17′ 24″, or 16·283°, the inclination of the earth's equator to that of the sun, whose square root is 4·035. The inclination of the planets' orbits to the Ecliptic is also given by authors—viz., that of Mercury is 7° 0′ 8″; Venus, 3° 23′ 31″; Mars, 1° 51′ 5″; Jupiter, 1° 18′ 40″; and Saturn, 2° 29′ 28″. Now the inclination of the earth's orbit to the sun's equator being taken as 7° 10′, those of the other planets are found by applying those angle last found to it, observing that in the cases of those planets whose axes incline to that of the sun by a smaller angle than that of the Earth, the inclination of their orbits to the Ecliptic must be taken from the 7° 10′, but in the others added to it. The results are — Mercury, 14° 10′ 8″; Venus, 3° 46′ 29″; Mars, 9° 1′ 5″; Jupiter, 5° 51′ 20″; and Saturn 4° 40′ 32″.

Example 1.—*For the Rotary Period of Mercury.*—The inclination of Mercury's equator to its orbit, as given by authors, is about 31°. Now, if the other elements as given in the tables are correct, this angle is given a trifle too large for the resulting rotation period of Mercury to agree with that found from observation: it should be 30° 40′ 38″; for 30° 40′ 38″ — 14° 10′ 8″, the inclination of Mercury's orbit to the sun's equator = 16° 30′ 30″, or 16·507969°, the inclination of Mercury's equator to that of the sun, whose square root is 4·063°. Then, say, by rule of proportion, as 4·035° found before, is to 23h. 56min. 4sec., so is 4·063°, to 24h. 6min., the given rotary period of Mercury, as seen in Lockyer's table.

Example 2.—*Find the Rotary Period of Mars.*—Of Mars, Prof. Lockyer remarks:—"The inclination of its axis to the plane of its orbit does not differ much from the earth's, and its seasons are, therefore, similar to ours"; but he gives the inclination of its equator to its orbit as 28° 51′. If this is the case, the seasons in Mars cannot be so similar to ours as they appear to be. He gives the rotary period of Mars as 24h. 37min. 23sec.; to obtain this by my law, the inclination of Mars' equator to its orbit should be only 26° 14′ 26″. Prof. G. W. Hill lately gave it as 24° 52′. The mean of these two given observations must be about the right estimation, for 26° 14′ 26″ – 9° 1′ 5″ = 17° 31′ 21″, the inclination of Mars' equator to that of the sun, or 17·2225°, whose square root is 4·150°. Then, by rule of proportion, as 4·053° is to 23h. 56m. 4s., so is 4·105° to 24h. 37m. 23s., the given rotary period of Mars.

Example 3.—*The Rotary Period of Jupiter.*—For my next example I shall pass on to the trans-asteroid group, and take the case of Jupiter, for its elements also are found very nearly correct from observations. Here is a chance to test my law. A planet a thousand times larger than any of the former, and hundreds of millions of miles further from the sun than any of them, and yet rotate on its axis in less than half of the time.

The period of the rotation of Jupiter, as found from observations on the large red spot, is given as 9h. 55m. 22s. The inclination of its equator to its orbit, according to Lockyer, is 3° 4′; this added to 1° 18′ 40″, the inclination of Jupiter's orbit to the Ecliptic = 4° 22′ 40″, the inclination of Jupiter's equator to the Ecliptic, which, in this case, must be *subtracted from* the 7° 10′, and there remains 2° 47′ 20″, or 2·7888°, the inclination of Jupiter's equator to that of the sun, whose square root is 1·67°. Then, say by rule of proportion as before, as 4·035° is to 23h. 56m. 4s., so is 1·67° to 9h. 54m. 19s., the rotary period of Jupiter which is within about 1m. to the observed period. Now there is no dodge in this. Can it be a chance coincidence? Have I not as much claim to my law as Kepler had to the revolution law when first discovered?

Example 4.—*Of the Rotary Period of Venus.*—Venus is one of those planets of which it is said that the landmarks observers have seen on their surfaces, are very precarious things; consequently, the value of some of their given elements is not much to be depended on. Sir William Herschel says of them: "As to the mountains of Venus, no eye that is not considerably better than mine, or assisted by much better instruments, will ever get a sight of them." Sir John Herschel says: "Sometimes we may, indeed, fancy to see obscurer portions, but can seldom rest fully satisfied of the fact." Nevertheless, Schroeter succeeded in tracing the paths of these spots and obtaining an approximate value of its rotary period; and as to the inclination of its axis to the plane of the Ecliptic, he said, "it is a large angle"; but how large he doesn't tell us; but astronomers now estimate the inclination of the axis of Venus to its own orbit at about 75°, but on what ground I never learnt. (See Steele's "Astronomy.")

To get out the rotary period given by Lockyer—viz., 23h. 16m.—according to my law, the above value is a few degrees too large. It should be only 70° 39′ 35″, for 90° – 70° 39′ 35″ = 19° 20′ 25″, the inclination of Venus's orbit to its equator, from which take 3° 46′ 29°, the inclination of Venus's orbit to the sun's equator: there remains 15° 22′ 55″, or 15·382084°, the inclination of Venus's equator to that of the sun, whose square root is 3·922°: then, as 4·035° is to 23h. 56m. 4s., so is 3·922° to 23h. 16m., the given rotary period of Venus.

Again, 15° 12′ 55″ – 7° 10′ = 8° 12′ 55″, the inclination of Venus's equator to the Ecliptic, and 90° – 8° 12′ 55″ = 81° 47′ 5°, the inclination of Venus's axis to the Ecliptic, or the large angle Schroeter observed but could not determine its value, alluded to before.

5. *Of Saturn's Rotary Period.*—The approximate value of the required elements of Saturn are more difficult to determine from observations than even those of Venus. It has been stated that the rotary period of Saturn is about 10½h., the period Laplace assigned for the revolution of the ring about the planet, and that its equator lies in the plane of the ring, and so inclining to its orbit at about 31°. (See Steele's "Fourteen Weeks in Astronomy.")

If both these statements were true, then, the law fails for Saturn. For if the first were true, Saturn's position in its orbit would be similar to that of Jupiter; but if the latter were true, its position in its orbit would be similar to that of Mars, and its period of rotation nearly the same. But on further inquiry, it appears there is but very small evidence that either of them is true. As to the latter, it is found that in the case of Jupiter the belts of the planet are exactly parallel to its equator; but those of Saturn are far from being parallel to the ring. Why should they differ so? Schwabe found that the globe of Saturn is not concentric with the ring, but inclines to a certain distance to the west.

These observations show that but little is yet known about how Saturn is situated in its orbit. It is thus known that the globe of Saturn is not placed in the middle of the ring, so the ring must be an ellipsis, and the planet placed in one of its foci; hence the ring is in the capacity of a satellite's orbit.

The orbit of our moon inclines about 18 degrees to the equator of the earth, so there is no necessity for the orbits of the satellites of Saturn and its ring to be in the plane of its equator. Prof. Asaph Hall, of Washington, from a spot he observed moving on the planet found the diurnal period of Saturn 10h. 14m. 23s. Sir William Herschel gave it as 10h. 15m.; so the rotary period of Saturn is not the same as the revolutionary period of its ring. Since the equator of Jupiter is exactly parallel to its belts, is it not more reasonable to assume the equator of Saturn to be also parallel to its belts than in the plane of the ring, which Herschel found incline more than 15 degrees to the belts? In all her circumstances Saturn and Jupiter are similar each other; so are Mercury and Mars, their urnal periods, eccentricity of orbits, &c. But ese latter are similarly posited in their orbits. 'hy are the former not so?

And suppose Saturn's equator were actually in e plane of the ring, as astronomers assume, should at be considered fatal to my law? Sir John erschel made allowance for what he termed *sidual phenomena*. Alluding to the retrograde ovement of the satellites of Uranus, though it ceives no explanation from what is yet known of e law of universal gravitation, yet the principle of avity as applied to planetary motion should not ignored on account of this. So, seeing my law greeing as near as it could be expected in the cases Mercury, Venus, and Mars, and again come to ithin a minute in the case of Jupiter at so vast a stance, it appeared to me that there must be a law rking there. **Thomas Job.**

Goshen, Utah Co., Utah, U.S.A.

## THE REFLECTING TELESCOPE.

[31560.]—"Tenebris" (letter 31512) refers to s visit to a friend "who uses a moderate-sized flector," and quotes the result in antagonism to e performance of reflectors. Now, as the "friend" luded to, I should just like to mention that I have ferred to my diary for particulars of the visit hich "Tenebris" describes. It was made on ay, 1887, and on a night when definition was at s worst; your correspondent says "sober stars" oked like "corkscrews," but this must have been ue to some idiosyncrasy of vision on his part, for I w merely the usual flaring due to a very disturbed tmosphere. I cannot understand his comparison ith "corkscrews," for we were both "sober," and ad not been requisitioning the services of the nplement named.

I certainly told "Tenebris" that my reflector did ot appear to give good star discs, but in explanation I may say that stellar astronomy is quite out of y line, and that on the very few occasions I have oked at stars they have not been beautifully steady nd sharp and surrounded with the diffraction rings s seen in a really good instrument. But I think, n the rare occasions alluded to, the air was not good, and I have certainly never tested my telescope properly on stars.

During a long experience, I have found the reflector a magnificent instrument, and capable of the most delicate work. No refractor could surpass it in definition. Their drawback is the liability of the mirrors to tarnish. In the refractor the great drawback is the inconvenient position of the observer while at work. I am sure that those who fail with reflectors should seek for the cause in themselves, for it does not lie in their instruments.

**A Friend of "Tenebris."**

[31561.]—The sweeping charges which "Tenebris" brings against the reflector will call forth many rejoinders from those who use it and know its excellence. I think "H. E." in your last has hit the nail on the head in saying that it is probable "Tenebris's" refractor is a 4in. or 3¾in., and the reflector 8½in. or 9in., and that he expects them to be the same. I have a 4in. o.g. by Wray, in which the discs are charming on almost any night; but they would not be so with a 9 or 10in. o.g. Some time since I was looking through a 10in. o.g. by Cooke, a very fine instrument, and I was surprised to see Arcturus with a less perfect disc—indeed, more flare than in the 10in. mirror I had at that time. "Tenebris" asks in your last if the cause which makes a close unequal double difficult to define would not also render the delicate marking next to the bright part of a planet or the moon indistinct. I should reply, certainly not. The definition of Jupiter or Saturn with my 12½in. equatoreal reflector, by Calver, is superb, as the reflected light is so different to the dazzling light of a bright star. I think it is admitted by all that for the moon or planets the reflector of equal aperture is superior in definition and effect to the refractor, to say nothing of the exquisite achromatism of the mirror. For dividing and measuring close unequal doubles, the refractor would be the superior; but I think it is not too much to say that for everything else the reflector bears the palm.

Those who have reflectors should master the adjustments, which to anyone with the usual enthusiasm of telescopists is easy enough; but to make them quite perfect, there is, I believe, nothing at all comparable to the "spot-and-pinhole" method, which I described in the English Mechanic of July 3, 1882 (Vol. XXXIV. page 520). The usual eye adjustment is nothing to the perfection which is attained by this, and it has everything to do with definition.

None but professed astronomers can expect to do much of any great value in the measurement of doubles, though it would seem that even for this nothing can exceed the beauty and accuracy of the 18½in. mirror owned by the Rev. J. J. M. Perry.

But what a world is opened by a 10in., 12in., or 18in. mirror in the nebulæ and star clusters! Put a 4in. o.g., and then an 8in., 10in., or 12in. mirror upon such objects as the clusters in Perseus, Gemini, and Monoceros in the Milky Way; or the superb isolated clusters in Hercules, Libra, and Canes Venatici; or the Nebulæ in Andromeda and Orion, and the amateur will not be long in deciding which he will have.

The perfection of my 12½in. mirror, and the accuracy of its equatoreal mounting, with clock, and all the mechanical arrangements described in the English Mechanic of May 7, 1886 (Vol. XLIII. page 213), would enable me to do anything with it in the distances and angles of double stars, if I used the micrometer; but I am not able to pursue it in this direction. I am content to see the beauties and glories of the heavens revealed in such a way as could not be equalled with a refractor, or a cost for instrument and observatory of less than £2,000.

Fordingbridge. **T. Westlake.**

[31562.]—All workers with the telescope will gratefully welcome such information as some of the replies to my inquiries contain, and it seems pretty evident that reflectors are steadily doing a great work. The tone of Mr. Calver's letter is to be regretted, as it was my aim to avoid the contentious spirit that characterised some of the contributions to the reflector and refractor controversy. Messrs. Calver and With have done for the former instrument what Dollond, Barlow, and Wray did for the latter, and they have the gratitude of every student of astronomy; but Mr. Calver's remarks are unnecessary, and suggest a weak case, whereas we know he has a *strong* one.

With everybody's friend, "F.R.A.S.," scattering broad-cast knowledge enough to build an encyclopædia, under a nom de plume, none of us need apologise for remaining incognito; besides, a man's writing under his real name is no *proof* of his bona fides. In my previous letters concerning the performance of reflectors, I wish it had been possible not to mention the refractor at all; but as it has been a tried and proved weapon for so many years, it must of necessity always be our standard of comparison when later forms are being discussed. I have abundantly acknowledged the value of a fine speculum upon a suitable night; but are such fine opportunities sufficiently frequent to justify anyone in investing in a large one? I ask in no carping spirit, though I must confess that putting out a reflecting telescope time after time to find it useless does warp one! As regards the great number of mirrors in use now, of course, that may be due to some extent to having been sold at less than cost, and may not point to high efficiency.

Mr. Calver's remark that "perhaps the success of the reflector disturbs" me may be taken for what it is worth, coming from one who evinces so much "disturbance" in his own letter. My reflector is 6½in., and my refractor 2½in. aperture, and both are very fine. The comparison I consider a fair one when stops are used on the reflector; but I may say that my experience of the use of stops is not pleasing, as the size of the diffraction rings seems to be so much increased by them. My eyepieces include several forms and makes. Why would it be unfair to compare a 4in. o.g. with a 9in. speculum? I should have thought the mirror would gain by such a comparison; but if the less cumbrous arm would do all the work of the latter on most occasions, and is more useful on poor nights, it is the best form to buy, especially as, even in price, the two are not very different when the repeated silvering is taken into account. My knowledge of refractors only extends to very moderate-sized ones, a 6in. being the biggest I have ever used. Their great value seems to lie in their certainty on fair nights, and they never give one that feeling almost akin to disgust that reflectors sometimes do.

Atmospheric conditions bad for reflectors are *not* always equally so for the other instrument. As "H. E." (31516) says, "there are very few nights indeed when a 4in. aperture (refractor) will not give good star-discs, and stand 80 to 100 to the inch." When could such powers be used on a 4in. mirror? About two or three times a year at the outside, and then the film must be good. **Tenebris.**

## PHOTO-MICROGRAPHY.

[31563.]—According to Mr. Bousfield we have had his last contribution to the discussion of what he defines as the "Dallinger, Nelson, and Mayall *v.* Czapski" question; and, like his other contributions to the discussion, it does not advance the question much if at all. It leaves no doubt, however, as to the position he has taken up towards Dr. Czapski. If Mr. Bousfield imagines that implicit faith in everything which Mr. Nelson does is sufficient to decide who is right and who is wrong, he may find himself grievously mistaken.

In regard to the presence of Dr. Dallinger at the first trial of the lens, all I can say is that my statement was founded on the report to which I referred —a report the accuracy of which Mr. Bousfield has not seen fit to call in question. I ask Mr. Bousfield, however, to point to a single sentence in any of my letters containing a charge of incompetence, or of deception, against any one of the three gentlemen named. If Mr. Bousfield is a gentleman who is "always willing to meet, fairly and above board, antagonists who can argue courteously, even under assumed names, scientific questions of general interest," he will do so; if not, we will know what to think of him. However competent a man may be, even though his insignificance may be covered by an assumed name, no one has a right to make such a charge as Mr. Bousfield makes against him, unless he can stand by it.

Mr. Bousfield has shifted the difficulty about the thread and the weight arrangement from the trunnions of his microscope to its collimation, and there, so far as I am concerned, it may remain. I may tell Mr. Bousfield, however, that instead of my focussing arrangement existing in my imagination, as he states, I have had one similar to that described by "F.R.M.S." (but without the screw) in actual use for nearly three years; and, further, I may say that, with the exception of stating how the thread was adjusted when it got out of line with the pulley, I never gave any description of it at all.

My "plain question" (31425, p. 514) about the use of eyepieces with photographically perfect lenses Mr. Bousfield says he will answer when I produce my photographically perfect lens. From the position he took up on this point he could scarcely have answered the question in the negative; and he dared not answer it in the affirmative, for it has already been answered in the negative by a far greater authority than he is. He thinks, however, he will get out of the difficulty by stating that there is no such thing as a photographically perfect lens. That there is not such a thing as an optically perfect lens, to which he evidently refers, may be quite true; but Mr. Bousfield knows very well that this is not what I referred to. There are plenty of lenses which are photographically perfect—i.e., their foci are absolutely coincident. I have a 1in. objective by Wray (first series) which is so sensitive photographically to any deviation from the visual focus that it requires the greatest care in focussing for the visual image in order to get the negative absolutely sharp.

I never put any absurd or other interpretation on Mr. Bousfield's remark about "F.R.M.S.'s" quotation about the use of the bull's-eye being the crux of the whole subject. I merely ridiculed Mr. Bousfield's trifling reference to the quotation. Anyone, however, who may be curious to know what Mr. Bousfield really does say will find the statement in the last paragraph of page 31 of his "Guide to the Science of Photo-micrography."

Mr. Bousfield is evidently anxious to know whether "F.R.M.S." and "Coarse Adjustment" know each other. Whether we do or not is a matter of little consequence; but I should be surprised to learn that Mr. Bousfield has had an opportunity of comparing our styles of caligraphy.

From what Mr. Bousfield has written on the subject I think his "mental adjustment" is not quite so fine as it ought to be. Mine may be "coarse," but his evidently requires a little looking to in "collimation." I asked him (31486, p. 555) where was Mr. Nelson's "successful" negative he told us about (31459, p. 531)? But he does not seem to have found it yet. Perhaps he may be able to do so when he gets his mental "collimation" properly adjusted.

In regard to the inquiries of "Pathologist," I would suggest that he should try the focussing arrangement with the thread and weight. I think he will understand the arrangement from what has been written; if not, I shall be glad to assist him. For a focussing screen for the final adjustment of the image nothing is better than a sheet of ordinary glass with a perfectly true surface, on which the thinnest film of beeswax has been rubbed, placed in the frame of the ordinary focussing-screen. Warm the glass, and rub over it smartly with the forefinger a small piece of the wax, rubbing until it has been almost all removed—in fact, until the glass has just been left dim. With a magnifier, very fine details can be seen on this.

**Coarse Adjustment.**

## HOMŒOPATHY.

[31564.]—I have no wish to stir up the well-known "Odium Medicum," but your correspondent, "Innominate," in his criticism of "The Lydney Dispenser," makes so complete an error, that I am tempted to ask him in fairness to read what I have to say.

He argues from "The Lydney Dispenser" to homœopaths in general. I need scarcely point out that it would be unfair for a homœopath to take as his standard for criticism of orthodox medicines the advertisements of allopathic chemists. I am a firm believer in the homœopathy of to-day, but I cannot understand the conceptions of the "Dispenser," nor do they represent more than the crude dogma of the similars in drug action which was the rule-of-thumb of the earlier homœopaths, and no more to be taken as the standard of the homœopathy of to-day than are the bleedings, purgings, and salivations of regular medicine of the same early days, to be taken as the standard of orthodox medicine of to-day, though it is probable that the rule-of-thumb of the first homœopaths was a safer thing for the patient than the bleedings, &c.

"Innominate" forgets that the homœopath has the same training as the orthodox man—the same diplomas, the same means of making a correct and scientific diagnosis, the same respect for the great intellects of the day in the profession, and the same conception of his duty as has the most earnest of non-heretical medical men.

Where we part is on therapeutics, and this is our only ground of difference; what the orthodox man does only occasionally, and that in some of his most successful practice, the homœopath does as a rule. When "Innominate" gives a patient arsenic for some gastric irritation, mercury perchloride for dysentery, nux vomica for some forms of spasmodic constipation, and many more such instances, he is giving the patient as a curative the drug which is the specific irritant of the organ or structure diseased—the drug which pathologically produces the diseased condition he has to deal with, and he has to give it in a small dose, because the larger one would increase the disease; and the homœopath not only gives the drug, but he believes that there is a definite law at work, and he selects, wherever he can, the drug which has this relation to the symptoms (which indicate the seat of the pathological change), this belief in specific medication, which is not contradicted by any of the great discoveries of the "brilliant intellects" which "Innominate" mentions. Can he fairly call it, as he does, "superstition and quackery"?

When the books on therapeutics of the dominant school of medicine teem with instances of this relation between drug and disorder, and when such instances are confessedly the most useful of all the regular practice, and in face of the grave tendency of modern medicine in this branch, therapeutics, to be led by fashion and fads in the place of natural law, orthodox men should pause before they so hurriedly condemn as "quacks, fools, and knaves" those who are working as hard and as earnestly as any to establish what they believe to be the natural laws which should guide us in our selection of medicines. If "Innominate" were to read the last number of *The Monthly Homœopathic Review* he would find there a distinct opinion that the instances which some euthusiast have taken to be those of cataracts absorbed, are fallacious.

His contempt of the abbreviations bry., calc., and merc. are out of place. The system of writing in the orthodox prescriptions is worse than that of the homœopaths—for example, hyd. for mercury is surely more unintelligible to the ordinary eye than is merc. for the same. Calc., for calcium he uses himself, and what is the fault of bry. for bryony? His example of the restoration of an amputated limb is nonsense, and unworthy of a scientific opponent. **Gerard Smith.**

Craigholm, Upper Clapton, Aug. 30th.

## FLEXIBLE SUPPORTS FOR PHOTOGRAPHIC FILMS.

[31565.]—The value of flexible supports for photographic films is so well known that I beg to call the attention of your photographic readers to the following patented invention of Mr. F. Crane, of New Jersey, U.S.A.:—

Paper has been used as a temporary support, the sensitised film being laid upon it in long strips, and apparatus provided by which rolls of this film can be placed in the camera, unrolled without opening the camera, and successive plates exposed. This improvement has lessened weight; but on account of the want of transparency in the paper, it has been found necessary, after exposure and development, to separate the film from the paper, and coat the film with collodion. The pyroxyline support, thus provided, requires skill to apply, and an accident may destroy the picture on the negative; while it has been found impracticable to thus secure anything but a very light and unsubstantial support.

Attempts to substitute pyroxyline for paper in the first instance have not proved successful, the strips of celluloid or plastic compounds of pyroxyline (either rolled or split thin) having insufficient flexibility for use on rolls. It has also been found impracticable to form these pyroxyline supports by means of ordinary collodion, the film which could be formed from a cingle application (unless the liquid when applied was too thick to flow) being too unsubstantial, while subsequent applications injuriously acted upon or dissolved the previously formed film. Moreover, the great contraction of collodion in drying was objectionable, as it caused the film to buckle.

The improved film or support may be made from a thin solution of pyroxyline flowed upon a smooth surface, called a "carrier," and the thickness regulated by the number of coats, when, by using a nearly saturated solution, I am enabled to apply successive coats of this pure pyroxyline compound, which, heretofore, has not been done. It may be made also from a very heavy solution of pyroxyline, and spread upon the carrier, the thickness being regulated by the spreader. In practice I prefer to use the heavy solution and spread it, as it is more quickly done, and cheaper than by flowing. In making these solutions, I use as a solvent any liquid or solvent which will thoroughly dissolve the pyroxyline, and will not give the film a greasy surface—to which the gelatine emulsion will not adhere—nor injuriously affect the gelatine emulsion when applied. In the heavy solution it is preferred to use gum camphor as one of the solvents, and I mix with the solution any of the miscible non-solvents, such as amyl alcohol, butyl alcohol, and petroleum naphtha, which, while having little or no solvent power in themselves, or often desirable ingredients in these solutions from their water-repellent qualities and cheapness.

For a thin solution to be flowed upon glass, or other polished carrier, the following is found to be a good formula: Methyl (or wood) alcohol, 40 gals.; amyl, propyl, or butyl acetate, or mixtures thereof, 20 gals.; Amyl alcohol, 40 gals.; soluble pyroxyline, 50lb. The solution is so nearly saturated that the second application thereof (which is frequently necessary to secure a sufficiently thick and substantial support) will not destroy nor injure the previously formed film. The solution is allowed to flow upon glass (preferably first coated with a thin solution of indiarubber in benzine, or other suitable coating, to prevent adhesion), and when dry it is stripped from the glass or other carrier and cut into desired sizes, or into long strips to be used from rolls, for which the invention is especially well adapted.

For a heavy solution, to be spread upon the carrier by a spreading-knife or a straight edge, the following formula is a good example:—Methyl (or wood) alcohol, 55 gals.; amyl alcohol or fusel oil, 20 gals.; amyl acetate, 25 gals.; gum camphor, 50lb.; soluble (photographic) pyroxyline, 100lb. For amyl alcohol in the foregoing formulas, butyl alcohol or its isomer may be substituted, and for the amyl acetate, the acetate of butyl or other ethers of butyl alcohol and amyl alcohol which are known solvents of pyroxyline, may be substituted. Also, the proportions in which the liquids are mixed will somewhat depend upon the amount of dampness in which they are to be worked, the degree of solvency of the pyroxyline employed, the consistency of the solution desired, and the amount of susceptibility to water required in the film.

The solution given in the last example is too heavy to flow, but it is distributed upon the glass or other polished carrier (prepared as before mentioned) by means of a knife or other equivalent device, as is well understood, and when the film has set or hardened, I strip it from the carrier and cut it into plates or long strips to be used from rolls. After taking the pyroxyline film from the glass or other carrier, I distribute upon it the sensitised gelatine emulsion from cylinders revolving in a trough containing the emulsion, or in any of the well-known ways of distributing the emulsion upon its support. Or I may distribute the sensitised gelatine emulsion by spreading it upon the pyroxyline film before its removal from the glass or other carrier. After being coated with the gelatine emulsion, the strips of coated films are placed in holders, or rolled upon rollers, and are then ready for use in the camera.

If, for any reason, it is found desirable to use less pyroxyline, or to use stronger or more energetic solvents in any of the solutions named, the surplus or too active solvent power may be reduced by the substitution of miscible non-solvents in sufficient quantity to neutralise the excess of solvent, the amount of these non-solvents to be used in any case depending entirely upon the amount of unemployed solvent power which is desirable to reduce.

It is to be understood that I do not confine myself to the particular solvents named, which are enumerated as examples. For instance, in place of, or in conjunction with, amyl alcohol, or fusel oil, or butyl alcohol, or their isomers, I sometimes use benzoline, or petroleum naphtha, or benzoline. It is necessary, however, to use about the proportions named of non-hygroscopic menstrua to prevent clouding the resultant film; but, in general, any of the well-known solvents may be employed, provided they are not of such a greasy nature as to prevent the adherence of the sensitised emulsion to the finished film; and the choice of these depends upon the time required for the film to set or dry. This invention may also be used as a support for photographic prints, especially in the production of transparencies.

Thinking this invention may be suggestive, but without knowing whether it is new or not, I send it for insertion in your columns, which are widely read by amateur photographers. **J. T. D.**

## STAINING WOOD.

[31566.]—Although the staining of wood is clearly against the canons of æsthetic art, the following may be useful to those who cannot afford the more expensive woods and do not like the colour of deal, &c.:—

To stain wood mahogany, take logwood and boil until you have a strong decoction. When cold, add some apple cider vinegar, say one-third of the quantity required. A simple application to the wood will give a good imitation; but if a fine job of staining is required, have some burnt umber mixed with just enough glue to bind or fasten the colour on the wood, being careful not to put on any more than just enough to accomplish that, as too much glue will spoil the next operation and make the whole job a botch. Try it on a piece of wood first, and if after this umber is dry the wood takes the stain of logwood, it is right; if it does not absorb quickly, then it has too much glue in it. Mucilage is a little more expensive, but I prefer it to glue, using it in the same manner. When this is applied or while wet, wipe with a rag; when dry, stain very freely with logwood, using a sponge or a rag to wipe out what the wood does not take, but do not rub so strongly as to work the umber. Then shellac and varnish or polish, as the case may be. The idea of the umber treated in this manner is to have it enter the grain of the wood, and lines seen through the logwood staining show the darker shades the same as the natural wood.

*Cherry Wood.*—Take common yellow ochre, getting the dark shade. Break it in water, add a little stale beer, and stain the wood with this for the first coat. Sandpaper lightly, to cut where the ground may have risen; then have some good red lake—ground in distemper for common work, but for better work in turpentine only—and add a few spoonfuls of drying japan, according to the quantity to be used, merely to bind it to the wood, and no more, wiping away all surplus; then shellac and varnish or oil. If you need something very fine, use a common grade of Munich lake. This will make the cherry now being used so extensively on furniture and house trimmings. Try it, and you will like its richness, especially when polished. These recipes I cut out of an American paper, and if any credit is due, that belongs to Mr. A. P. Daire, though whether he is the real author I cannot say. **T. L. M.**

## THE MULTIPLE CREATION AND EVOLUTION THEORIES.

[31567.]—Not being an expert in natural history, comparative anatomy, or geology, I found myself unable to intelligently decide between the somewhat conflicting statements of the evolutionists and the multiple creationists. I could not expect, equipped with specimen basket, geological hammer and shovel, to sally forth and dig up the "missing link" in the first field I entered. Hence it was necessary, if I wished to form an opinion for myself (other than that derived from books) to proceed on different lines. So paying no heed to the past history of the mammalia, I determined to compare the human species with those nearest to them in the descending animal scale, this comparison being chiefly (but not exclusively) with the various branches of the Simian tribe. It was not to be anatomical, but principally in the direction of some mental quality or instinct common to both. Should a strong family resemblance be apparent, it might fairly be taken to indicate blood relationship; should, however, none be discovered, then the result would be so far simply negative.

For certain reasons the reproductive instinct was determined on, and a comparison was made between the genera above mentioned, under the three following heads:—1st. inter-coition; 2nd, hybridisation; 3rd, aberration of the reproductive faculty. Of course, it will be understood than no details can possibly be given; the results alone being summarised in the briefest manner. First, however, be it stated, that the information was collected during a period extending over many months, by correspondence and conversation with expert and reliable persons (and some unreliable ones too!), together with personal investigation in zoological gardens and elsewhere. It was, however, not as full and thorough as I could have wished, an account of ill-health and want of sufficient pecuniary means (owing to the anti-rent movement in Ireland), still, I think I am justified in the following conclusions:

No. 1. Most certainly exists.

No. 2. Not proven.

No. 3. Every form that this takes in the genus Homo is exactly paralleled in the Simian tribe, and is also to be found, although in a far less marked degree, still lower down in the animal scale.

Hence on reviewing the whole evidence before me, I cannot avoid the conclusion, that it seems likely at least, that the relationship spoken of exists; and blood relationship means a common ancestor, more or less remote. Therefore, for the present anyway, I incline more to some form of the evolution doctrine than to the multiple creation one. In conclusion I would say that there are other strong resemblances between the genera in question based on the action of this faculty, which have not been noticed in the foregoing hasty sketch; as well as some entirely unconnected with it, but quite as striking in their similarity. **Edward M. Richards.**

Grange, Enniscorthy, Ireland, Sept. 2nd.

## THE PERSEID RADIANT.

.]—Mr. Monck (letter 31532) correctly re- iat in my catalogue I do not affix the term ds" to certain showers emanating from the tion Perseus in July and August. This is I desire to limit that appellation to the gust meteor system alone. The contigu- wers are clearly different; they are to be by their feebleness and by their erratic , as well as by their positions. Thus my seid radiants at 31° + 49° Aug. 6, 30° + 46° -13, and 32° + 50° Aug. 14-23 are very d irregular in their manifestations. I only d 15 meteors from them, whereas I recorded han 113 meteors from Perseid radiants near t 31° + 54° on the four nights from July 28 lusive. The latter is extremely rich nearly ar; its meteors are very brilliant, and it is y quite a distinct shower to the scanty previously alluded to from a mean radiant 48° Aug. 6—23. The true Perseids can be ished from neighbouring showers by the f the radiant eastwards, by its dominant relatively to other streams, by the annual r of its returns, and by the similarity of its

If we except the Aquarids, which are es very prolific at the close of July, the form the richest display in the heavens July 25 and Aug. 15; and this special furnishes an important guide in disassocia- from other systems in the same locality. ck has drawn his inferences from the mere s of the various radiants; but other elements be carefully weighed in forming just ons. In the case of a long-enduring, mov- wer like the Perseids, we must naturally o find some minor systems in play from the gion of the sky; but these need not disturb ect consistency of the great shower, or pre- eful observers from discriminating between

onck's theory is ingenious, but it is opposed bservation and to reason. It seems to me le to conceive that during about forty similar number of meteor showers become separated by about 1½° in R.A., and that on ccessive night the shower next east attains num!

h Mr. Monck has little confidence in my ns, I cannot feel otherwise than indebted for directing attention to the subject. His will have served a very useful end if they n incentive to further observation. I am e aims at getting at the truth of the matter, clearing up a difficulty which has already d too long in abeyance.

e clever mathematician devoted himself to searches, and his efforts were supported by w and accurate observations, I am confident ld soon learn the true story of this remark- eor system. **W. F. Denning.**

l, Sept. 5.

## METEOR RADIANTS.

.]—As to the general prevalence of ry or long-enduring meteor radiants, I r. Denning and myself are agreed, although posed to admit fewer exceptions than he s I already intimated in your columns, I e evidence in their favour is conclusive to who will study it (which, in my opinion, he without repeating all the observations for . But the explanation of the facts is a matter, and it is to this that I would now he attention of your readers. How is it teors which come to us for months in suc- re referable to the same radiant, notwith- the change in the direction of the earth's which has taken place during the interval? idea (which I stated in the *Observatory* for er, 1885, and January, 1886), that the fact e explained by supposing that the motion of sphere (i.e., of the earth) was fully im- on the meteor before it became visible (I use the term *ignited*); but I have recently so many objections to this view that I must be rejected as untenable. I therefore e attention of your able astronomical corre- ts to this hitherto unsolved problem, or if they deny the fact after a study of Mr. Den- atalogue, the grounds of denial would be onsidering. The problem of stationary has been in a very unsatisfactory con- dnce Mr. Proctor's theory of the great of the meteors proceeding from stationary has been rejected as not in accordance with . I hope it will be taken up and dealt with competent mathematician and physicist.

6. **W. H. S. Monck.**

## THE MOON.

.]—Replying to the remark of "F R.A S." 1530, p. 32), I am sorry to find that my 1475) seemed to convey the idea that I was account for the colour of the moon on the ion that it was due to the presence of dust, which had fallen *some time ago* and *once for all*, which, of course, as "F.R.A.S." kindly pointed out, is neither the case, nor did I intend to base my argument on that supposition.

Until it can be shown that Prof. Langley is certainly at fault in his estimation that the temperature of the moon is sufficiently low to remain nearly at freezing point during even the lunar day, it seems reasonable to suppose that any moisture there may be in the moon should exist as snow; and as the temperature of the lunar surface must vary immensely between day and night, it seems also not improbable that a certain temporary and local evaporation and redisposition, to some small extent, from this snow surface will probably take place, and which would continually cover up the meteoric dust as it fell in a manner differing in various localities, unless all the conditions which would influence such a process were absolutely uniform over the whole surface, which does not seem to me to be probable.

As "F.R.A.S." also says there is no need to reopen the question of an atmosphere in the moon here, unless, indeed, it is on a different basis from the way in which that question has hitherto been discussed; for—as the only atmosphere likely to be present, if due to the presence of snow on the moon, is an exceedingly tenuous and temporary one of aqueous vapour, and even then of a local character —this question cannot be settled by any single cases such as those quoted by "F.R.A.S.," for it is not a proof that there is never an atmosphere of this kind present—which is all that is premised—because it has been shown to be absolutely the case, that, at certain regions and times, an atmsophere is entirely wanting.

So that until it can be shown that there is never *any* vapour on the moon, or that the temperature is much higher than the researches of Prof. Langley seem to show, or that snow on the moon would present a very different appearance to that which is manifest to us, I think that the statement of Mr. Peal—his main statement, that the moon's is a glaciated surface—presents less great difficulties, explains more phenomena, and is more nearly in accordance with what we should expect, than any other theory of the lunar condition. **H. G. D.**

## COMET-SEEKING.

[31571.]—Apropos of Mr. Denning's letter (31536, page 34), might not useful work be also done in a cometary section by the examination of known nebulæ? It might lead to the knowledge of what nebulæ, if any, are variable, and also to the discovery of variable stars in the same field. In the case of many nebulæ there is little chance of discovering changes that have taken place, as the existing descriptions and the classification of nebulæ in the order of brightness are exceedingly broad, so much so in some cases that the description of one is applicable in its vagueness to hosts of others. On August 6, 1889, ℌ. V. 44 (G.C. 1541, R.A. 7h. 23m. 18·6s., N.P.D. 24° 0′ 3″) was noticed as having a brightish nucleus like a comet, the nebula much extended and involving two stars, one at each extremity. Of these two stars I could find no mention till I referred to Mr. Ingall's useful "Notes on Nebulæ," published in the "E. M." On page 229, November 12, 1886, he notes it as curious that no mention has been made of these two stars.

In the same field with ℌ. II. 757 (G.C. 4064), there is a faint star. I have no reason to think it is variable, though it appears much brighter on some nights than on others, while two neighbouring stars show no difference. Possibly the circumstances of the particular night effect the visibility of the star and the nebula in a somewhat similar manner. By comparison of the nebulæ one with another, and with stars in the field, and by other means which will suggest themselves, much work might possibly be done among the nebulæ visible in small telescopes that will prove useful in future.

Hendon, Sept. 8. **P. F. Duke.**

## ASTRONOMICAL OBSERVATORY.

[31572.]—I am very pleased to see that astronomical matters are again taking their place in "Ours," and that your columns have been so generously opened to assist in the formation of what will, no doubt, be shortly *un fait accompli*—the B.A.S.—a society which upon the lines laid down bids fair to be an incalculable boon to us astronomical amateurs. Might I make one suggestion—that in addition to fixed periodical meetings in London, meetings should be held at various important centres in other parts of England—e.g., Bristol, York, Manchester, Cambridge, Southampton, Plymouth, &c., taking in rotation towns which are easily accessible from the various districts of the country. I feel sure that, by this course, its usefulness will be increased, and the interest of the provincial members sustained.

I am about to make a fresh observatory for my 8½in. reflector, equatorially mounted, and shall be glad of any suggestions which will help me. The two deciderata are efficiency and economy—the last is a necessity. The one I now have is not large enough, was made originally for a 4½in., and has answered splendidly, but I am doubtful whether it is practicable on a larger scale. It is square, made with wooden posts at corners, sunk in the ground, forming a square of 6ft. by 4ft. 6in. high; battens at top and bottom, all round, except the doorway, forming a framework, which is filled up with matchboarding. The roof is a span one, rising to 6ft. 6in. high in centre, and is made in two halves, a wood framework covered with Willesden paper, opening at the ridge and hinged at the bottom to the sides. A triangular framework, also hinged, fills up the angle left between the roof and the sides at one end. The door opens at the other end. When observing, it is but a minute's work to turn back either or both halves of the roof, and to let down the triangular end, when you are practically "out of doors." If any readers would like details of the construction I shall be only too pleased to send them. **W. S. P.**

## LONDON AND THE B.A.S.

[31573.]—Your correspondent "An Old Member of the L.A.S." asks at the close of his terse letter in your issue of date the 29th ult., "Why centralise everything in London?" In the light of the body of his letter he means, Why have the headquarters of the B.A.S. in the metropolis? With your kind permission I should like to reply to that question.

1st. Because more than 180 Fellows of the Royal Astronomical Society reside within the London postal district, and not 20 live within as easy a range of Liverpool and Manchester combined, and we think it fair to infer that a similar proportion of amateur astronomers, not Fellows, are living in the immediate vicinity of London, and as the B.A.S. is for amateurs, whether Fellows of the R.A.S. or not, the numerical claim is overwhelming in favour of the metropolis as a centre. The lists of the R.A.S. will verify these figures.

2nd. Because if you take the whole population of England as data, London is more accessible as a railway centre than any other town. Busy Manchester and energetic Liverpool are not very accessible to the S.W., S.E., and E. of England, and it is conjectured that there are a larger number of observers in the comparatively favourable atmosphere of the South than in the more murky skies of the North.

3rd. Because the R.A.S., the Greenwich Observatory, which is the recognised centre of the British and Colonial astronomical work, and kindred scientific societies, are more largely found within the London postal district than in any part of the British dominions, and the convenience of those attending such scientific gatherings should be considered in preference to the scant, though admirable, societies of the provinces. It is hoped by many Fellows of the R.A.S. that the meetings of the B.A.S. will be held at conveniently near dates, that both meetings may be compassed when in town.

4th. Because London is more adjacent to the Continent, and when eminent foreigners become honorary members, or Associates, it is hoped the metropolis will be more likely to secure the interest and value of their attendance than any provincial town.

5th. Because for the purpose of amateurs at least, there is a far larger number of astronomical instrument makers in London than elsewhere, and in saying so we are not unmindful of Birmingham. The eminent firms of Grubb, Cooke, Calver, &c., &c., and when amateurs go to town they have generally some piece of apparatus to rectify, requiring personal attendance.

6th. Because the Northern provinces have a kindred institution already, viz., the L.A.S., which, though somewhat paralysed by unhappy circumstances, is by no means defunct, and which, we hope, when personal animus subsides, as it always does among scientific men, will display an amount of energy worthy of its former self, quite adequate to the requirements of Lancashire and the adjacent counties, and should it cease to be A 1 as an Amateur Astronomical Society, will regard with no unfriendly eye its more prosperous daughter in the sunny South, and will probably in many ways contribute to its success and applaud its activities.

We could add to these reasons if necessary, but we feel we have already exhausted Editorial space, and possibly patience. Our hope is that the six reasons we have assigned in their cumulative force will outweigh in the minds of non-contents anything that might be said in favour of a provincial centre for the British (not London) Astronomical Society.

Dorset. **W. R. Waugh.**

## THE REFLECTING TELESCOPE.

[31574.]—It is a curious circumstance that the vexed question of the relative excellence of the reflector *versus* the refractor should periodically crop up in the columns of this journal. I should like to say a few words on the subject.

The letter of "Tenebris" gave me the impression of a bias in his mind against the reflector. He may not have intended this to be so; but it is desirable that he should have stated the respective diameters of the o.g. and speculum he wrote about, because it is generally conceded that while a 5in. o.g. may not render atmospheric disturbances very visible, a speculum twice this diameter would be likely to show it in a more marked manner if it existed: but then a 10in. refractor would in all probability fare no better than the 10in. speculum. An optically perfect flat surface is very difficult to make, and I have reason to believe that many observers who may possess first-class specula are often indifferent about the optical truth of the flat mirror.

Quite lately I tested five flats sent me by an occasional contributor to these pages, which he has most industriously ground, polished, and edged. Not one of them was fit for celestial purposes. A short time ago I had the opportunity to test a first-class 9in. o.g., elaborately mounted, against a 12¼ spec. of my own make and figuring. The night was not altogether a good one, but I admit the o.g. gave rather neater stellar images than the spec.; but the next day, on testing the flat mirror of the 12¼ mounting, this was found to be decidedly concave when tested by my testing plates. I may just mention that this flat had been supplied a few years before by a well-known optician who keeps a shop. A few days after the testing mentioned, I was trying a 19in. spec. (2½in. thick) which I had refigured, and, judging by the star disc indications, I pronounced the flat mirror to be imperfect. On testing, this was found to be a fact, the surface of the flat (!) being quite convex.

Not only must the surface of the "flat" be perfect, but it requires carefully packing in its cell. I quite believe that a flat not quite perfect, which would give with a good or perfect speculum very good definition on the planets, would give scattered or woolly-looking star-discs. We must bear in mind that the intensity of the light from these two classes of objects is different, except in the case of Venus and Mercury, and we know quite well that these two are extremely difficult to define from the intensity of their light, and any imperfection in the flat would be apparent.

Some time ago there was a controversy as to the suitability of plate-glass for optical surfaces, and some seemed to think it is, or ought to be, good enough for the purpose; but I venture to think that if they had the opportunity to observe the whole process of manufacture, such as I had two months ago up in the North, including annealing, rough and fine grinding and polishing, they would alter their opinion entirely, and would concur with me that the commercial process of plate-polishing is one pre-eminently calculated to produce an optically uneven or irregular surface.

In the case of very large specula I do not feel at all sure that we have the best system of support that could be devised, for while I readily admit that the plan of balanced levers with six or more sustaining discs for the back of the speculum to rest upon is an elegant appliance, and apparently mechanically correct so long as the telescope is nearly, or quite, vertical, I still strongly believe from the phenomena observed that when the telescope is shifted more than 30° to 35° from the vertical, a greater stress would be thrown upon the lowest pair of sustaining discs (not necessarily on the same lever), thus allowing that portion of the speculum to sink, coupled with the fact that the pair of discs diametrically opposite to the two at the bottom would tend to push the upper part of the speculum forward, and thus aid and increase the relative sinking of the lowest portion of the speculum below the general level of the surface which exists when the telescope is vertical or nearly so. This must throw the speculum out of adjustment, because its optical axis would now be in a different direction.

I am always very busy in the summer months; but a little later on I propose to try the effect of placing an "optically flatted" disc of plate-glass on the open end of the tube of an 8½ or 10¼ reflector, thus altogether excluding air currents. This has been tried before; but it is very doubtful whether an "optically flat" glass cover was used. I feel certain that in the instances which "Tenebris" mentions that the star images are at fault, and are like "cork-screws"; the chief cause lies in swirling air currents of unequal density in the tube, and that in many instances where good or perfect definition is not obtained the fault lies with the flat mirror not being good enough, because the science of mathematical optics teaches us that a well-formed speculum in other respects may have a good deal of uncorrected aberration without affecting the definition of stellar objects in a material degree, but that a faulty flat is highly detrimental. I hope to shortly explain this matter more fully.

Ramsgate. **J. C. Linscott.**

## JOSHUA'S COMMAND.

[31575.]—"E. L. G.," in his last letter (31555), having given us such a conclusive proof of the value of his criticisms on the translation of the Hebrew text of Josh. x. 12, 13, it is useless to continue the discussion. I may remark, however, that a curious change seems to have taken place in his mind after writing his first letter, as to the person who uttered the "oracular words" in question. In that letter (31497) after quoting his —or Bryant's—view of the meaning of those words, he adds,—"This is what Joshua said." But in his last letter (on p. 36) he asserts:—"I had always supposed the *Lord* was implied as giving this oracular answer to Joshua." This, however, is only a side issue, and does not affect the main question, viz.: What is the true meaning of the Hebrew text of what is generally spoken of as Joshua's command to the sun and moon; and, what was the effect produced by that command? Learned men in all ages, from the time of the LXX. downwards, have generally agreed that the meaning was that given in our English Bible, but "E. L. G." says they are all wrong, including the LXX. When challenged to prove his assertion, he changes front somewhat; adopts my correction as to the force of the preposition prefixed to the nouns "Gibeon" and "valley,"—so far abandoning Bryant—and then, by way, I suppose, of emphasising his own peculiar qualifications for the task of translation, he says, "I am no Hebraist." Our thanks are due to him I think for this candid admission. The fact was clear enough in his first letter, but now, none of your readers can fail to estimate his opinions on the subject at their true value.

If the writer of the Book of Joshua had intended his readers to understand that the command in x. 12 was addressed to the sun-god and moon-god, he would doubtless have used *their* names, instead of the names of the *luminaries* ruling "over the day, and over the night."

I do not intend to follow "E. L. G." into the cloud of dust he has raised, nor to speculate on what might have been. My sole concern is with the Hebrew text as it has come down to us, and I fail to find in that the very smallest foundation for attributing to it such a meaning as that put forward by Bryant, and accepted with such satisfaction by "E. L. G." **Tyler.**

## DEWING OF SPECULA.

[31576.]—One of the great drawbacks to the use of reflectors is the dewing of the specula. I have a 12¼in. fitted in an iron tube. The speculum is in a zinc cell, with a zinc cover to cover it up. I find on looking at it in the morning, say 9 o'clock, the surface of the speculum is covered with dew. This of course dries, but it leaves marks behind, and this, being repeated daily, destroys the silvering in a very short time. I had mine silvered beautifully about a month ago, and it is now very much deteriorated, so much so that it does not show a sharp image.

I left it, last evening, with the cover off the speculum, and I found this morning that the surface was not dewed. This makes it appear to me that the cover is a mistake. I should like to hear others' experience in this matter. I may state that the iron tube has also a cover at the further end.

**Amateur.**

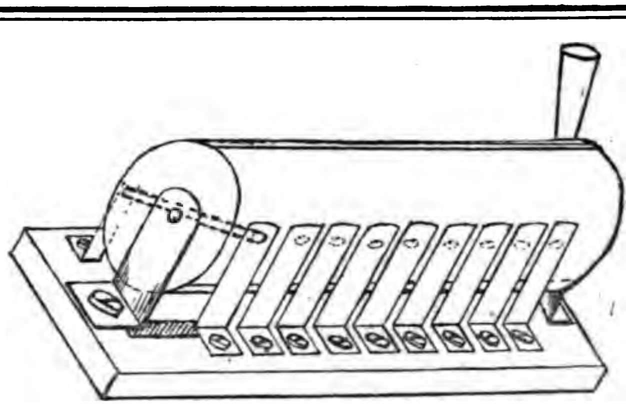
## A MECHANICAL PARADOX.

[31577.]—The problem set by Walter M. Hardie (letter 31547, p. 35) might be solved in many ways. It is merely a question of relative and absolute motion.

In the first case each small wheel makes two rotations relative to line joining their centres. This line is fixed in space, so that the small wheels make two absolute rotations.

In the second case the rotation of the link or line joining centres takes the place of the rotation of wheel C.

*As before*, each small wheel makes *two* rotations relative to this line. But to find the number of absolute rotations we must compound with these the one rotation of the link (for the wheels are fixed to the link and partake of its motion), which is positive for A and negative for B. We thus get three absolute rotations for the former, and one for the latter wheel. **S. S. R.**



## A USEFUL SWITCH.

[31578.]—The accompanying sketch shows a very useful instrument which may be new to some. It is a switch for use with primary or secondary batteries, or any other arrangement where it is desirable to quickly connect in series or parallel. The principal part is a cylinder of insulating material mounted to turn horizontally on an insulating base. The cylinder is pierced by a number of radial metal wires insulated from one another. At the two points at right angles to this diameter are two metallic rods running along the cylinder. On each side a row of contact springs are fixed to the base, each fitted with a terminal screw.

To use the instrument, all the negative poles of the battery are connected to the springs on one side, and all the positive to those on the other; then the end poles of the battery will always be connected to the brass supports of the cylinder which form the terminals of the outer circuit. When the cylinder is in the position shown, the positive of each cell will be connected to the negative of the next through the springs and connectors in the cylinder.

If by means of the handle the cylinder is turned through one quarter of a revolution, the metal bars connect all the positives to one terminal and all the negatives to the other; then all the cells are in parallel. The instrument is of simple construction, and very useful for experimental work, and with accumulators which may be chraged in parallel and discharged in series. **J. W. Beauchamp.**

150, Askew-road, Shepherd's Bush.

## MOTORS FOR CYCLES.

[31579.]—Having given some thought to the above, would some of your readers give their opinion as to whether the following idea is feasible, namely, to drive the cycle by compressed air, having a reservoir beneath, and keeping up the pressure by two air pumps driven by the feet on the system of levers. An opinion from some competent man would much oblige the writer. **Beasley.**

[31580.]—In reply to your correspondent "S. G. R.," it is a fact that I had a successful ride in a Bath-chair propelled solely by a Sherrin motor and battery, and at the rate of about six miles an hour on level ground. This speed is now, I understand, exceeded. If "S. G. R." or anyone else does not believe my written statement, they better go and see for themselves. Sherrin has also successfully applied his inventions to the auxiliary propulsion of tricycles, which, I believe, most people will appreciate who like the healthy exercise of propelling, but with assistance when going uphill, with increase of the speed generally, and for assisting when tired or when carrying loads. To my mind there is no question of Sherrin's inventions being the solution of the question so long sought for, and, as I say again, see for yourselves if you do not believe it. **J.**

[31581.]—Under the above heading "Jack of All Trades" (in letter 31544) says:—"The steam-engine as it stands is a disgrace to our mechanical world." And a little lower down he tells us why. "You put steam into it at one end, at so much per square inch, and the piston recedes. Is not the same pressure upon the cylinder *cover?* Decidedly so. Then we get no power out of that, as it is a fixture; but if we let the power in between two pistons, we then utilise the whole of the power, &c."

A short time ago some gentlemen were good enough to reply to another gentleman about the impossibility of that said gentleman's invention, which consisted of a number of steel rods, which rods were supposed to expand by heating at one end and so produce a given pressure at one end greater than that at the other end, and so cause locomotion. Well now, we have "Jack of All Trades" saying that we get no power out of the cylinder cover. Where, then, does the *forward* pressure come from? There must be at least an *exact balance of power* each end of the cylinder even when the rod recedes.

us suppose you put in steam "between two ' (the pressure and quantities being the *where* or *how* can we expect to get more ut than is put in, whether single or double be used? **F. G. Willatt.**

2.]—I HAVE been much interested in your ondence respecting motor for cycle, and, by rmission, should like to give my view of the I see "Nun. Dor.," "Nig.," "Petro- and others are agreed that steam is not the power to drive a cycle. But I differ from this—steam being the best and cheapest *water*) motive power we have. Surely a ngine can be made to develop sufficient o propel a trike and not weigh more than tryke's" engine. I do not see that more o-man power is required. I have an idea eam-engine that would develop this amount r, and would not require above half the Petrotryke's" engine does, boiler included. igh and low-pressure engine, three cylinders dem-fashion, one piston rod, or rod with istons attached. Now "Nun. Dor.," ryke," and others, bite this tempting bait; a high-pressure toy, or what you please. his is of sufficient interest to readers, I may its working parts minutely. The boiler is (*tubular*), and would work with perfect t 200lb. pressure; could be heated by lamp. turn to the trike: I do not think, as they made, it would be possible to fix any motor the machine a good appearance, which a any people study. So like "Petrotryke," t make a machine for the engine, or rather the machine. The parts to carry the engine, c., must be much stronger, and therefore be much heavier. Wheels of trike would e stronger, and a slight difference in their tion to the style now in use; altogether the would not exceed the present trike by ounds. With due respect to "Petrotryke," l like to see his engine at work, and hope he ceed; but I fear his method of keeping his cold will not prove the success he antici- Neither do I think he will obtain the speed lates with the consumption of a gallon of Nun. Dor." does not approve of steam or m. I ask, have we gone to the fullest n utilising these powers, or does he give it gether as useless to try; if so, I will use the f one of our late great statesmen, and tell hat nothing is impossible to the persevering I believe if some of our cousins over the pond had taken the matter in hand we have had a perfected steam trike ere now. with "J. H. H." that nothing but steam ve a satisfactory motor to suit the require- f the many; also to suit their purse.

**A. B. C.**

3.]—THOUGH an outsider, I look out for the n MECHANIC before any other paper, and I ch interested in the discussion about cycle Cycles may be good evercise, but it is to have too much of that. Riding is also a xercise; but how many medical men ride ed with those who drive? All that is ry is an engine small and light enough to wer to drive a bicycle 8 or 10 miles an hour el road in good order, and those who say it be done must have a poor opinion of the ics who have developed the modern bicycle he old dandy-horse. The difficulty, I think, boiler, and my idea may serve as a basis of n. It is that the boiler consist of a con- piece of fine steel tubing, coiled and wound he furnace, through which a stream of water pressed by means of a piston at the one end, of course, would be of much larger diameter. er end would supply the engine—a single ing one would do at first. The engine would wheel of 3 to 5in. diameter, which would the front wheel, the whole assuming the a gigantic lamp. The chief difficulty I see e in superheating the steam too much; but furnace should always have the same fuel engine be working at full power—when at all—a little practice would show the pressure. There may be something radically n this, and if so, perhaps some reader would out, or else suggest dimensions—viz., size, of tube, engine, &c. **Ulsterman.**

## LLIPTICALLY-GEARED WHEELS ON CYCLES.

4.]—I DON'T know whether it is one of equent occurrences of two or more hitting same plan, or not; but about three years ought of this elliptical wheel in place of the hain wheel on crank, and applied it to my I rode it often in the streets of London, and ted a good deal of attention. I wondered d been communicated to the gentleman ote to the *Pall Mall*. I would not on any return to the round wheel. the disadvantage of a slight slackness of the chain in one part of the stroke, it is not $\frac{1}{8}$in. in the length of chain, and one does not notice it after a little riding. At first it is more apparent than real through the pedal at the upper part of the stroke going quicker, and overtaking the foot which had been used on the circular wheel to go round the stroke at an unvarying rate. After being used to the elliptically geared wheel and getting thoroughly into touch with it, much the same thing is experienced on riding a machine with a round wheel, only in a reverse way.

By using an elliptical wheel it has the practical effect of varying the geared height of driving wheel in every part of the stroke. For instance, my machine by the ordinary rule, $\frac{30 \text{ by } 19}{10} = 57$ is geared to 57in. Now at the upper part of the stroke the height is lowered to 44in., and so the pedal goes quickly over. When the crank has reached the horizontal position the geared height has been raised to 70in., and consequently the pedal goes so much slower, giving you time to exert your full power in taking your stroke.

As to the plan spoken of by Mr. Pierce of having two elliptically geared wheels, I had the same in consideration when I first thought of this matter. I thought, and if I may be allowed to express an opinion, still think, that the excessive rate one would have to pedal would never do. Further it is to counteract an evil which in practice does not exist.

Gloucester. **Alex. Paice.**

## AN IMPROVED CYCLE-LAMP BRACKET.

[31585.]—REFERRING to your illustration and description of an "Improved Cycle Lamp Bracket" (page 24, No. 1328), it might save Mr. James Scourfield both money and disappointment if we inform him through you that about three years ago our Mr. Banks made such a bracket for his own use, and has since made and fitted many for the trade and otherwise. He took out no patent, and the bracket is so well known that no valid patent can be now obtained, even if it were worth while to do so. **Banks, Wilson, and Co.**

172, St. John-street, Clerkenwell, E.C., Sept. 8.

## THE MINING AND METALLURGICAL EXHIBITION.

[31586.]—WITH your permission, I should like to draw the attention of those of "Ours" who can spare the time from the "ether controversy" to the above very interesting Exhibition at the Crystal Palace, Sydenham, as I find that, outside the circle of those scientifically or financially interested in the collection, its existence does not appear to be much known; and, judging from myself, I think a visit will repay the trouble, if it be only to see the various modes in which nature conceals her universal treasures, and the ingenuity and labour she consequently forces mankind to exert in order to obtain them. I may add that no extra charge is made for the Exhibition, and there is still some doubt as to whether it will not close next month. The first thing that strikes a visitor is the profusion and value of the exhibits. Those who are accustomed in their own minds to associate a mineral exhibition with a dozen or two of glass cases containing various small pieces of assorted ores and metals, labelled more or less unpronounceably and frequently unintelligibly also, will here find gold, silver, and other ores literally in tons weight; while one bar of gold alone in the New South Wales Section is worth over £7,500. It luckily weighs something above a cwt., or I should not care to be its guardian on a busy day. The official catalogue is, unfortunately, unavoidably incomplete at present, and therefore not of much use, except as regards the mass of Colonial statistics contained therein; nearly all, however, of the exhibits are labelled in such a plain and intelligible manner that the shortcomings of the book in this respect are not of much consequence. Several of the exhibiting Colonies have their own catalogues, which they will readily hand (free) to anyone who appears really interested in their exhibits. The largest exhibitor is the Colony of New South Wales, South Australia, West Australia, New Zealand, Natal, Servia, Mexico, Uruguay, Norway, Sweden, our own mining industry, and various mining companies of India, Canada, Mexico, Burmah, &c., being also represented. According to the official catalogue, New South Wales has up to the end of 1889 yielded minerals to the following values: Coal, £22,618,263; gold, £37,614,887; silver, £4,909,952; copper, £5,645,027; and tin, £8,925,543. Iron has, owing to the cost of erecting smelting furnaces, &c., not yet received much attention; but, in 1888, bars and rails to the value of £23,721 were produced. The other mineral riches of the country are lead, zinc, antimony, asbestos, chromite, bismuth, and manganese; alum stone, marble, and building stones are found also, and the list of gems includes the diamond, sapphire, ruby, emerald, opal, amethyst, garnet, topaz, chrysolite, cairngorm, onyx, &c.; and specimens of all the above will be found in the Exhibition. This colony has up to the present time yielded about 50,000 diamonds, the largest whereof was a stone of $5\frac{5}{8}$ carats.

Entering the transept from the gardens, and turning to the left, we are at once among the exhibits of New South Wales, which occupy the south nave and also a large part of the S. and S.E. galleries. The collection commences with various coal trophies, and masses of bog-head mineral, graphite, &c.; then succeed huge lumps of gold and silver ore (one exhibit contains five tons and one adjoining two tons of silver ore); and divers cases containing smaller samples of rich gold quartz, also many nuggets and saucers full of the precious metals in grain form, as well as specimens of the other mineral wealth of the colony. Near the centre of the collection are cases containing various gems, both in their rough and cut state, and a beautiful specimen of gold quartz, estimated to contain over 258oz. of gold; also a nugget of fine gold weighing over 313oz. A little further on a lofty silvered pillar rises, bearing Atlas and his globe on its summit; this represents a yield from The Broken Hill Proprietary Silver Mine of 16,500,000oz. of silver. In cases at its base are various specimens of the ore as obtained from this mine; and the line of exhibits here is closed by various other metallurgical specimens of the colony. Turning now to the left, and ascending the stairs, we find the same colony still represented; the collection containing numerous specimens of ores, metals, and gems; here is the £7,000 gold bar. The light from the glass roof develops the beautiful colours of several of the ores in a remarkable manner, and shows off in great perfection the lovely hues of the opals here exhibited. I was under the impression that the opal was found only as a roundish stone; but here it also appears in small lumps or slabs, one brownish piece showing the "fire" in a remarkable manner. The opalescent colouring also appears on pieces of basalt, &c. In this collection the obliging exhibitor pointed out to me a large piece of pure copper as dug up, looking precisely like a piece of branched coral imitated in that metal. He informed me that the specimen was unique, and I certainly have never seen a similar mass before. Here also will be found a quantity of that substance which appears to have been invented by Nature as a mean practical joke for the purpose of deluding ignorant prospectors into the belief they have discovered a fortune, only to find after they have borne the heavy lump for miles that a competent authority will pronounce the attractive scales pyrites, and the value of the prize practically *nil*. In a glass case here is a large specimen of quartz thus ornamented in a manner suggestive of a most cruel hoax. Jasper, agate, carnelian, malachite, bornite, and many other "ites," whose acquaintance I have made for the first time, are in various cases around. Continuing our way along the east gallery, we pass through the South African and Scandinavian exhibits, consisting of imitation gold bars, showing the output of various mines, samples of gold and silver, &c., and the usual masses of ore; the latter exhibitors also showing nickel, cobalt, marble, &c. Retracing our steps to the southern end of the building, we come upon specimens of New South Wales building stones, marble, alum, asbestos, and various colonial woods; also a large collection of fossils showing fish, ferns, &c., with fearsome names thereunto appended. Then follows the exhibit of *The Sydney Morning Herald* and other papers, comprising their stereotype cylinders, &c., and portfolios of the said papers. We then perceive life-sized groups, a la-Tussaud, with appropriate scenery and surroundings, representing coal-winning and gold-washing. Thence we proceed through the exhibits of Western Australia, New Zealand, Mexico, Tasmania, Queensland, Bolivia, and other countries; and descend the stairs to the west corridor behind the Chinese court. Glancing at the model of the harbour of La Guaira (Venezuela), we proceed through various collections of ores and metals contributed by Cornwall, Uruguay, Venezuela, the Argentine Republic, Spain, Italy, Servia, Corsica, Switzerland, and "gallant little Wales"; the exhibits comprising gold, silver, copper, tin, lead, aluminium, quicksilver, antimony, arsenic, wolfram, and the costly uranium. Near the end of the corridor we find a pedestal bearing in a glass case on its summit two specimens of the celebrated "weather plant" in pots from Kew. This plant, it will be remembered, created a sensation about a couple of years ago from its being stated to possess the power of foretelling stormy earthquakes, &c.; its scientific name is *Abrus precatorius*. The exhibited plants are about 9in. high, and strongly resemble small acacias or sensitive plants. Round the pedestal are cases containing dried specimens of the leaf-stalks, showing the different positions they assume when prognosticating, together with various newspaper cuttings, as to the value of the predictions. Its English name appears to be the "Paternoster pea," it being so called because the hard, bright seeds are used for rosaries. I presume the air of the palace, or the proximity of the high-level station or the dynamos, has dulled the sensibility of these specimens, as I have been unable to detect any particular change in either or any of the three or four visits I have paid them, either during the rest or running of the dynamos; and we have certainly had all kinds of weather during the period. Near these plants is a Siamese exhibit, consisting of gold, implements, and ornaments; and here also will be found miners' lamps, tools, electrical fuses, &c.

The machinery is in a separate corrugated iron building erected on the grass outside the Tropical department. On entering one finds rather a handy fire-extinguisher, consisting of a metal water tank about the size of an office wash-stand, wherein are a number of zinc pails fitting into one another. They can be lifted out as fast as the handles can be grasped; there is no suction between them, and they all come out brim-full. Near this is a small working model of the Man Engine invented by Dörrell early in 1800; I believe it is still used in a Cornish mine or two. To those who are not acquainted with this ingenious contrivance, I may explain that it consists of two parallel perpendicular bars, upon which, at regular distances, platforms are fixed, so that, when the machine rests, the platforms on opposite sides nearly touch in the centre of the shaft. These bars are caused by machinery to rise and fall alternately, one descending while the other rises; thus a miner wishing to descend merely steps upon a top platform. The next movement of the machine carries him down 10 or 12ft., when he will find a platform on the other bar exactly before him; upon this he steps, the engine pausing a second or two for him to do so, and down he goes again, and, by repeating the process, is carried to the bottom of the shaft; in ascending, this process is reversed. Here a machine takes a dose of powdered ore, and, by a whirling arrangement, a horizontal "rose" in a twinkling hurls the pure metal into one receptacle, and the powder, according to its fineness, into others. Another calmly takes a lump of rock, champs it in a second or two into little bits, sends these up a shoot in small buckets, tilts the contents into a pulveriser, and, in less time than it has taken to write this, produces the result as grey flour. The principal features of the machinery exhibits are the compressed-air rock-drills, of which there are several, and which do not act like an ordinary drill by a merely revolving motion, but hammer and bang away like a pointed piston-rod upon the stone submitted to them in a manner that soon perforates the material and reduces the number of adjacent spectators considerably, as the "row" is awful. I think I have now drawn attention to the main features of the Exhibition; visitors will doubtless find many more interesting matters there for themselves. I have only to add that I have no pecuniary interest whatever in the show, or in any of the companies, &c., exhibiting, so that this letter cannot be considered (to speak metallurgically, as befits the subject) as an *advertisementiferous* specimen.

**B. Harcourt.**

## BEE-STING AS A POISON AND AS A MEDICINE.

[31587.]—The "Lydney Dispenser," letter 31548, here affords me an excellent opportunity for demonstrating the manner in which homœopaths arrive at their conclusions.

The poison of the bee-sting is an acrid principle of an extremely irritating nature to the skin and subcutaneous tissues. Its effects are generally exclusively local; but when, as in the case recounted by Dr. Newton, it is introduced into the circulation through a vein, dangerous toxic symptoms may result. What I wish particularly to insist on is that the local effect is only that of an irritant which, in certain constitutions, has its effects considerably aggravated. Similar conditions, in a greater or lesser degree, as the case may be, result from fleas, bugs, pediculi corporis, gnats, mosquitoes, certain spiders, the introduction of acrid chemical materials subcutaneously, even occasionally the injection of morphia, &c. Erysipelas is a constitutional disease with local manifestation of redness, œdema or cellulitis, varying with the character or else the severity of the disease.

Well, given these two conditions, the one caused by the direct application of the poison to the skin, and the other a symptom of a constitutional disease. For the cure of the latter one is to give, if you please, a tincture of bee-stings by the mouth. Now, owing to a merciful dispensation of Providence, such poisons are rendered innocuous by the digestive fluids; to this property we owe immunity from numberless dangers which threaten us daily.

The heart-disease theory is too ridiculous, and serves only as additional evidence of the ignorance of our old friend the foxy dispenser.

**Innominate.**

## ELECTRICAL EXPERIMENTS.

[31588.]—I am pleased to find my experiments regarded as important. I thought I had only repeated old but interesting experiments. A simple way of observing the phenomenon is by means of an old incandescent lamp, provided the vacuum is not destroyed, holding the lamp in the hand, well charging it by presenting the electrodes to an electrical machine; in a short time a spark will leap from the electrodes to the hand, and a very smart shock felt. At the same time the bulb will be illuminated.

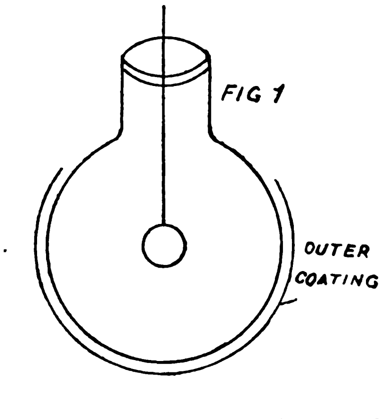


FIG 1

The most important experiment is the one in which the condenser is charged when full of air, and then not being capable of giving up its charge until exhausted. This seems to me to furnish the clue to the theory.

Suppose a small metal ball be placed in a glass vessel filled with air, the ball being in connection with a source of electricity at high potential, the air surrounding the ball will become charged with similar electricity, and, of course, repelled. It will be repelled as far as possible—viz., to the surface of the glass vessel, and the electrified molecules would collect there until their united potential equalled that of the bell. When this occurred the air molecules would be repelled from the ball and from the glass with equal force, and no further charge can be given to the apparatus. I think this is quite clear. The outer surface of the glass is covered partially with tinfoil and connected to earth.

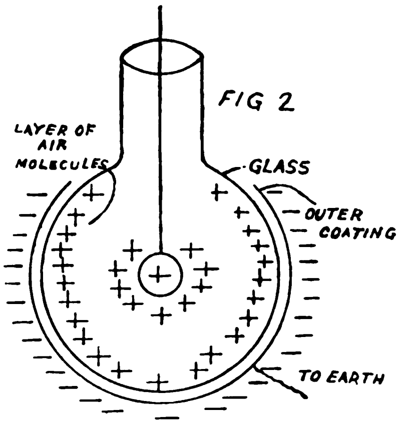


FIG 2

Fig. 2 will represent the state of affairs, the space between the ball and the glass being occupied by uncharged molecules of air. Now why is the condenser not discharged when the ball and the outer coating are connected? Air at ordinary pressures is a perfect insulator, so that if we connect the ball and outside by a discharging tongs the circuit cannot be completed between the two charged surfaces (Fig. 3.)

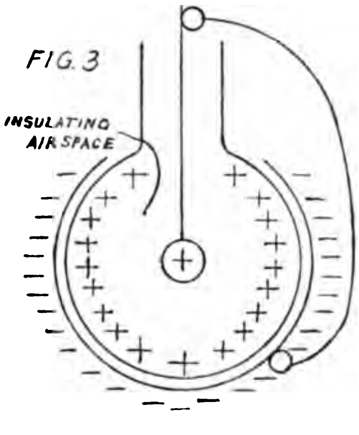


FIG. 3

If it were possible to insert a conductor between the ball and the electrified air layer, the circuit would be completed, and the condenser discharged. This is what is practically done by exhausting the vessel. At pressures below 30mm. air becomes a partial conductor (a good conductor for electricity at high potential), the conductivity increasing with reduction of pressure until a maximum is reached. In my experiments no discharge could be obtained until a lower pressure than 30mm. was reached; in other words, not until the air became a conductor. I should think that the maximum effect would be produced at the pressure at which air is the best conductor. I am continuing the experiments, and will communicate the results.

Plymouth. **W. A. Rudge.**

## A MAN-FISH.

[31589.]—Flying machines seem to be things of history, and locomotion at *will* through the air appears to make little, if any, progress at all; but submarine appliances do seem, at least, *practical.* Now, the idea occurs to me that an appliance might be constructed to carry one man, with his body well covered, having means of perfect locomotion in any direction; having his arms at liberty, yet very easily protected; having perfect means for breathing, and swimming powers equal to any fish the same size. He could, of course, see clearly all around him, turn upon his back or side, and swim just the same. Surely, if this were practicable, a ready means of visiting the ocean depths (not too deep) would open out much that remains mystery at present. Then look at the trips which might be done, &c.

I should like very much to know, from those having had any connection with diving or atmospheric pressures, &c., what obstacles would stand in the way? I will be brief. A torpedo sort of tube or casing, having holes for arms to project through (arms encased, except hands, in water-tight flexible sleeves), said tube balanced so that flotation under water would be horizontal, propulsion worked by the feet. Adjustable fins, fans, or blades moved by the hands, so as to rise or fall at will, also assisted by retaining air in case or dispelling same more or less, the said air to be in some part of machine in compressed form, which would, of course, be self-regulating from its confined compartment into the case, and this would keep the case ventilated, for air would be continually escaping, except only when it was necessary to go down very deep, where pressure of water would be too great to allow of such air escape; then the air-valve would close automatically (that is, the outlet valve from case). There would be stout glass outlooks, &c.

But there may be some great drawback to the practicability of such an apparatus, and this is what I want pointing out. If, on the other hand, there is no such great drawback, and any gentleman or gentlemen would like further particulars, or can give any useful information respecting same, I shall feel it an honour to receive such, or give such, information.

**F. G. Willatt.**

## SAP IN TREES.

[31590.]—I have been much interested in reading the chapters on Botany for Students in the "E. M.," and especially that portion on page 24 which relates to the ascent of sap in plants as follows:—

"The causes of the general movements upwards are (1) root pressure (2) capillary action, (3) evaporation by the leaves; and by the law of osmosis there will be a flow from the lower to the upper fibre."

The above forces for the ascent of sap in trees are always quoted in textbooks on botany; but it appears to me there is not the slightest justification for doing so for the following reasons:—

1st. *Root Pressure.*—Suppose the root of a tree to have some contractile force (although there is no evidence of it), and let that force be 50lb. or 50 tons to the square inch, is it likely water could be forced up the stem of a tree? Would not the water exude out laterally or downwards into the soil rather than rise 50 or 100ft.; or if by some means the water in the root were forced into the stem above, how, I would ask, is the root to obtain its next supply?

2nd. *Capillary Action.*—Where, I would ask, is the evidence that water will rise up the stem of a tree by capillary attraction, seeing that it will only rise in any material (earth excepted) but a few inches.

3rd. *Evaporation from the Leaves.*—This is usually called transpiration, and the flame of a lamp drawing the oil up a cotton wick is often quoted as an apt illustration; but a greater mistake was never made than to suppose the flame has any such power, for the oil will rise as high without the flame as with it.

4th. *The Law of Osmosis.*—This is one of the latest inventions for raising the sap. Let a vertical glass tube, having the lower end covered with a goldbeater's skin, be suspended over (but ching) the surface of water, and let a small y of syrup be poured into the tube, then the rill pass through the goldbeater's skin, and the bulk of the syrup above four, five, or s.

the above fact it is assumed that water will ie lower cells of wood, and rise through ove constituting the stem of a tree. How onclusion was ever arrived at it is difficult ive, for first of all there is no liquid water oot of a tree; next, if the divisions between ical cells of the wood be considered so many nes, then no rising can possibly take place. ube before named be prepared with several, only two membranes, one, say, an inch above r, the water will not rise. Osmosis is, there- useless as any of the preceding assumed

lso worthy of notice that moisture in the trees always appears in the spring *first* in er part and *last* in the root.

umbeth-road, Brixton. **J. A. Reeves.**

## ECHANICAL PARADOX — VIOL D'AMOUR.

..]—With regard to letter 31547 on p. 35. rst case, where C is revolved and the link is ry, the observer notices the true number of ons of each wheel—i.e., those with regard nk. In the second case, as the wheel B is rried round by the link, it revolves in the direction on its axis. But the link D turns el B and itself round, axis and all, half as other way as the wheel revolves axially; ntly by the time B has revolved twice rela- the link, the link and wheel have been nce the opposite way, so that it appears to onary observer that B only revolves once. osite action takes place with regard to A. es in the same direction as the link, but revolves relatively to the link twice, the lf revolving once, makes a total of three ons of A with regard to the observer, but relatively to the link itself.

ns to me that the viol d'amour would cer- worth reviving. Can Mr. Tahourdin give her details? What was the length of the part of the metal strings?—from the tail- the shoulder or from the tail-piece to the the latter, how were they protected from ab, since they passed under the neck? The the peg-box must also have been peculiar mmodate 14 pegs, unless the metal strings ed with iron pins. **Caldemone.**

## ATOMIC WEIGHTS.

.]—By the *Annuaire* quoted, p. 556, of meant the current one, dated 1890. If U are isolated as metals, it must be knowable they have the extremely low specific heat at of Bi, or nearly four times as high.

**E. L. G.**

## ETHER NONSENSE.

.]—"Sigma" asks me "if I do not consider nse' for people to talk of things of which e wholly ignorant as though they had ?" No doubt it is worse than nonsense, mischievous; yet in some of the subjects e occupied the human mind much of this

o asks me "if it is not nonsense for scientific tors to leave the ground of experiment and for fancy?" One must answer "Yes." on't think "Sigma" can seriously bring ge against all those who have investigated ect under discussion. Clerk-Maxwell, for —whether or not all his conclusions will be , he was certainly a shrewd and honest tor.

a's" third question need not be answered ffirmative—viz., "Is it not nonsense to to the imaginary actions of an *hypothetical* enomena known only as conditioned by the taking place among the particles of *known* ' (italics are mine.)

claims more for ether than that it is a r something supposed to pervade space. ething must be matter of some form, and must have attributes or properties In the r to discover *what* the something is and properties are, something is assumed for it r the purpose of investigation to see what or known phenomena will agree. This is more than a legitimate use of analogy. ries must start with some hypotheses; must assume; as soon as some phenomena ved to agree with the assumed, the process character of a safe working hypothesis, herefore, not "nonsense." Any opinion l by Clerk-Maxwell is sure to be the result tigation and mature thought, and not ' as "Sigma" describes it.

remember reading "Sigma's" able letters city, and if he were called upon to *demonstrate* all his statements, much might, by a critic, be called fancy. A theory is not shown to be "nonsense" because all its details cannot be demonstrated.

"Sigma" may be quite right in ignoring much of the speculations concerning the ether problem. Yet there is, I think, at the bottom of it something that have not been shown to be "nonsense"—viz., the idea that space is, as far as we can penetrate, pervaded by matter, and that the phenomenon of light, electricity, gravitation, &c., make use of (so to speak) this matter as a medium of transmission. If "Sigma" disputes the theory that light reaches us through space by means of undulations through a medium, it appears he is obliged to assume a condition of which he knows nothing—viz., that there is *unoccupied space*, and that light as a *material*, and *not as motion*, is thrust across the vast abyss. This view would embrace the old corpuscular theory. Of course, "Sigma" is not logically bound, in denying a theory, to give another one in its place, or to prove a negative position; yet, as a mere destructive policy does not advance us much, perhaps "Sigma" will give us his own ideas on this interesting question.

I am not aware that the idea of interstellar space being filled with matter in some form is denied by known facts; it is, I believe, in harmony with the nebular theory. That we should expect it thus I think follows from an *a priori* consideration. Is it not more in harmony with what we *do* know, that, if every particle of matter in the universe is attracted by every other particle, it is by some kind of *contact* rather than isolation?

We find law ever present, yet how can we admit ever-present law without ever-present matter in which it resides? Have we any warrant for supposing there is any point of space where energy is absent? and can energy exist *per se?* As matter and force are inseparable, and are the only reality, we can safely postulate all phenomena must be attributed to the forces of matter, the phenomenon of light included.

As "Sigma" says, we know so little of the nature of light, electricity, &c., the less we dogmatise the better about that which we don't know. Let us wait for more light, yet not *wait*, but work.

**G. Calver.**

## SOLAN GEESE.

[31594.]—One of the most interesting sights in connection with these birds was witnessed at 8 a.m. last Sunday morning (Aug. 24th) at Sumburgh, in Shetland.

In order that the reader may quite grasp the circumstances of the case, a slight topographical sketch will be necessary. At the southern extremity of the largest island of the Shetland group, called the "Mainland," two narrow promontories run into the sea, inclosing between them a bay which is termed "West Voe." This bay, which faces the south, is at the mouth about a mile wide, but somewhat more than that deep. Across the mouth of this voe runs a strong tide—viz., the celebrated Roost of Sumburgh. If anyone happens to be in it during a westerly gale and a spring ebb, he will most certainly have the circumstance indelibly impressed on his memory.

On that particular Sunday morning, however, the sea in West Voe was perfectly smooth; any outside swell there may have been was run off by the strength of the tide, so that in the bright sunshine it looked like a mirror. Towards the head of the Voe the water was somewhat darkened by a slight agitation of its surface, which was caused by a vast shoal of herring driven into the Voe by some of their numerous enemies of the deep; in this instance most probably by the "saith" or "coal fish" (*Merlangus carbonarius.*)

When the herring are thus driven in they are in such a crowded mass that the upper layer often sprickle on the surface of the water. This by no means unusual event in these islands is always accompanied by flocks of gulls, mostly the *Larus argentatus* or "Herring Gull," which swoop down and gorge themselves with herring. (On Saturday, Aug. 30th, at 5.30 p.m., in West Voe, seven boats were baling in herring with scoops and landing nets; and a boy on the rocks at the shore caught a dozen with his hand.)

On this occasion, however, the gulls were disconsolately seated on either promontory, a prodigious flock of "solan geese," or "gannets" (*Pelecanus bassanus*) being in undisputed possession of the feast.

To attempt to adequately describe this scene would be simply futile; but if those who have seen Ross in the breeding season will multiply by 10 the number of birds there, they might have some idea of the tableau before us that Sunday morning. (See "The Shetland Isles in the Birds' Nesting Season," by T. Digby Pigott, C.B.—*Contemporary Review*, Aug., 1890.)

To those acquainted with the habits of solan geese, we may exp[illegible]at they do not swoop down on the herring lik[illegible]ulls, but drop vertically head foremost, making a splash about 2 or 3ft. high. The bird quite disappears for the instant; the splash reminding one of the ricochet of a small cannon-ball on the water.

The scene before us might be most fitly described as a hail-storm of gannets. My first impulse was to roughly estimate the number of immersions of these geese in one minute over the bay. To this end I sought to isolate a small portion by examination through a telescope with rather a small field. Even in this small field I observed seven immersions at precisely the same instant, followed so rapidly by others that counting was as impossible as the counting of the drops of rain in a shower.

In about an hour many of the birds, being gorged, were swimming on the water; nevertheless, there was a considerable cloud of others flying over them. Six hours afterwards they were still at work, but in diminished numbers. Towards evening they were widely scattered, and next morning, with the exception of a few stragglers, they had all gone.

Solan geese are common visitors here, but it is doubtful whether any breed in these islands. This very remarkable flock were probably a migrating herd that had halted on their road to dine.

**Edward M. Nelson.**

## THE GASSNER DRY BATTERY FOR BELLS AND LAMPS.

[31595.]—I have read with interest the letters of Mr. G. E. Bonney (31306 and 31520) on the above subject, and would much like to know the results of his experiments with the cell after its being recharged by dynamo or battery. We know that for a short time it gives 2 volts; but I think he will find that the extra voltage passes off in a day or two, even if the cell is not worked. Also I doubt whether he gets the amount of work from it as he did with the original charge; but, however, I should like to hear (from him) if he got the 118 hours bell-ringing from it again. Also he quotes the E.M.F. to be 1·60 volt, when an advertisement I have of the cell quotes it as 1·44 volt. Has the cell been recently improved? I should like to hear a little more about the cell on these points. **A. E. Ball.**

## CHEAP MUSIC OF HIGH QUALITY.

[31596.]—I have before me Novello's Catalogue of Organ Music. Twice, many months apart, I tried to get the prices lowered, believing that a lessened price made purposely so is an inducement to purchase more. The reply sent me stated it was under consideration—and will get no further, for the old prices are maintained in new issue. I turned to Select Organ Pieces, a valuable and desirable collection of Vincent Novello's, and here I would note 3 vols. at 21s. each, or 18 books at 6s., or 108 numbers at 1s.; so the rich man buys at £3 3s. what the poor man, like myself, pays £5 4s., whether in numbers or parts. Surely this is not fair; and the Cathedral Voluntaries (3 vols.) follow the same rule. Now I, through the trade, can buy these vols. for £1 11s. 6d. by taking the three, so that there is a very large profit that way, and a still larger out of the poor man, who pays his £5 4s. Of course, firms have their rules. This house, built up by its efforts to bring cheap music and good to our doors, has laid us under great obligations. At one time I was very careless of my guineas; long sickness and an older head have made me careful of my shillings. The shillingsworth is well exemplified in the Cavendish music books, and no word can be said in dispraise of quantity. They are used in schools, and form excellent teaching models. If the firm of Novello or others should say, We prefer to keep volumes on our shelves rather than alter the price of 25 years or more back, then I will hie me to Peters or Litolff for the moderate desires of my soul. Many pounds have found their way out of my pocket to N. and Co. They have given me many a pleasure. I am far from content. Organ players and lovers of the harmonium are multiplying—why should not their desires be as well worthy of culture as choral societies? These people have made Novello's fame, and the firm can afford to meet the public, who pay cash, and I am one.

**Henry Ussher, B.A., M.B., Surgeon.**

It is not generally known what an immense quantity of cheese now reaches this country from Canada. Last year the imports amounted to nearly 90,000,000lbs. weight, and up to the middle of August the shipment from Montreal numbered 665,865 boxes, as against 553,449 boxes in the same period in 1889, and 500,005 in 1888.

A new locomotive with downward draught furnace has been run for a week, two round trips per day, on the route for Portland, Me., to Sebago Lake, eighteen miles, making seventy-two miles each day, with one baggage and two passenger cars. The results are said to be good. The inclines are heavy, though the load is light. The grate's bars are water tubes. The ashpan has a water bottom, like that used by Mr. Webb; the intention is to get rid of sparks. It appears, however, that the exhaust nozzles have had to be contracted, and after all sparks are emitted.

# REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[71439.]—**Aniline Colours.**—As "Sm." and others had left this query without any reply at all, I sent a suggestion which I thought better than nothing. If most aniline colours fade, and the colour in question doesn't do so, that is some evidence in favour of its not being aniline. Perhaps "Sm." will give some accurate test, as he appears to know something of the matter inquired about.

Glatton.

[71874.]—**Cupric Sulphate.**—That the blue colour of crystallised cupric sulphate is due *in some way* to its fine molecules of water of crystallisation is fairly obvious from the fact that if these molecules be expelled by heating the salt, the colour vanishes. I, however, do not know what is the real connection between the water of crystallisation and the blue colour, and I believe that no one knows the exact nature of the connection. A very similar answer will apply to most of the other questions put. It is not true, as stated by "A Foreigner," that "cupric sulphate is a combination of copper and sulphuric acid." The latter compound has the formula $H_2SO_4$, and as the dry salt does not contain hydrogen, it cannot be a combination of the metal and the acid. The salt is really a substitution derivative of the acid, in much the same way that methyl chloride is a substitution derivative of methane. Little or nothing is known as to the real connection between the formula of a compound and its colour, and it is to be remembered that the latter is in some degree dependent upon the nature of the light by which the substance is seen. That the colour of a compound is in some way a function of its formula is scarcely to be disputed; but the real connection is a mystery. Mercury is a silver-white liquid metal, oxygen is a colourless gas; one combination of the two is black, the other is brilliant scarlet or yellow. The facts are not in dispute; but the explanation is beyond us, and very likely will always remain so. The quotations with which the querist concludes read curiously. If by his use of the phrase "Noblesse oblige," "A Foreigner" means to imply that science is bound to explain all observed facts, he must be very ignorant. We ourselves are products of matter, our thoughts and ideas are functions of some dreadfully complicated compound in the nerve-cells of the brain; and there must, in the nature of things, always be limits beyond which we cannot get—limits imposed on us by our organisation. No one can possibly be less disposed than I am to set bounds to the progress of science; but in dealing with some problems we will fail necessarily. Our knowledge of the "mysterious thing called matter" is enormously greater now than it was fifty years ago. What that knowledge will ultimately become I cannot tell; but it may be that we will never know why sugar is sweet and acetic acid is sour, and it is certain that the real connection between matter and consciousness is for ever out of our grasp.

Wm. John Grey, F.C.S.,
Newcastle-on-Tyne. Analytical Chemist.

[71926.]—**Working Model.**—The siphon may or may not succeed; I think it would if water were allowed to rise somewhat above the dotted line in the lower figure. If you do not care to experiment, why not adopt the cork? It can hardly fail, and is simple, too. B might be a leather bellows. The delivery pipe (dotted in Fig. 1) should end above the level of water in A, and the lower end should just penetrate the top of bellows. Closing the bellows would return the water. But why not draw off the water, by a cock in B, into a jug and pour it into A?

Glatton.

[71944.] — **Small Wood Cylinders.** — Cedar pencils are (or used to be) made by cutting grooves, to take the leads, in a plank, inserting the leads, and gluing another plank on. The compound plank is, when dry, passed between revolving cutters of semicircular shape. Usually there are six pairs of cutters in a row; their centres being exactly the same distance apart as the leads. The effect is to cut a series of six beads on each side of the plank, and as these are opposite each other, and the clearance between the cutters is a minimum, the result is that six cylinders are formed, each containing a lead. The cutters run at about 4,500 revolutions per minute. They leave the pencils perfectly smooth and ready for polishing. (Knight's "Dict. of Mechanics," page 1658.)

Glatton.

[71949.]—**Coupling two Portable Engines (U.Q.)**—You are morally certain not to get the shafts in absolutely the same straight line; hence any shaft or other mechanism between them must have play. If by a Hooke's joint or some other non-rigid coupling you allow for this play, you can couple them, but must expect rattle. If the present flywheels are properly designed, one of them will not be wide enough to take a belt of the proper size to carry the combined power. Hence you will want a wider wheel for the belt. You will not have measurably greater power with the two belts; but you will have far less annoyance in working.

Glatton.

[71929.]—**Oil and Gas-Engines (U.Q.)**—I give you a few extracts from trials of gas-engines which have appeared in *Engineering*. For full particulars refer to that periodical at the places quoted. Spiel's petroleum engine is said, on p. 128, Vol. XLI., to use about a quart of benzoline per horse-power per hour for a power of from 2H.P. to 3½H.P.

Name of Engine, References, Horse-power, Revolutions per Minute, and Gas in Cubic Feet per Horse-power per Hour.

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Atkinson's, Vol. XLVII. p. 179:

| | | | | |
|---|---|---|---|---|
| I.H.P. .... | 11·15 | 6·59 | | |
| Gas ........ | 19·22 | 20·18 | | |
| B.H.P. .... | 9·48 | 4·74 | 8·29 | 7·08 |
| Gas ........ | 22·14 | 26·8 | 22·75 | 22·29 |
| Revs. ...... | 131·1 | 129·6 | 110·5 | 100·5 |

Crossley's Otto, Vol. XLVII. p. 203:

| | | | | |
|---|---|---|---|---|
| I.H.P. .... | 17·12 | 9·73 | .. | .. |
| Gas ........ | 20·76 | 21·2 | .. | .. |
| B.H.P. .... | 14·74 | 7·41 | .. | .. |
| Gas ........ | 24·1 | 27·77 | .. | .. |
| Revs. ...... | 160·1 | 158·8 | .. | .. |

Griffin, Vol. XLVII. p. 204:

| | | | | |
|---|---|---|---|---|
| I.H.P. .... | 15·47 | 10·23 | 3·84 | 16·39 |
| Gas ........ | 23·1 | 22·92 | 25·91 | 23·05 |
| B.H.P. .... | 12·51 | 6·3 | [No load | 13·39 |
| Gas ........ | 28·56 | 37·2 | on] | 28·21 |
| Revs. ...... | 198·1 | 201·8 | 200·1 | 206· |

8-horse Griffin, Vol. XLV. p. 362:

| | | | | | |
|---|---|---|---|---|---|
| I.H.P. .... | 18·82 | 18·42 | 18·62 | 18·26 | 11·45 |
| Gas ........ | 18·89 | 18·96 | 18·92 | 18·87 | 25 |
| B.H.P. .... | 15·13 | 14·75 | 14·94 | .. | 7·72 |
| Gas ........ | 23·5 | 23·66 | 23·58 | .. | 37· |
| Revs. ...... | 228·7 | 218·9 | 238·8 | 210·4 | 215·5 |

2-horse Griffin, Vol. XLV. p. 362:

| | | | | |
|---|---|---|---|---|
| I.H.P. .... | 4·48 | 4·83 | 4·92 | .. |
| Gas ........ | 22·75 | 23·8 | 23·88 | .. |
| Revs. ...... | 204·7 | 203·1 | 192· | .. |

Beck, Vol. XLV. p. 469:

| | | | | | |
|---|---|---|---|---|---|
| I.H.P. .... | 7·25 | 6·51 | 6·42 | 5·62 | .. |
| Gas ........ | 21·68 | 21·18 | 22·15 | 20·67 | .. |
| B.H.P. .... | 6·31 | 5·71 | 5·85 | 4·84 | 6·5 |
| Gas ........ | 27·67 | 27·27 | 26·10 | 26·14 | 27·54 |
| Revs. ...... | 206·5 | 212· | 163·2 | 168·9 | 183·8 |

Simplex, Vol. XLVIII. p. 186:

(Town's gas.)

| | | | |
|---|---|---|---|
| B.H.P | 6·7 | 8·67 | 9·28 |
| Gas .. | 22·09 | 20·66 & 20·12 | 21·23 & 20·73 |
| Revs.. | 160· | 160· | 160· |

(Dowson water-gas.)

| | | | |
|---|---|---|---|
| B.H.P | 7·12 | 3·61 | 5·26 |
| Gas .. | 89·97 & 88·03 | 188·14 & 114·85 | 100·71 & 98·88 |
| Revs.. | 160· | 160· | 160· |

(The anthracite coal used per brake H.P. per hour in making the Dowson gas is given as 1·148lb. to 1·3lb. for a 35 to 40 brake H.P. engine.)

Forward, Vol. XLVII. p. 227:

| | | | | |
|---|---|---|---|---|
| I.H.P. .... | 5·54 | .. | .. | .. |
| Gas ........ | 21·15 | .. | .. | .. |
| B.H.P. .... | 4·807 | 3·084 | .. | .. |
| Gas ........ | 24·386 | 32·51 | .. | .. |
| Revs. ...... | 176·86 | not giv'n | .. | .. |

Simplex, Vol. XLI. p. 306:

(Town's gas.)

| | | | | |
|---|---|---|---|---|
| B.H.P. .... | 6·79 | 8·79 | 9·41 | .. |
| Gas ........ | 21·8 | 20·3 | 20·9 | .. |
| Revs. ...... | 154·3 | 161·2 | 157·4 | .. |

(Dowson gas.)

| | | | | |
|---|---|---|---|---|
| B.H.P. .... | 7·22 | 3·66 | 5·33 | .. |
| Gas ........ | 89· | 116· | 99·2 | .. |
| Revs. ...... | 163·9 | 158·7 | 159·1 | .. |

Atkinson, Vol. XLIII. p. 433:

| | | | | |
|---|---|---|---|---|
| I.H.P. .... | 5·563 | 4·16 | .. | 5·811 |
| Gas ........ | 19·78 | 21·78 | .. | 20· |
| B.H.P. .... | 4·889 | 3·326 | 1·642 | 5·255 |
| Gas ........ | 22·51 | 27·24 | 37·04 | 22·11 |
| Revs. ...... | 147·8 | 149·3 | 149·9 | 146·04 |

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Glatton.

[71960.]—**Lever and Spring (U.Q.)**—What is your difficulty? Would a spiral spring, attached by one end to a stud near the lower right-hand corner of base-board and by the other to the lever, not answer your purpose?

Glatton.

[71980.]—**Slag—as a M[illegible]ine.**—To "Innominate."—I meet "Innomin[illegible]" upon his own grounds. According to all the drug-books of allopathy, mercury, in its crude form, is inert; but ground up with chalk, i.e. lime-stone (*calcium*) mercury one part, chalk about 10 parts by volume, the lime-stone has *then* produced one of the most powerful, frequently-used medicines allopathy possesses; vide "Neligan's Medicines: their Uses and Modes of Administration" (Longman, 1858); Royle and Headland's ditto, 1868 (Churchill). Slag cannot be formed in the blast furnaces except by lime-stone, and present to the average extent of about 40 per cent. by weight. It is to the *calcium* plus silicon, sulphur, alumina, iron, phosphorus (all allopathic medicinal agents), &c., that slag (in an attenuated form only, and à la the above mercury and chalk or grey powder) owes much of its vast power as a medicine. But modern science has recently produced for allopathy's pressing needs a powerful antiseptic salt (used as a lotion) formed by a combination of three of the eight or more elementary bodies present in slag, i.e. sodium, silicon, fluorine, and named by its inventor, William Thomson, F.P.S., &c., "*Salufer*," meaning "health-bearer"—the inventor's scientific reputation alone giving a guarantee as to the worth of the commodity and of its author's "amazing assurance." In replying to "Innominate's" question as to whether "'The Lydney Dispenser' takes all these wild remedies himself," I have to say that no remedy has ever been prescribed at this dispensary except and until the leading features peculiar to the said drug had been ascertained by me through experience and on my own person. Salufer in internal doses of $\frac{1}{1000}$ part of one grain invariably causes in me an irritating itching in the outer and inner ear passages, acts as a powerful muscular and motive-power stimulant, removes as if by magic the carrion-like stench from the breath of typhoid and other fever patients, remedies septic indigestion and its attendant symptoms, &c. Now, then, my jovial antagonist, can *you* produce any one therapeutic piece of information elucidated out of your own personal researches calculated on a par with this for enabling you to combat with disease? On the contrary, I fear that the tractate No. 12 "The Dangers of Modern Medicine," somewhat expresses the experience of the average of those to whom you may have happened to advise so-called therapeutic treatment.—N.B.—"Abertify" shall be dealt with next week.

The Lydney Dispenser.

[72026.]—**Prurigo.**—The "Lydney Dispenser" is wrong in saying that quackery gives "dis-ease" to orthodox physic. The medical profession, strong in truth, treat bone-setters, homœopaths, herbalists, etc., with unmeasured contempt. I have nothing to do with Dr. Burnett or his writings. I only know that cataract is a permanent affection, curable only by removal of the lens. If one in a thousand had been cured by physic, every case would undergo a course of treatment before operation. This case might interest the "Lydney Dispenser": A man I knew was ordered two teaspoonfuls of Epsom salts for constipation, which was relieved, but the man died about three weeks afterwards; the patient, it appeared, had been in the habit of resorting to this remedy for years; but that it had any effect in producing his death is not believed by

Innominate.

[72036.]—**Guessing Number Thought of.**—In my former communication the following expression occurs: "If the two products by 3 are even, there is very little fractional labour." This should be: If the two products by 3 are even, there is fractional labour. Arithmos.

[72060.]—**Celluloid.**—Perhaps I do know a little more than the general public about celluloid. It is a solution of very pure dinitrocellulose in camphor, effected by heat and pressure. The cellulose is prepared as for collodion, but dissolved in camphor instead of ether alcohol. Sm.

[72069.]—**Beef.**—Meat which has been killed in the afternoon, the weather being warmer than the evening, has a better chance to cool prop on account of the pores being kept open by the action of the weather. Meat killed in the evening does not so readily give up its heat, because the pores naturally have a tendency to close. Take ourselves for example: we enter a warm room, our pores begin to open and give out heat which, coming in contact with the cooler air, forms a kin of dew on our skin, vulgarly known as "sweat among which we can find impurities of the b which have been driven out by the action of heat. It therefore stands to reason that, if the is allowed to escape from the meat, it must b out with it any impurity which may happen t present at the time, and the meat will be likely to keep longer. I wish I had replied be and saved you trouble. J. Pawl

[72098.] —**Immediate Life Annuiti** Security is the primary consideration, and B Government annuities can be bought and lis prices obtained from the National Debt Office, Jewry, London. The General Post Office also p lishes lists and transacts the business. N

[72111.]—**L.C. and D. and L. and S.W Locos.**—The numbers of the front-coupled t on the L. and S.W.R. are as follows:— to 68, built 1888; Nos. 69 to 75, built 1889; to 77, built 1890. No. 77 was only put on in the beginning of last month. I believe ms intends to construct twenty engines of s.

ow. METEOR.

.]—**Caledonian Old 8ft. Singles.**—ngines were built by Neilson, Glasgow. s, 17½in. by 24in.; driving wheels, 8ft. 2in.; and trailing wheels, 3ft. 8in.; working , 120lb. per square in.; weight in working loco., 30 tons 13cwt. Valves are worked xed box link motion. There are both inside ide frames. These are all the particulars I .

J. A.

.]—**Regular Polygons.**—In last equation eply, p. 39, 2 sin $\frac{\pi}{17}$ should be 2 sin $\frac{\pi}{34}$

E. L. G.

.]—**Cog - Wheels.**—I am very much to Mr. A. S. W. for his kindness in answer- query. I should be more so for a drawing, ld like to try this contrate wheel and pinion, could give me a table of simple arithmetic ate train of wheels, as I want to make one ee pinions on the same principle. W. S.

.]—**Phonograph.**—The difference between needles is this: that the recording needle is all gouge, which turns into the wax of the to various depths as the needle vibrates; reproducing needle has a small ball on the s not to destroy the groove in the cylinder ks along. F. T. SHAW.

.]—**Electric Bell and Battery.**—It does er to which terminals of an electric bell the om the battery and from the push are con- r which pole of the battery goes to push h to bell. "A. B. T." is mistaken when in his reply that it does. For convenience wever, it is advisable to conform to one that the carbon pole is generally taken to nd not zinc, as "A. B. T." shows in his . On page 113 of "Practical Electric Bell ' I have pointed out an instance where it advisable to take zinc to push; but the fer to is not one of common occurrence.

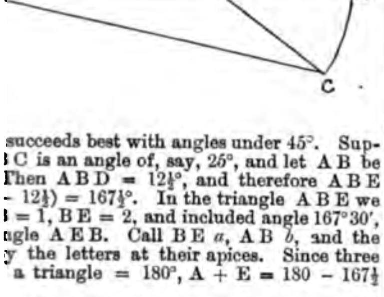
F. C. ALLSOP.

ueen Victoria-street, E.C.

.]—**Clock-Mending.**—Pendulum of 3⅛in. bout 212 vibrations per minute. Wheel of gives 60 vibrations per revolution. Work- these figures, 'scape-wheel pinion revolves about 17 seconds—near enough for our . Horizontal 'scape-wheel has 15 teeth, and vibrates five times per second. 'Scape- therefore, turns once in six seconds. To is speed proceed as follows:—Take off old heel, and mount in its place a wheel of ; let this drive a pinion of six, carrying 'scape-wheel. This arrangement will make vibrate about five times per second. There ous other ways of arriving at the same ut perhaps this is the easiest.

F. J. GARRARD.

.]—**Trisecting an Angle.**—The follow- an easy method of accomplishing this nately. Let A B C be the angle. Bisect it , and produce this line backwards to E, B E twice B D (i.e., twice B A). Join A E he angle A E C is (nearly) one-third of the B C. I devised this method about six years



succeeds best with angles under 45°. Sup- C is an angle of, say, 25°, and let A B be Then A B D = 12½°, and therefore A B E - 12½) = 167½°. In the triangle A B E we = 1, B E = 2, and included angle 167°30′, ngle A E B. Call B E $a$, A B $b$, and the y the letters at their apices. Since three a triangle = 180°, A + E = 180 − 167½

½ (A − E) = $\frac{a-b}{a+b}$. Tan. ½ (A + E).

gives—

(A − E) as an angle of 2° 5′ 27″
(A + E) = 6° 15′ 0″

btracting downwards = 4° 9′ 33″ = E. his is 8° 19′ 6″, which is one-third of ″, instead of 25°. DIRECTOR, R.R.I.

[72195.]—**Magic Lantern.**—If you remove the front lens of your portrait combination, and insert it, convex side facing the screen, in the place of the back combination, you will double your focal length. Safe distance of condenser to lime, about 6in. S. BOTTONE.

[72225.]—**Trisecting an Angle.**—If it be less than about 70° call the angular point A, mark B on one of the legs, and from B drop a perpendicular to the other leg at C, and carry an indefinite from B, parallel with A C, consequently perpendicular to C B, and call its further part E (the most remote from A). Now take a straight-edge, at least four times as long as A B, and mark two points thereon at an interval twice A B. Lay this edge so that the two marks are on the lines C B and B E while the edge touches point A. It then cuts just a third of the given angle B A C, as you may prove by calling the two marks D E, and the middle point between them F, then joining B F, and observing that A B, B E, D F, and F E are all equal, forming the three isosceles triangles A B F, D B F, and B F E, and each of the angles F B E, F E B, or D A C is half D F B or D A B and therefore a third of C A B. To trisect an obtuse angle it is necessary, and for any larger than about 60°, it is advisable to put within it three lines instead of the two, B C, B E. Suppose the angle just double your present B A C and call it B A G, and that your line B C continues to G, so that A B = A G. On B G erect two indefinite perpendiculars, B E and G H. Then your straight-edge, touching A and having its marks B G, B E, will be one of the trisecting lines of B A G; and when the marks are on B G, G H, it will be the other trisecting line. It is most readily adjusted if you plant a fine needle at A, against which your straight-edge can rest, with both a sliding and turning movement combined, till you get its two marks accurately on the two mutually perpendicular lines. This is figured (but not well) in Vol. VII. p. 411.

E. L. G.

[72228.]—**Logarithms.**—I picked up the other day at a second-hand book-stall, an old mathematical volume (printed in 1771) containing Abraham Sharpe's celebrated table of 61-figure logarithms. It may interest some of your readers to see whether we may really expect as many figures correct as the logarithm has decimal places. We need not take the whole of the 61 figures; it will be sufficient if we take the first 20, the number mentioned by "F. R. A. S." (p. 33). Well, then, the logarithm of 88 is 94448267215016862639; multiplying by 8, we get 555586137720130901112, which is between the two following:—

Log. of 3597 is 55594043781851111325
„ 3596 „ 55581968306119115743
Difference 00012075475731995582

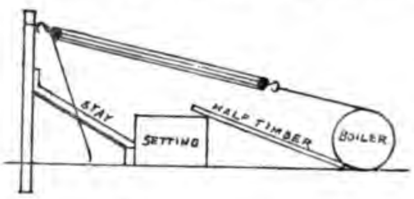
If we construct a table of proportional parts from this difference, and use it for obtaining the number we require, the result will by no means be true to every figure of the eighth power of 88. I think it will be found correct to eight figures only. Hence it seems that tables of logarithms calculated to abnormal length, though useful in some calculations, would not be of the general practical utility sometimes supposed. T. S. BARRETT.

New Athenæum Club.

[72228.]—**Logarithms.**—In reference to this question, it may be useful to state that when logarithmic work is occasionally required correct to 12 figures, the late Peter Gray's Tables (Layton; 3s. 6d.) will enable anyone to calculate the logarithms and antilogarithms by a simple and short arithmetical process. (A more expensive work by the same author gives the process for obtaining 24 figures.) It must, however, be always borne in mind that multiplication (as in involution), in proportion as it increases the number of figures in the characteristic, diminishes the number in the mantissa—i.e., those that are reliable; so that if the multiplier is very large we may get a logarithm of which we only know the characteristic; in which case, of course, we get no result, excepting the knowledge of how many figures there would be in the answer. A curious example given in Mr. Gray's book is worth quoting. It is required to find the 387,420,489th power of 9, correct to the first 12 figures. This number "is the greatest that can be expressed by three figures in the Arabic notation," the index being itself the 9th power of 9. Mr. Gray takes the logarithm of 9 to 23 places, and multiplies it by 387,420,489. The product consists of 32 figures—viz., characteristic 9 figures, mantissa 23. The last 11 figures of mantissa are rejected as unreliable, giving us 12 to work upon; and from these, together with the characteristic, we find that the required number is an integer consisting of 369,693,100 figures, the first 12 of which are 428,124,773,174. "If this number were written down in a line, allowing 1-10th of an inch to each figure, it would extend 583 miles; and to write it down, working night and day, at the rate of two figures per second, would occupy nearly six years."

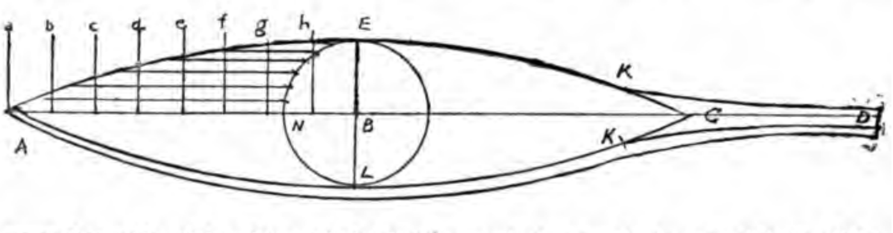
T. S. B.

[72231.]—**Erecting Machinery.**—Fix ropes firmly around boiler, about 2ft. or 3ft. from each end, bring other ends down the off side of waggon, and give each rope two turns round the rail; get boiler over parallel with side of waggon, and let it run slowly down the incline you have put up of two half-timbers. When it gets to bottom the ropes will be coiled around boiler, and you will see that by pulling ropes towards waggon the boiler will come up incline on to waggon again. Get boiler over to furnace same as in sketch; put ropes round same way, with as many turns of rope round it as will take it up incline on to its setting; if you can't get hands to give you a pull, fix a 15ft. half-timber one end 3ft. in ground behind furnace, and fixed with stay or two guy ropes, as shown. Fix blocks at top, tie the ends of your two ropes coming from boiler to your tackle, and pull away. Engineer your hammer off the waggon on to as many half-timbers as you may think safe, and coax it gently down incline; get over to its place, rig up two shear legs, fastened with two guy ropes, get your blocks fixed at top, put sling around hammer, hook on your blocks, and pull away. Do not get excited, keep yourself cool, and be careful and look after the safety of yourself and your men.



THE FIFE, ADAMSON.

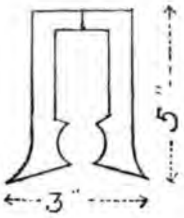
[72232.]—**Balloons.**—The length of the gore must be half the circumference—10ft × $\frac{22}{7}$ = 31ft. circum., nearly; 15½ft. will therefore be the length of gore for the spherical part. For the width of the gore it depends how many you take to the balloon—say twelve; $\frac{1}{12}$ of the circum. = about 2ft. 7in. Draw A C = 15½ft.; halve it at B; describe circle with radius equal to half of 2ft. 7in. = 1ft. 3½in., and draw E L vertical. Divide the quadrant E N into a number of equal parts, say sixteen, though I have only shown eight for clearness. Divide A B into a like number, and erect perpendiculars $a$ to $h$; draw parallels to A B from each point of division in quadrant to perpendiculars, as shown, and draw A E through points of intersection forming one-quarter of the gore. Repeat the process to get line E C. Now for the neck. Produce A C to D, letting C D equal one-quarter A C. Let orifice of neck be 2in. diameter, or about 6in. circumference; end D will be ½in. wide; draw end D this width, and taking point K about two-thirds E C, join K D in an easy curve. Repeat construction to obtain the other half, A L D, of gore, and when finished, before cutting out, add a margin of about 1in. to one side for sewing. As regards the number of gores to the balloon, you must consider the width of the stuff you are using, so as to cut it with a minimum of waste. This method of cutting out is applicable to any number of gores if you draw E L equal to its width. May I ask what you want with such an inconvenient size of balloon? It will certainly not carry you, since it only contains 524ft. of gas. CALDEMONE.



[72233.]—**Tisane.**—Many thanks to "Solanum" and "B. Sc." But these answers are so widely different from each other that I intend to wait and see if any answer will come from the other side of the Channel. I can make out all the French words except "patte de chat." What might be the English for it, Monsieur "B. Sc."? SUTARG.

[72256.]—**Small Dynamo.**—Make a pair of field magnets of the shape and size figured below.

Wind both armature and fields with No. 24 silk, covered wire, using about 2oz. on armature, and 12oz. to 14oz. on the fields. Magnetise well, and then connect up in shunt. You will find it best to use castings. You should get about 2 to 3 ampères at 15 to 20 volts. The advantage lies in the fact that the electro-magnets are more powerful than the permanent magnets, and do not lose their magnetism, since they are fed by the current produced in the dynamo itself. S. Bottone.



[72263.]—**Japanned Wire.**—Dip the articles in hot, and hang up to drain. Jack of All Trades.

[72264.]—**Gramme Dynamo.**—To Mr. Bottone.—Since in the Gramme armature more than half the wire is inactive, so it follows that to get 59 volts (say 60) we shall require a much larger amount than that mentioned by you. It is usual to allow one yard per volt (of active wire), and since No. 20 runs 80 yards to the pound, we may safely allow 3lb. of wire, or 240 yards of wire, of which about 80 will be active for the purpose. The excess of voltage will serve to overcome the resistance of armature and leads. Owing to the fact that small castings do not magnetise up well unless a rather large current circulates round them, it will not be advisable to follow Sir Wm. Thomson's rule for large dynamos, but to put on about 11 or 12lb. No. 20, connected in shunt with the brushes. S. Bottone.

[72266.]—**Battery Solutions.**—If the S.G. of your cell is as low as you say, the cell is not properly charged up. Test it with the voltmeter, and if it does not give its 2 volts, it should be cut out of the discharge till it does. F. C. Allsop.

[72266.]—**Battery Solutions.**—There is nothing abnormally low in a sp.gr. of 1·160 in the acid of a storage cell, which is, I presume, what you refer to. The Drake and Gorham cells are, by the instructions of the manufacturers, to be run with an acid of even lower sp.gr.—viz., 1·150. S. Bottone.

[72271.]—**Tempering Drills.**—Get the drills a blood heat, about 1in. from point, then dip in clean cold water, then polish them—rough emery is what I use; hold in gas, about 1in. from point, when a straw colour will appear; let this run down till pink reaches the point, then dip in water. If the steel should be brittle, let them run lower to a blue; if too soft, not too low, dark straw colour. A small blowpipe is the best for this purpose. Wm. Fairburn.

[72271.]—**Tempering Drills.**—Make them red-hot, about the colour of red-lead, so as you can see them in the dark, and if small plunge them into oil or cold fat, if large into water. Clean bright with emery-cloth or sandstone, and hold them over a piece of hot iron, or the back end in a fire or lamp until the edge polished is a golden yellow, then quench, and when ground up are ready to use for anything but glass or hard steel. Jack of All Trades.

[72272.]—**Tool-Cutting.**—These tools are called scorpers, they are gravers—section, lance shape, spitsticks, square, or lozenge-shape gravers (these are different sizes); bull-nosed bullsticks, round-nosed, square-nosed, clearers, parting-tools, knife-tools. A sandbag, and a cone tap for cementing things (this is a conical wood-block with a hole through the centre), some files, and an oilstone. Jack of All Trades.

[72273.]—**Corrosion in Pipes.**—Is the deposit really the effect of corrosion—i.e., rust, or is it lime from the water? A solution of hydrochloric acid should remove it in either case; but there is danger of the iron pipe being attacked if the treatment is carried on for too long a time. Sm.

[72273.]—**Corrosion in Water Pipes.**—I presume "J. D." means hot-water pipes. Please say if it is so and I will do what I can to assist; also say if he disconnects them for cleaning. I should be very much obliged if "J. D." would make me a present of a short piece of the pipe, or a socket with the corrosion in it. C. E. Gittins.

St. George's House, Eastcheap.

[72274.]—**Intermittent Streams in England.**—A very vigorous one flows, at uncertain intervals of years, into Brighton Steen, down the usually dry London road, from near Clayton tunnel. E. L. G.

[72276.]—**Battery Life.**—Surely you can test the battery during the day by ascertaining whether the bell will ring or not. If it fails, notice whether the cells require water; if water does not remedy the defect, add ammonic chloride. When that is no longer any use, the cells require renewal. Generally speaking, the cell lasts out the zinc rod. Sm.

[72276.]—**Battery Life.**—If the gradual deterioration in the power and brilliancy of ringing is not a sufficient guide to you as to the state of your battery cells after a long period of work, you can immediately test the condition by means of a low and high resistance detector. The peculiar result noticed by "Chirurgo" in the behaviour of his cells when first coupled up to lamp, may depend largely on osmotic causes, which reduce the internal resistance shortly after the current has set up. S. Bottone.

[72276.]—**Battery Life.**—You can detect the exhausted condition of the Leclanché cells by testing each cell with a detector galvanometer, using the thick wire coil. The less the deflection the more exhausted the battery. On inspection, the zincs will be found to be eaten quite thin, and the solution milky. See my book, "Practical Electric Bell Fitting," where there is a chapter on the Leclanché battery, giving full instructions for setting it up, keeping in order, and testing with the galvanometer. In places where the running-down of the batteries is a great nuisance, such as in hotels, &c., my usual practice is to inspect and clean the batteries every eight or nine months. F. C. Allsop.

165, Queen Victoria-street, E.C.

[72278.]—**Division of Land.**—From the plan and dimensions of field given by "Tee Square," it appears that the width of the pieces increases $\frac{3}{20}$ths of a foot in every foot of length, and that the area of a $\frac{1}{7}$th portion = 297½sq.ft. Therefore the area of the first portion commencing the narrow end may be stated as follows: Let $x$ = number of feet along the 70ft. line occupied by the first plot. Then—

$$x\left\{\frac{24\frac{1}{2} + (24\frac{1}{2} + \frac{3}{20}x)}{2}\right\} = 297\tfrac{1}{2}$$

which gives $x$ = 11,722ft. In the above equation—

$$\frac{24\frac{1}{2} + (24\frac{1}{2} + \frac{3}{20}x)}{2}$$

represents half the sum of the two sides of the first plot, which, when multiplied by the width $x$, gives the area. The other portions may be found in the same manner. Walter Herbert.

[72280.]—**Acute Rhinitis.**—"Athlete" will almost certainly find relief and probably cure by trying the following:—Procure a nasal douche, which is used by putting the nozzle into one nostril, placing the finger outside the nose so that the fluid does not regurgitate, and then syringing through about a pint of fluid; all this time, if the mouth is kept open and he breathes only through the mouth, "Athlete" will find that the fluid will run out through the other nostril in an uninterrupted stream. I will give him two prescriptions; I advise him to try No. 1 first: (1) Acid. Boraci, ½ drachm. Aq. ad op. An equal part of warm water to be added, and to be used twice a day as a nasal douche. (2.) Sod. bicarb. pot. chlor. aa ptes. æq. Sacch. alb. ptes. iv. Fiat. pulv. A teaspoonful of this powder to be added to a pint of water. If there is great pain, "Athlete" will find almost instantaneous relief by a spray of 2 per cent. cocain, which must only be used on rare occasions, and not more than twice a day. Innominate.

[72281.] — **Moulding and Casting.** — Use either air-slaked chalk, lime, French chalk in powder, or plumbago, or a mixture of each with about a tenth part of finely-powdered rosin. Flux your metal and pour gently in a well or bay, and make the runner a nice incline, that the mould is not washed by the lobbing of the metal into it or breaking its neck. Jack of All Trades.

[72286.]—**Electro - Coppering.**—By the processes described by G. E. Bonney at 72068, Aug. 29, and by myself at 72068, Aug. 22, you can easily copper your cast iron. To coat 5sq.ft. about one-sixteenth thick will take about 7lb. (say 8) of copper. This will take 3,000 ampères to do in one hour, or 300 ampères to do in ten hours. A dynamo giving 300 ampères at one or two volts pressure can be had for £50. The solutions would cost but a few shillings; the horse-power required to drive the dynamo would be between ¾ and 1H.P. S. Bottone.

[72290.]—**Pressure.**—A 1,000lb. if you want it, and it is sound. Jack of All Trades.

[72292.]—**Accumulators.**—To Mr. Bottone.—I do not find anything better than a paste made by mixing red lead and sulphuric acid to the consistency of dough. This can be spread into the holes or grids of the lead plates with the aid of a wooden spatula. The paste must be allowed to dry in quite hard before the plates are used again. S. Bottone.

[72293.]—**Electrical Winding Castings.**—Wind the armature, which you say is 1½in. dia. and 2¼in. long, with 5oz. No. 20 wire d.c.c., then wind the field-magnets with about 3½lb. No. 22 d.c.c. Connect up in shunt with the brushes. This should be driven between 2,000 and 2,500 revs. per minute, when it will light four small lamps of 8 to 12 volts each. If the commutator gap be made pretty wide (the winding remaining the same), this dynamo will give shocks, but not light so well. But if the current from this dynamo be used to work a small induction coil, severe shocks can be given without any alteration at all. S. Bottone.

[72294.]—**Algebra.**—Denote the sum of the series by S. Then—

$$S = x^2 + (x-1)^2 + (x-2)^2 + \ldots\ldots$$

By expanding (to $n + 1$ terms)

$$S = (n+1)\,x^2 - 2\,(1 + 2 + 3 + \ldots\ldots n)x + (1^2 + 2^2 + 3^2 + \ldots + n^2)$$

The co-efficient of $x$ being an A.P., and the other series well known—

$$S = (n+1)\,x^2 - n\,(n+1)\,x + \frac{n\,(n+1)\,(2\,n+1)}{6}$$

The sum to 12 terms ($n = 11$) is—

$$12\,x^2 - 132\,x + 506.$$

W. R. Cooper.

[72295.]—**Menthol** is the stearopten or camphor from the Japanese oil of peppermint? Its composition is, if my memory serves me aright, $C_{10}H_2O$. S. Bottone.

[72295.]—**Menthol.**—Menthol $C_{10}H_{19}OH$, is a stearopten, and is the odoriferous portion of oil of peppermint. It constitutes, when crystallised, the whole Chinese oil. One ton of the plant yields about 5lb. of oil. Sm.

[72295.]—**Menthol.**—The chemical formula for menthol is $C_{10}H_{20}O$. It is a stearoptene derived from various peppermint oils. It is present in large quantities in Japanese oil of peppermint. This may account for it frequently being known as Japanese peppermint camphor. J. West.

[72295.]—**Menthol.**—May be obtained by cooling the oil obtained from Mentha arvensis and Mentha piperita; menthol is really a stearoptene, a monhydric alcohol $C_{10}H_{19}HO$. As we find it generally in commerce in compressed masses it is not quite pure, being frequently adulterated with thymol, spermaceti, or sulphate of magnesia. The pure is generally in very beautiful acicular crystals. The menthol obtained from Mentha arvensis is prepared largely in China and Japan; that from Mentha pip. is whiter in colour and prepared in England. The melting point of pure menthol is about 108° to 110° F. There are two varieties of Mentha arvensis from which menthol is prepared—namely, Mentha piperaceus and Mentha glabrata. Menthol is sometimes called mint-camphor. Some fine specimens may be seen in the museum of the Pharmaceutical Society. Frederick Davis.

86, Newington-causeway, S.E.

[72298.] — **Gearing Safeties.** — Multiply the number of the crank pulley teeth by the number of inches diameter of driving wheel and divide result by number of axle pulley teeth, which will give the gear in inches. C. E. B. K.

[72300.]—**Steam Coil for Dryers.**—I should erect a W form of say 12 B.G. galvanised sheet-iron, and circulate the steam in one out of the other as many times as I had room for. Jack of All Trades.

[72301.]—**Papermaking.**—You will find a most interesting and practical paper upon the subject in the *Pharmaceutical Journal* of August 30th, entitled "The Pollution of Streams by Paper Works," by S. Thresh, D.Sc. (Lond.) Dr. Thresh was formerly an examiner of the Pharmaceutical Society; you can, therefore, depend upon the accuracy of the matter contained in the paper. Frederick Davis.

86, Newington-causeway, S.E.

[72302.]—**Observing Chair.**—At page 215, et *seq.*, in "Chambers's Handbook of Astronomy," (Instruments and Practical Astronomy) being volume II. of that work, are descriptions of Dawes' observing chair, Cook's observatory ladder, and the Dearborn observatory chair for refractors. From an examination of these, "T. D." might devise somet which would meet his requirements. A packing about 32 × 18 × 20 will give three different he a description of which appeared some year in the English Mechanic in a letter, No. but I cannot give the date. This is probably suited for a refractor. Chambers says, for a telescope, he has found "that a dwarf p carpenter's steps, an ordinary music stool, foot-stool suffice to give all the change of p usually requisite." G. G

[72304.] — **Vine.**—The white sweetwater the early black July, or "Black Prince" freely in Surrey, Sussex, and Kent. He Carlshalton there are cottage gardens, and urs covered with white sweetwater, which well in ordinarily good seasons. The Hampton vine is under glass. S. Bottone.

304.]—**Vine.**—The vine cannot be said to be ated out of doors in England; at the same many vines are grown out of doors against rably situated walls with a south aspect, and od seasons will produce an eatable grape, but be compared with a hothouse grape. In the of Wight I have tasted wine from grapes n on the roof of a low house, which were palatable. In the south midland counties s are grown in the open air. I have never them in any part of continent I have visited, in Italy, that were at all to compare with our use grapes. Here, in the neighbourhood of erland, the vine will grow and make plenty of , but in my experience I have never seen one the wood sufficiently to bloom.

Wm. Grimshaw.

305.] — **Moulding and Casting in** l.—See answer 72281.

Jack of All Trades.

305.]—**Moulding and Casting in Metal.**—best and finest casting sand is that sold at l depots for gold-plate work. This sand can rchased by anyone, and will be found of very ior quality. It should be mixed with a little damp it, and the die should be well rubbed French chalk. Previous to pouring the metal, and should be heated, as an accurate and h casting is only rendered a certainty when d into a hot mould. J. West.

306.]—**$CO_2$ Gas.**—Carbon dioxide can be ied both by cold and pressure. The usual d is to pump the gas into a strong metal ler kept cool by ice, using a pressure of about mospheres. If the liquid is allowed to flow f the vessel, the sudden depression of temperaaused by its expansion freezes a portion into a -like body, in which form it evaporates slowly. d $CO_2$ is much used for freezing purposes. The is not used except in experimental work.

Sm.

307.] — **Wimshurst Machine.**—Your maseemed to work all right with the 16 sectors; ischarging balls are not large enough. I have machine, my own make, which gives 7in. s; the discharging balls are, negative 3in. in eter, positive 1¾ with a small ½ ball ⅜in. in eter stuck on it. G. H. D.

309].—**Septagons, &c.**—Largely erroneous, ially the latter. In the first figure you make leg of your triangle A E B = 3·5 times A B; or H be called 1, then H E = $\sqrt{48}$, the logarithm hich, in Vlacq's ten-figure tables, appears 6206187. This is log. cotangent of the angle H, which is therefore, by Vlacq, about 8° 12′ 48″; our chord A B cuts 32° 51′ 12″ of your circle, eleven times this you find too much by 1° 23′ 12″. e other figure you make A E or B E 2·5 A B, lling A H = 1, H E = $\sqrt{24}$. The log. of this 9901056208, which is log. cotan. of about ° 12″; so that your chord A B cuts off 46° 8′ 48″, times which falls short of your circle nearly You would find making A E but twice and a ter A B give a much nearer approach. The polygons possible to construct with compass of Gauss's numbers 3, 5, 17, 257, or 65537, the iples of two or more of these, and their multiby powers of 2. You can have no square ber, observe, except the even powers of 2. e are all the divisions below 100 that you can , and the number of compass openings sary for each, except in the multiples of 17, h I leave to be invented by querist of No. 72151.

Openings.

| | | | | |
|---|---|---|---|---|
| 1 .. | 8 by 2 .. | 17 by ? .. | 34 by ? .. | 64 by 5 |
| 1 .. | 10 ,, 4 .. | 20 ,, 4 .. | 40 ,, 5 .. | 68 ,, ? |
| 2 .. | 12 ,, 2 .. | 24 ,, 2 .. | 48 ,, 3 .. | 80 ,, 6 |
| 4 .. | 15 ,, 4 .. | 30 ,, 4 .. | 51 ,, ? .. | 85 ,, ? |
| 1 .. | 16 ,, 3 .. | 32 ,, 4 .. | 60 ,, 4 .. | 96 ,, 5 |

e divisions not obtainable by compasses alone, ike the trisection of an angle, by only one pair arks on a movable rule, or a straight-edge, are :—

| | | | | | | |
|---|---|---|---|---|---|---|
| 7 | 19 | 35 | 42 | 57 | 73 | 84 |
| 9 | 21 | 36 | 45 | 63 | 74 | 90 |
| 13 | 26 | 37 | 52 | 65 | 76 | 91 |
| 14 | 27 | 38 | 54 | 70 | 78 | 95 |
| 18 | 28 | 39 | 56 | 72 | 81 | 97 |

E. L. G.

308.]—**Dynamo Governors.**—The magnetic ut will close when the E.M.F. reaches the right , that is presuming the cut-out is properly sted. If the governors are at all worthy of the , they will certainly prevent the E.M.F. g below that of the cells. If when the engine ning at 700 revs. the E.M.F. is sufficient to ge the cells, but not to close the cut-out, then ut-out can be closed by hand, as when once d it will probably keep closed till the E.M.F. below that of the cells. As regards switching e accumulators, in large installations I always r to start the dynamo on a resistance frame till the right E.M.F. is obtained, and then transfer, by means of a switch, the dynamo from the frame to cells, thus avoiding all shock. Shall be pleased to give further information on knowing more particulars. F. C. Allsop.

# UNANSWERED QUERIES.

*The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.*

Since our last "Glatton" has replied to 71929, 71949, 71960.

| | |
|---|---|
| 71778. | White Leather Shoes, p. 409. |
| 71790. | Medical Coil, 409. |
| 71792. | Gilding Aluminium, 409. |
| 71801. | Combustion, 409. |
| 71803. | Painting on Tiles, 409. |
| 71806. | Furnace for Welding, 409. |
| 71813. | Washable Wall-Paper, 409. |
| 71819. | Hecla Lava, 409. |
| 71821. | Model Hot-Air Engine, 409. |
| 71985. | Clock Wheels, p. 497. |
| 71992. | Chain Mail Cloth, 497. |
| 72020. | Tricycles, 497. |

**Breaking-up Iron.**—In a paper on "The Destruction of Large Masses of Iron and Steel by Blasting," by Hugo Muench (*Proceedings* Institution of Civil Engineers, Vol. C.) the author classes these under three heads, viz.: (1) Bodies which can be broken, or rather blown to pieces, by charges of dynamite laid loosely on or against them; (2) hollow bodies, where the blasting charge can be placed as in a bore-hole, or whose capacity is sufficiently large to admit of their being filled with water, into which the dynamite charge can be placed; (3) huge masses of steel or iron which must be bored into as if they were rock and then blasted. Under the first head is included mainly the destruction of iron railway bridges in time of war, and which the civil engineer, therefore, seldom has an opportunity to deal with. The author, however, quotes the iron bridge—on the Leipzig-Dresden line of railway—over the Elbe at Riesa, which, destroyed by a flood in 1870, fell into the river below, completely blocking the bed, and had to be blasted out. The formula adopted by the Corps of Military Engineers for bodies classified under the first head is $L = 0{\cdot}0063\,ba^2$, where $L$ = dynamite charge in kilogrammes, $b$ = breadth of body in centimètres, $d$ = thickness of body in centimètres, and this formula applies to wrought-iron structures, solid or riveted, provided the rivets are more than 16cm. apart; but wrought-iron plates with rivets less than 16cm. apart, and all cast-iron plates, require only half the charge given by the formula. Cast-steel plates, however, require double this charge.

**Aniline as a Therapeutic Agent.**—Prof. Kremianski, of Kharkoff, has for some years advocated the employment of aniline as an inhalation in phthisis because of its great microbicidal power. He continues to practise this method, as he says, with considerable success, and has just published a fresh brochure on the subject in which he details an interesting recent case in which, he states, it proves more beneficial, and he describes a new and more convenient form of inhaler. His methods have hitherto found but little general favour, it having been stated by some observers that the inhalation of aniline was very dangerous. Dr. Kremianski has, however, always denied this, declaring that aniline, if pure, is practically non-poisonous, and this view has been confirmed by the researches of Prof. Stilling of Strassburg, who has just published an important work on the subject of aniline colours as antiseptics and their employment in practice. He finds that the most antiseptic of these colours is the violet, which is known to microscopists as methyl violet. A solution of this of the strength of 1 in 1,000 can be injected under the skin of a guinea-pig to the amount of 20 cubic centimètres, or more, without causing any hurt to the animal. Half that quantity, however, if ejected into the peritoneal cavity proves fatal, the viscera, and especially the kidneys, with the exception of the Malpighian corpuscles, being coloured blue. A few drops of the solution instilled into the eyes of rabbits coloured the conjunctiva, but left the cornea—if this were uninjured—unaffected, the colouration disappearing the next day. Prof. Stilling then employed this solution with marked success for the treatment of many eye and other diseases, including scrofulous ulcers of the cornea, conjunctivitis, eczema of the lids, parenchymatous keratitis, serous iritis, disseminated choroiditis, sympathetic ophthalmia, whitlow, varicose ulcers of the leg, &c. A pure form of methyl violet for surgical purposes is now manufactured under the name of pyoktanin. It is only right to add that Dr. Mauthner, of Vienna, has just published a state[illegible] that he has been quite unsuccessful in his [illegible]als of this substance in a number of eye cases similar to those in which Prof. Stilling has recorded such favourable results.—*Lancet.*

# QUERIES.

[72310.]—**Skin.**—My wife complains of having frequently a burning sensation in the tongue, and a dragged feeling of the skin on the face, which, she describes, is like the after-effects of bad soap. This is sometimes accompanied by a dryness and hotness of the skin which is very unpleasant. Could any of "our" readers suggest a safe remedy or point out the cause of these symptoms?—W. A. L.

[72311.]—**Water-Power.**—I wish to obtain ¼H.P. from a water-motor which I assume will have an efficiency of 60 per cent., with a fall of 20ft. How many gallons per minute shall I use, and what size pipe will convey this requisite quantity? Shall be obliged to any reader who will answer the above.—W. D.

[72312.]—**Dissolving Nickel off Copper-Plates.**—Will some kind reader answer the following question? I have some valuable copper plates that have been covered with nickel. I wish to dissolve off the latter without injury to the plates. How can this be done? I have tried nitrate, potash, and sulphuric acid, but this attacks the copper.—One in a Fog.

[72313.]—**Cigarette Making.**—Will any reader tell me how cigarettes are made for the general public? Are they made by machinery or by hand? If by machinery, kindly explain. Also how many the machines will turn out in a day?—Intending Patentee.

[72314.]—**Telephones.**—I am attempting to make a pair of telephones to work about 40yds. of wire. I want to know how much and size of wire to put on iron core on end of straight permanent magnet of ⅜in. diameter, 6in. long. Should one end of magnet be north, and one end south on diaphragm end? The best way to connect a call bell at each end?—M. C.

[72315.] — **Adjusting Refractor.** — I have had occasion to remove the o.g. of my 4½in. refractor, and to take the crown and flint lenses apart, and since replacing them, the instrument does not define so well as formerly. What adjustment is required in putting the lenses together? I have not screwed them up too tightly.—Wings.

[72316.]—**Cheap Blue.**—Can any reader give me full particulars of the method and materials employed in the manufacture of cheap laundry blue? The one I have in mind must cost less than three half-pence per pound for material. The quantity I use is about 25 gross ¼oz. blocks weekly. Any additional information as to cost of wrapping, &c., I should be thankful for.—Fred.

[72317.]—**Dynamo.**—I have made a small dynamo to light two 8c.p. lamps, 12 volts, but I only get a dull, red light out of them. The armature is 1⅝in. diameter, by 4in. long, wound with ½lb. of No. 20 silk-covered copper wire. The field-magnets are wound with 6lb. of No. 16 cotton-covered wire. There is a wire space on field-magnets of 4in. by 4in. by ½in. Is the wire on the field-magnets too large?—if so, would you kindly say what size I would require, and what quantity?—F. Christie.

[72318.]—**Oil-Stones.**—Would any correspondent inform me what is the best oil-stone to use for small tools, such as gravers, broaches, &c.? And what is the best kind of oil to use for the stone, and for lathe bearings?—Carolus.

[72319.]—**Marine Engines.**—Will any engineering correspondent kindly explain the reversing gear of an oscillating marine engine, 2 cylinders, with rocking valves? I am constructing a model, and am in difficulties as to the above. A sketch would greatly assist me?—W. H. S.

[72320.]—**To Mr. Allsop.**—I have an electric signal to put up, like Fig. 114 in "Practical Electric-Bell Fitting." The distance is 600yds. Would it be best to use relay and local battery at each end, and how many cells do I require? Would the Mackenzie sounder (Fig. 20) act the same with a relay as without? There is a 3in. water-pipe runs to each end (metal pipes). Shall I connect earth wires to this?—T. Talbot.

[72321.]—**Modern Miracle.**—Can any of "ours" explain this illusion? A portion of a room is partitioned off from the remainder. About 4ft. from the back of the space so inclosed, a chair is placed upon a piece of oilcloth, doing away with the trap theory. A young lady takes her seat upon the chair, and a narrow curtain is dropped in front of her. At the same time, another curtain is drawn from side to side behind the chair, the extreme ends of the latter curtain being in view of the audience. When the narrow curtain is drawn up, the lady has disappeared, and on the other curtain being drawn, there is nothing behind it. On the curtains being dropped and again raised, the lady has returned. Now how is it done?—Wamow.

[72322.]—**Carbon Dioxide.**—Being anxious to experiment with the above gas, I shall feel extremely obliged if "Sm." or other experienced gentlemen will answer the following questions? If a drawer (which closes sufficiently tight into a case or shell to exclude atmospheric air) is filled with liquid gas ($CO_2$) and closed, will there be any pressure at all on the case or drawer, so long as all air is excluded?—if so, what thickness of metal would be necessary for a ½in. square drawer, and what metal should the drawer be made of? Having the gas at hand, how shall I proceed to fill the drawer with safety? What chemical action has the liquid gas on brass, copper, lead, and iron? Labby.

[72323.]—**Lantern Lens.**—Will any reader kindly inform me the best objective lens for magic-lantern, 3in. condenser, with 2in. focus? I have at present one composed of a bi-convex and a meniscus, with a focus of 3in. each. They are put close together, meniscus outside, with the concave side outwards; but this is not very satisfactory, as it gives a very large disc when very near the screen; but the light does not seem strong enough, although I have a Duplex paraffin lamp.—Slide.

72324.]—**Medical Coil.**—A friend of mine, while staying at the seaside, recently had a battery current applied to him for rheumatics. He had a metal handle in each hand and metal plates at his feet, chest, and back. Being a great sufferer from rheumatics, he desires to have a similar appliance at home, and would be grateful if our excellent friend, Mr. Bottone, would inform him of a suitable battery and other things necessary for the purpose, and if a medical coil is required? Also how the connections are made to the plates and handles to enable the current to be felt at each place, and any other particulars respecting same; also if you think he would gain any benefit from it.—W. B.

[72325.]—**Surveying.**—Will any kind reader inform me of a good work on surveying, chiefly treating on the uses and adjustment of theodolites of different patterns? Also best methods of working out horizontal and vertical angles taken in traversing or triangulation?—Malta.

[72326.]—**Small Glass Furnace.**—Will some practical glass-maker say whether it is possible to operate a small glass furnace occasionally? That is to say, would the pot stand repeated heating and cooling without cracking, if the furnace was lighted one or two days a week? I should be glad of practical advice on the subject of making common penny ink bottles; also say what quantity a man could make per day? I propose to collect broken glass and re-melt, would this answer? Any information on the subject will be esteemed a favour.—J. M. Proctor.

[72327.]—**L.C. and D. and L.B. and S.C. Locos.**—Can anyone oblige with sketch of L.C. and D. goods engine, "Taciter," which ran into the River Ravensbourne at Beckenham?—when it took place, and what became of the engine, also its number? What engines were in the collision on the Brighton Ry. in Clayton Tunnel, some years since?—Locomotive.

[72328.]—**L. and S.W. Tank Locos.**—Could Dendy Marshall send sketch of 517 and 123 classes of tanks, also one of 61 class? I believe those numbered 177 to 194 are slightly different, having smaller wheels, &c., than 61 to 80. No. 185 is named "Alexandra," what is the reason of naming only this one? If it is not asking too much, I should also like dimensions of all the above?—Locomotive.

[72329.]—**Oxide of Aluminium.**—Will any of "ours" kindly inform me how to remove rust (or oxide) from a pair of valuable aluminium field-glasses which have been laid in a damp cupboard so long that they are covered with a white, salt-looking substance, which simply refuses to leave the glasses without bringing away pieces of aluminium?—Alox.

[72330.]—**Lighting Towns by Means of Oil.**—I would like to have some information and will be pleased to have an answer to this. I would like to know the size of town, what sort of lamp and oil is used, and if it is satisfactory, the cost, and the number of lamps one man can accomplish? Or any other information regarding this matter?—Anti-Gas Monopoly.

[72331.]—**Logarithms.**—I shall be glad if "F.R.A.S." will have the goodness to inform me whether any complete table of logarithms has ever been published in this country or elsewhere extending to more than seven figures? I have occasion to make a great many calculations by the aid of such tables, and sometimes find the inconvenience arising from the limitation of the figures. I am informed that "Callet" has published a portion of the table extending to twenty figures, but I have not been able to obtain a copy.—C. E.

[72332.]—**Cement for House Cistern.**—One of the cisterns in my house has developed some leaks, and I do not wish at present to replace it with a new one. As a temporary measure, I have had the holes stopped up with putty. Can any of your readers tell me of a cement that I could use for the purpose, and which I could apply myself without calling in the aid of a plumber? The water of the tank is sometimes used for drinking purposes?—R. M.

[72333.]—**Lithanode Cells.**—Will any electrician kindly tell me what these cells are used for, their nature, and construction?—W. P.

[72334.]—**Camera Lucida.**—To R. J. Lecky.—I find it is a convex lens, and the prism is perfectly clean. The dust you speak of must have been on my brain instead of the prism. Thanking "F.R.A.S." kindly for the trouble he has taken.—Remo.

[72335.]—**Model Watermill.**—I want to make a little model watermill, with a fountain alongside. Now the difficulty to me is making the same return again. I think I have seen it described in some of your back numbers with a contrivance of tanks. Please send sketch, and oblige.—Nemo.

[72336.]—**Lawn Tennis.**—Is it possible to make a winter lawn tennis court of tar-gravel and cinders?—if so how am I to set to work?—Inquirer.

[72337.]—**To Soften Pasted Cloth.**—In operating on pieces of stout cotton cloth, I have occasion to affix the same to another surface by means of ordinary paste. The cloth can easily be removed from the surface to which it is affixed; but the paste which adheres to the said cloth leaves a hardness which I wish to remove. It might be sponged or washed, but is there any kind of wash which would prevent this hardness when the article is dry? Will some kind reader inform me?—Vincent.

[72338.]—**Pyrogallic Acid and Smoking.**—In your issue No. 1322, p. 475, the above acid is recommended to smokers. I have upon that recommendation obtained a 10 per cent. solution of the acid, but as the same has been supplied to me in a deep-blue coloured bottle bearing the legend, "Not to be taken," I have refrained from using it, awaiting more light upon the subject. Will anyone who knows kindly say if this 10 per cent. or, say, 5 per cent. solution is sufficiently poisonous to do injury? Citric acid is also mentioned. I should be glad to know if that should be used of a similar strength. I once tried acetic acid (Coutts') solution, I do not know of what strength, but I should think about 10 per cent. After a few days, I detected a sensation on the tongue and in the mouth, as if from a scald. I ceased the acid, but for two or three months—more or less severely—this feeling prevailed. It finally left me. So I am cautious now not to repeat that experience—hence my inquiry. I dropped some two or three drops of the acid solution on a sponge and smoked through it.—Chas. Eric.

[72339.]—**Distillation of Petroleum.**—Will any reader kindly inform me what percentage of gasoline, benzoline, and paraffin can be obtained by distillation from, say, a gallon of crude petroleum?—Inquirer.

[72340.]—**Schneeberger Schnupftabak.**—Many years ago there was—and perhaps still is—sold in Germany a white, impalpable powder under that name. It was sold in small, oblong, woodex boxes, and used as a snuff to cure a cold in the head. Could any kind reader give me the ingredients?—Sutarg.

[72341.]—**Driving Mechanism for Tricycles.**—I would be glad if any reader would kindly inform me if there are tricycles driven by rack and pinion mechanism. Dropping the ordinary crank movement, I set to work, and have arranged a double rack and pinion, together with a lever arrangement, which, though put together in a rough and ready way, gives excellent results. The pedal movement is a simple up and down one, and I think a machine made well on this principle would go very easily at high speed. Can anyone inform me if a double rack and lever arrangement has hitherto been applied to tricycles? If so, a sketch of the most successful would greatly oblige.—Cycloid.

[72342.]—**Iron Piping.**—Will any reader give me the following information? I wish to bring water into my house by an iron pipe from a spring situate on a hill a short way above it. The water contains a certain amount of iron—I am not sure what percentage, but not very much. I am told that if I use an iron pipe, owing to the presence of iron in the water, that in course of time the pipe would become filled with rust and the water would cease to flow. Would that be the case? If so, is there any other metal I could use instead of iron not exceeding the cost of iron, and that would not injure the water for potable purposes?—Scotus.

[72343.]—**Discharge of Water.**—Can any of your readers enlighten me upon the following? 1. What quantity of water will be discharged from a crescent-shaped orifice formed by opening a circular valve at the end of a long pipe, length not attainable, pressure, say, 65lb. before opening. What would be the velocity of efflux? Also the quantity discharged by a circular orifice any diameter in a circulating system of water supply, as in a large town, the pressure being known?—Aqua Pura.

[72344.]—**Clark Gaslighter.**—I have a Clark gaslighter which will not work. I have tried to localise the fault, but failed. If an explanation of current circuit or induction phenomena would help, please oblige. I understand the charge is static. Could it lose it?—Greenock.

[72345.]—**Dry Steam.**—Would some practical reader kindly give an opinion on the following case? Where I am employed we have a steam boiler which primes very much. The furnace tube stands high in the shell of the boiler, consequently there is very little steam space. Would a dome improve this defect, the plate under dome to be perforated with a sufficient number of small holes to supply engine? Would this break the flow of spray and give us drier steam? An anti-priming pipe is objectionable owing to limited space in boiler. There is a deposit of scale inside boiler. Would the removal of this improve steam raising? Is there any method other than chipping to remove this scale, which is from ½in. to ⅝in. thick?—An Old Subscriber.

[72346.]—**Spotted Drawing-Paper.**—Will some one suggest a way to prevent drawing-paper from spotting? I am told by artists' colourmen that painters living in damp and variable climates should keep their paper (I allude to Whatman's drawing paper) in a tin box; but I find from experience this is no remedy, and that the paper is useless at the end of a few months. Messrs. Winsor and Newton offer to water-colour painters at an extra price very old drawing papers (which are preferred by some artists), and I believe they have no special process for preserving them. What is the cause of such papers assuming, when kept in a damp climate subject to sudden changes of temperature and where condensation is consequently rapidly going on, a consistence analogous to that of blotting paper on all parts of their surface in the shape of spots varying in size from a pin's head to that of a pea, and how can this be remedied? A solution of this difficulty would be a great boon to—A Water-Colour Painter.

[72347.]—**Teeth.**—Will any dental reader kindly help me? I have succeeded in fitting myself with two front teeth on gold plate, which, after wearing for a week, has turned entirely black, much to the amusement of my friends. The gold is coin alloyed to 15ct., and the proportions are 2 copper wire to 1 part coin silver. My sister has a gold plate which was made by my brother (a dentist now deceased), and although she has worn it for 12 years it is still bright, and is 15ct. gold according to a local jeweller. I now want some kind reader to give me the right proportions of alloy for, say, one sovereign, as well as the way to make a solder to keep the colour. Is there any book on the subject, as I hear that the alloying of gold for jewelry and dentists' uses are different matters altogether?—One in a Fix.

[72348.]—**Chemical Analysis.**—I can estimate the quantity of iodine in a sample of potass iodine by displacing the iodine by chlorine and titration with decinormal sod. hydrosulphate. Could I estimate the bromine in KBr by setting free the Br and passing it into KI solution, and ascertaining as aforesaid the quantity of I set free by the Br? When analysing a mixture of am. oxalate and potass chromate, on coming to test for the acids, I found it difficult to get rid of the chromium. What is the best way of dealing with the Cr when about to test for the acids present?—A.

[72349.]—**Sloping Girder.**—How am I to arrive at the correct flange stresses on a sloping girder? After I have calculated it for a horizontal girder, say, 10ft. span, what corrective must I apply for the sloping position, say, 12ft. span or slope?—J. R. C.

[72350.]—**Planetary Influence on the Weather.**—"Tempus," in letter 31447, hopes that I may find it worth while to try the astronomic theory of weather changes. I do not know what this theory is. I am not acquainted with Mr. Bell, and though I knew Prof. Kingston, I never heard him refer to theory referred to. Will "Tempus" state his theory as concisely as possible? Possibly it may be useful.—A. Elvins.

[72351.]—**Strains.**—Having to occasionally design ironwork, in which rolled joists are employed, the ratio of depth to length is sometimes as 1 to 60. I find that to calculate the stresses on the flanges and proportion these at 5 tons per square inch is too great, and the beam will deflect in the middle. Hitherto I have used an empirical rule of settling the stress on flanges in proportion that the above ratio (or whatever else it may be) bears to a girder whose depth and length are as 1 to 12, and stress on flanges 5 tons per square inch. In this case (1 to 60) it would be 1 ton per square inch. Can any reader kindly give me a rule for settling the point properly?—J. R. C.

[72352.]—**The Banana.**—Does "Solanum" allude in his letter (31550, p. 36) to the pomeloe (pronounced pom-e-lo) when speaking of what the English call the "Forbidden Fruit"? The pomeloe (spelt so, I believe) is round like an orange, about 5 to 6in. in diameter, colour of the lemon, full of pips, and possessing a bitter sweetness that is very seductive to the palate. They are bought in London for a few pence, and are called the "Forbidden Fruit."—S. H. C.

[72353.]—**Fresh Water Medusa, Botanic Gardens, Regent's Park.**—What kind of creature is this? Does it belong to the same class as the polypus? Any information on the same would much oblige.—J. C. S.

[72354.]—**Resistance of Induction Coils.**—Will Mr. Allsop say what resistance the primary wire of an induction coil should be in relation to the resistance of the microphone, as I have noticed that the coil used with the Blake transmitter seems to be a short one, wound with about 28's B.W.G. wire, and that the coil used with the Gower-Bell is a long one, wound with about No. 18's B.W.G. wire? Suppose the transmitters were to be changed on to the opposite coils, would they be equally as good, and has the number of turns of wire anything to do with the result? Any information on the above will oblige.—F. W. B.

[72355.]—**Freckles.**—Can any reader tell me of a cure for freckles, without injury to the face? I have had them for the last five years.—Fred.

[72356.]—**"E. M." Receiver.**—When Mr. Allsop uses an induction coil with the "E. M." receivers, does he wind the receiver coil with more resistance than when you are without induction coil, as he states in your valuable papers that the best resistance is 50 ohms? And sometime ago I tested a Thompson's receiver which was supplied with the large transmitters of the New Telephone Co. make, and it tested 80 ohms, and, as no doubt he is aware, these instruments gave good results. Your reply will oblige.—F. W. B.

[72357.]—**Violin Strings.**—Would any experienced violinist kindly give a wrinkle to a novice on the preservation of violin strings? I contrive to break 2 or 3 E strings every week, and am told that the natural moisture of the hand (which is excessive in my case) is the cause. I shall be grateful for advice as to the probable remedy.—Young Fiddler.

[72358.]—**Medical Coil.**—Will Mr. Bottone kindly give a sketch for the connections of a medical coil for both primary and secondary currents? I have seen one which has 12 studs and switch to regulate same with, but no draw tube. According to what I was told, the primary was wound as follows:—The first end of the wire was taken through a hole in end of bobbin, and wrapped three times around the core, then a wire soldered to, and taken out at end, then another three rounds was wound, and taken out as before, and this was repeated until there were 12 sections on the first layer of primary; then there were three layers of primary on top of this, wound continuously from end to end of bobbin. The secondary on top of this was in one continuous length, not divided into sections. Is the above way of winding correct, or have I got hold of a wrong idea? The information asked will be thankfully received by one who has looked through many years of back vols.—F. W. Bernard.

[72359.]—**Metropolitan Railway Locos.**—Will some correspondent give me full dimensions of these engines which run between Hammersmith and New Cross (S.E.R.)? Would be much pleased with sketch of same.—Flywheel.

[72360.]—**Brighton Engines.**—Will some correspondent kindly oblige a fellow contributor by answering the following names to the following engines, L.B. and S.C.Ry.:—Nos. 121, 158, 177, 314, 324, 433, 453, and 474, 500?—J. W.

[72361.]—**Power of Elastic Springs.**—Can any reader tell me exactly how much more power can be stored in elastic, weight for weight, than can be stored in steel springs? A correct answer will oblige.—Inventor.

[72362.]—**Building Safety Bicycle.**—Having been recommended by my doctor to take up bicycling, and feeling anxious to make my own machine, I should feel greatly obliged to any fellow mechanic for any hints as to the best form of machine to build for ordinary road work. Also whether it would be best to make a frame or buy the same ready made. If some one would reply who has built his own machine I should be thankful.—Norfolk.

[72363.]—**Constituents of Plants.**—Would some of your scientific readers kindly instruct me as to the best book bearing on the constituents of plants—viz, the mineral and non-mineral elements, and the parts they play in their construction? Will it be advantageous to go through a course of organic and inorganic chemistry, and which most important, as the two subjects are divided? Is botany more important?—Mec. Science.

[72364.]—**Bath-Heating.**—What is the simplest and quickest way to heat a bath by means of paraffin? Bath in question is metal, about 5ft. long, water led from small cistern in same room. If possible, I should like to make use of a Defries stove. I hope some of your best correspondents will notice this, as I have not seen the question yet treated properly.—G. H. V.

[72365.]—**Exploding Glass Cones.**—Projectiles or small glass cones are thrown into the centre of a lake from the bank a quarter of a mile distant. The cones are made of very thin glass and are filled with a liquid. It is desired to make them explode or break with certainty so as to discharge their contents the moment they touch the water. How can this be done?—J. G. T.

[72366.]—**Leclanche Cells.**—I have three of the above cells in use working my electric bells, two No. 2 and one No. 3 size. I have them arranged as follows:—No. 2—No. 3—No. 2. Is this the best way to have them arranged in order to get the most amount of work out of ınd for them to last longest ? Will there by any rent owing to the cells being of different sizes ? ᴏɪɴɴᴇʀ.

**—Cataract—Eserin Lotion.**—Best thanks ınd kind correspondents. On reading replies, secretary of a London ophthalmic hospital, who ne with name of specialist in whom he said I perfect confidence. The result is that indica- taract are confirmed, but lotion of any sort held ss, and not ordered. Is this reassuring or the Is it reassuring as regards glaucoma ? Shall with the lotion as a precaution ? The first opt. sur. to large suburban hospital and -Anxious.

**—Organ.**—Would Mr. William Robinson or organ builder inform me if the violoncello stop metal or wood, and what is the size of scale ? is meant by one stop being one scale less than -Harvey.

**—Resin Oil.**—Will any reader describe a good r sweetening resin oil ?—E. C. M., Ipswich.

**—Dividing Ellipse.**—Could any reader with a solution of the following ? Divide an ı. by 2¾in., into three parts equal in area and .—Mac.

**—Colliery Fan Work.**—Will "Marienberg," ibuted the interesting letter on the above (31525), me the name of the fan he mentions, and also me a book (cheap) giving sketches and descrip- e following fans ?—the Pelzer, Cappel's, and the -F. G.

**—Electric Gaslighter.**—I notice in "Ours" II. page 205, and Fig. 8, a diagram of a gas- ıt there is no description how the gas is turned , nor how the gas is lit. Will some one kindly ıe working and connection of wires, and also if it is patented ?—E. M.

**—G.N. Railway No. 18.**—Can any corre- oblige me with sketch and dimensions of the nbered engine, and of the Pacific on the L.N.W. -G. J. B.

**—Silver-plating.**—Will some one kindly how to silver-plate on brass and soft solder ?—

**—Telescope.**—My 4¼ refractor does not define s it should, it having had a railway journey ? ikely to be wrong ? What is the centring of an how is it accomplished ? Does it mean making l centres of the crown and flint lenses to coin- m told it requires a mirror with a hole in it. is used ?—Centre.

**—Ghost in Refractor.**—When a bright s the field of my refractor, its "ghost" enters ite side and advances to meet it and passes it by, off the field when the star does, but in the direction. Is the defect in the o.g. or e.p. ?—

**—Umbrella Stand.**—I have a glazed earthen- brella stand, 24in. high, 9in. diam. It being the top, will any of our readers kindly tell me t it off level ?—Surrey.

**—Guessing a Person's Age.**—We have ad two very ingenious puzzles in the "E.M." s denomination. One by which the age of any s found, and the other the age and the day of h. But one I lately saw demonstrated by an ntleman with unvarying accuracy here (Keyns- ainly surpasses both, as by it he told the day of h, the month, and the year in which a person , and consequently the age to the very day.—The

**—Colouring Wax Ornaments.**—Can any form me the best and cheapest method of colour- rnaments in various colours ? The ornaments with white wax. I want orange, lemon, dark- ht-green, black, and red.—W. H.

]**—Rudders.**—Can any gentleman tell me if he any disadvantages in the balanced rudders used es in America ? In what way does the fin-for- udder post affect the steering ? Are they harder to steer than boats of the ordinary keel type ? I longer or shorter tiller required ?—G. H. V.

]**—Hardening.**—Can any reader tell me how n perfectly straight steel spindles, about 1ft. thick, to prevent them from curving (bending) ning ? My spindles generally curve about ⅛in. ning. Is there any chemical to be mixed with , or is there any other method to prevent it from —S. U. A.

]**—Electrical.**—I recently saw an advertise- vertising model arc lamps to light with four Vill you kindly tell me size of carbons, if that be rial used, and such information as to enable me uct one, say, one to light with six or seven ells ? What candle-power are these lamps sup- give ? Also is the Lalande and Chaperon oxide battery any use for electric lighting on a small an hour or two a day ? Will you tell me the f this battery, and how the oxide of copper is to ed ? Could I prepare it myself ? Particulars of ery will oblige.—F. Askew.

]**—Mathematical.**—A maypole, broken in ed with one end on the ground at a distance of n the base. After being repaired it broke again t 8ft. lower down, and then rested with one end ound at a distance from the base equal to the the part first broken off. Find the length of the n this be solved, except by inspection, after the ary stage ?—F. W. C.

]**—Hot-Water Apparatus.**—Could any of merous readers explain the cause of hot-water collapseing ? I know it is caused by a vacuum ated in the inside; but what is the cause of the and what is the combination of events that bout ? We sometimes have a cylinder working ps twelve months, then it collapses, and another d in its place and it only lasted four days. The had a supply pipe from store cistern, two cir- pipes to boiler, and an expansion pipe on the top. I thing the cause is in the expansion and supply pipes. I have never seen one go that has the expansion pipe run straight up; but if run at an angle they almost always.—J. Smith.

[72385.]**—Telephones.**—I am desirous of having a district, two miles long and one mile broad, put into 11 sections, and one section in the middle or centre to be in telephonic connection with the other surrounding 10 sections. I have applied to several firms to give an estimate on such a plant. Some state that they will guarrantee me free from any claims that may be made by the National Telephone Company; others state that they cannot make me this plant, and neither can any other person make me it to give satisfaction and free me from the companies' claims of infringement. What is the opinion of our readers ? Also I shall be glad to have an application from any firm capable of supplying such a plant. My address is in "Address" column.—Querist.

# ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

## HINTS TO CORRESPONDENTS.

**1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.**

***** Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

**The following are the initials, &c., of letters to hand up to Wednesday evening,** Sept. 10, **and unacknowledged elsewhere :—**

W. E. Hitchcock.—R. Valli.—A. J. W.—A. C. P.—Constant Reader, Cinderford.—Frank.—G. G.—W. P. W. —Writer.—Foto File.—W. H. S.—W. E. H.—J. C., Engine Turner.—R. H. A.—L.—Rogo.—J. Webb.—Student.—Anti-Smoke.—Georgius.—A. C. P.—Jack of All Trades.—A Fellow of the Royal Astronomical Society.—H. J. Hook.—S. S. R.—L. G.—Locomotive, Brixton.

Oculi. (How can any one give advice without examining the eyes ? If you can, as you say, "read and see very well, and not short-sighted nor long-sighted, but right," anything else must be due to some constitutional derangement, which, perhaps, a week at the seaside would remedy. At any rate it is useless to ask advice from those who cannot examine the eyes (and you); and remember, if you are too proud to go to an ophthalmic hospital, you can always subscribe to its funds.)—Hope. (As you live in S.E., go to the Finsbury Technical College, Leonard-street, E.C., and take all they will allow you to enter for, including practical fitting work, as we presume you mean dynamo, &c., building by "electrical engineering." If you would prefer it, there are some classes at King's College, Strand; but you have still plenty of time to make a choice, as the classes rarely commence until October.)—S. Jarvis. (If you have read the paper "for years," you must know we have given many articles and letters about constructing coils. Puzzling over what you can possibly mean we conclude that you want to arrange the coil as a "medical" one, so as to have varying amounts of current. If so, you will find full directions in back numbers. Possibly the index published in this number may guide you.)—Subscriber. (We know nothing more about Electric Cooking than we gave, and as you are a subscriber you ought to know we do not give addresses: but in the case in question the address you suggest will be quite sufficient, seeing he is a state official in the U.S.A.)—R. H. (Already "sent," as you put it. Why not look up your back volumes. The G.N. 8-footers have been illustrated many times.)—Humilus. (There is Wanklyn and Chapman's "Treatise on Water Analysis," published by Trübner at 5s., which might serve your purpose; but we cannot say definitely without knowing more of what you want to do. You speak of "mineral" waters, and necessarily the analysis of them must be done by a chemist who has had a large experience of analytical work.)—W. Pask. (If you mean the letters on the "Home Manufacture of Cameras," see pp. 119, 157, 299, 339, 379, 423, 462, Vol. XLVIII.; or, in fact, it would not be a bad investment if you bought the volume, for you would be sure to find much to interest you, if not always of commercial value to you.)—Science. (We doubt whether any book gives so much information as you can find in back volumes about mounting microscopical objects; but the "Manual of Microscopical Mounting," by J. H. Martin, published by Churchill, New Burlington-street, may suit you.)—Nickel Plate. (Please see indices; or if you will make up your mind and determine whether to silver or nickel plate, we will refer you to back numbers where all the required information can be found. Why not look through the back volumes yourself ? You will learn much by that method.)—J. C. Linscott. (You will see by the index published in this number that the article on "Artificial Silk" appeared on p. 237, May 16, 1890, No. 1312.)—St. Crispin. (We do not know what you refer to; but as you live comparatively near the Patent Office Library, Southampton-buildings, Chancery-lane (which is open until 10 p.m.), you can surely go in there and look over the back volumes, and let us know which series of articles you require.)—Apprentice. (A "principle" may be the subject of a valid patent, provided a method of applying it is also described; but your query should really be put to a patent agent.) —Engineer. (We do not know. Procure the programme from the Secretary, Gresham House, E.C.)—A Would-be Brunel. (How can we advise without more knowledge ? As you are at Newcastle, try and see some of our correspondents in that town. We are sure they will help you. Try at the places where the science classes are held.)—Telegraph. (Why not look up back numbers or procure one of the textbooks ?)—Ignorant. (The descriptions and values of the electrical units are given in all the textbooks.)—Hy. G. Chislett. (Dr. Aveling's articles on Botany will, we believe, be republished shortly in volume form by Swan Sonnenschein and Co.)—F. G. (Better apply to the Pulsometer Company, Nine Elms, London, S.W. They will, perhaps, send you what you want.)—Chas. E. Stevens. (If the maker likes to send us drawing and description of his motor, we will insert—if it is novel and useful, that is. It is of little use referring our readers to other journals.)—W. L. (You can find some information in back volumes; but there is nothing better than the official handbook as a guide to emigrants.)

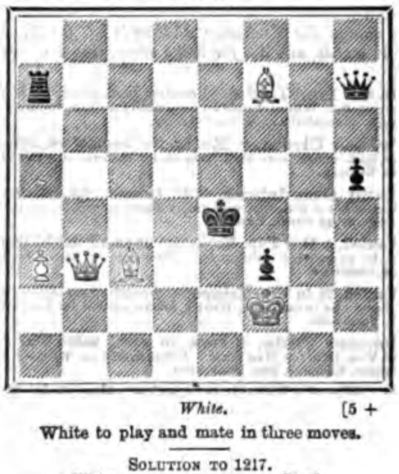
**More Proof.**—The late Editor of *The Electrical Engineer*, after a thorough examination of Mr. Harness' Curative Electropathic Belts, declares them to be perfect appliances for the self-application of mild, invigorating currents of electricity for the prevention or cure of disease. Copy of his report may be obtained gratis, on application to the MEDICAL BATTERY CO. (Ltd.), 52, Oxford-street, London, W. Book of testimonials, descriptive pamphlet, and consultation free. Rheumatic sufferers and those troubled with any form of nervous, muscular, or organic weakness should call or write at once.—[Advt.]

# CHESS.

**All communications for this department must b addressed to "J. Pierce, Knollside, Yawl, Lyme Regis, Dorset."**

PROBLEM MCCXIX.—By W. Mackenzie.

*Black.*



*White.* [5 +

**White to play and mate in three moves.**

Solution to 1217.

| *White.* | *Black.* |
|---|---|
| 1. Kt-B 6. | 1. K-K 4 (*a*). |
| 2. B-Kt 4. | 2. Any. |
| 3. B or Q mates. | |
| | (*a*) 1. K-Kt 6 (*b*). |
| 2. B-Kt 4, &c. | |
| | (*b*) 1. P-Kt 5. |
| 2. Kt takes P, &c. | |

Also 1. Q-Q 3.

## NOTICES TO CORRESPONDENTS.

Correct solutions to 1217 by W. L. Martin and W. Sangster (second solution); to 1216 by J. Kistruck, W. Sangster, and W. L. Martin.

Problems and entrance fees to Tourney received from D. Mackay, W. A. Clark, and J. Rayner. We are only waiting for one more entry in Solution Tourney to make a start.

In prob. 1215, the W P at Q 3 should be a W B. Variations (*d*) and (*e*) are to be omitted.

# CHARGES FOR ADVERTISING.

| | s. | d. |
|---|---|---|
| Thirty Words .. .. .. .. .. .. | 2 | 6 |
| Every Additional Eight Words .. .. .. .. | 0 | 6 |

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|---|---|---|
| Twenty-four Words .. .. .. .. .. | 0 | 3 |
| For every succeeding Eight Words .. .. .. | 0 | 3 |

ADVERTISEMENTS in the SIXPENNY SALE COLUMN

| | s. | d. |
|---|---|---|
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**The address is included as part of the Advertisement, and charged for.**

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English Mechanic
WORLD OF SCIENCE AND ART.
FRIDAY, SEPTEMBER 19, 1890.

# BOTANY FOR STUDENTS.

ward Aveling, D.Sc. Lond., Fellow of Univ. Coll., Lond.

## Chapter XXIV.—The Leaf.

'INITION.—Leaves are lateral ap-pendages of the ascending axis or stem its branches. They arise acropetally

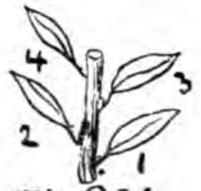
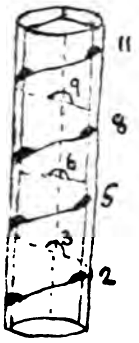


Fig. 281.

ogenously from nodes below the grow-ints, and are flat, expanded. The al name for leaf organs is phyllomes. hology.—There are four classes of all of which have been studied in our ration of typical plants of the 14 l Orders. Indeed, in this account of orphology of the leaf, little more is than the re-enumeration of certain



.282.

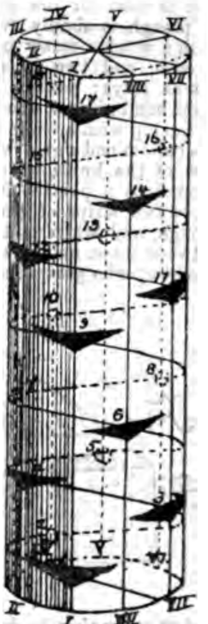
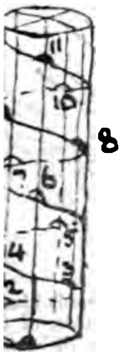


Fig. 284.



.283.

and reference to the particular plants ting them.

classes are (*a*) leaf scales, (*b*) true (*c*) bracts, (*d*) floral leaves. All four n in the Hyacinth [Liliaceæ], Chapter

arrangement of the leaves on the axis hyllotaxy of the plant. ταξις (taxis) ement. Thus far in our study of we have only noted the three general ements of leaves—alternate, opposite, d.

we must now go somewhat more into ails of phyllotaxy. If a line is drawn round the stem of a plant and through the bases of successive leaves, the line describes a spiral. In Fig. 281, e.g., is represented the simplest phyllotaxis. The spiral would pass from 1 to 2, and then to 3 directly above 1, and on to 4 directly above 2. The series included by the spiral line in going from a given leaf to the first leaf immediately above it is a cycle. κυκλος. (kuklos), a circle. Thus 1 and 3 are a cycle; so are 2 and 3 or 3 and 4.

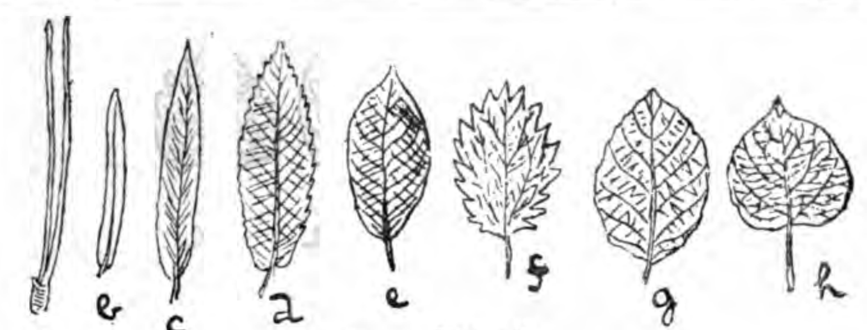


Fig. 287.

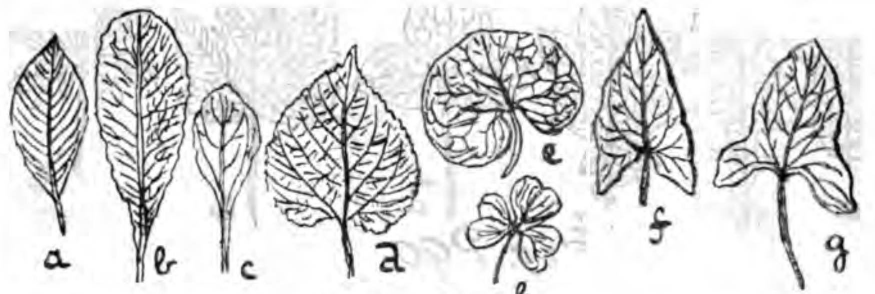


Fig. 288.

Between any two successive leaves of this particular phyllotaxis the fraction of the circumference of the stem, measured horizontally, is $\frac{1}{2}$. And this fraction is the angular divergence of the leaves. Its numerator (1 in this case) tells us how many times the spiral turns round the stem in describing the cycle; its denominator, 2, tells us how many leaves there are in the cycle. This particular arrangement is also called distichous. δις (dis), double; στιχος (stichos), a row. It is common in Grasses.

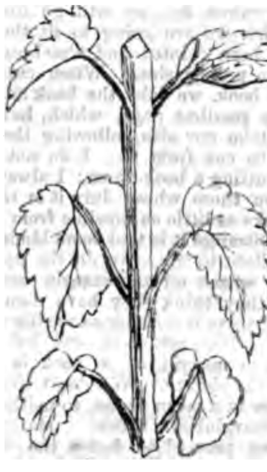


Fig. 285.

In Fig. 282 is a diagram of the next simplest arrangement. Here the angular divergence is $\frac{1}{3}$—the spiral makes 1 turn to, and there are 3 leaves in, the cycle. This tristichous arrangement is seen in many Monocotyledones.

$\frac{1}{2}$, $\frac{1}{3}$ are the numerators and denominators of these two fractions, and we have $\frac{2}{5}$ the next one (see Fig. 283). Here the distance between leaf 1 and leaf 2 is $\frac{2}{5}$ of the horizontal circumference of the stem; between 1 and 3 is $\frac{4}{5}$; between 1 and 4 is $\frac{6}{5}$ (the spiral has gone more than once round the stem without finding a leaf immediately over 1); between 1 and 5 it is $\frac{8}{5}$; between 1 and 6 it is $\frac{10}{5}$, or 2. 6 is directly above 1; the spiral has made 2 turns in passing over the cycle of 5 leaves. This pentastichous, or quincuncial, is common in Dicotyledones. Quincunx, πεντε (pente), five.

Note how the angular divergence $\frac{1}{3}$ occurs commonly in Monocotyledones, the parts of whose flowers are arranged in threes (see Table of Vegetabilia) and the $\frac{2}{5}$ in Dicotyledones, whose floral organs are in two's and five's.

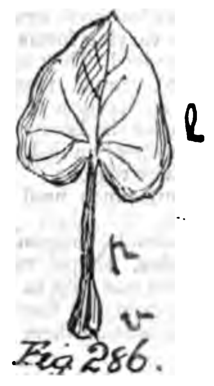


Fig. 286.

$\frac{1}{3}$. $\frac{2}{5}$. Adding numerators and denominators, we have $\frac{3}{8}$, the next phyllotaxis, Fig. 284. The spiral takes three turns in passing from leaf 1 over 8 leaves to leaf 9 directly over 1. The Holly has this $\frac{3}{8}$ arrangement.

$\frac{2}{5}$, $\frac{3}{8}$. $\frac{5}{13}$ comes next $\frac{3}{8}$. $\frac{5}{13}$, and $\frac{8}{21}$ next. These complex phyllotaxies are seen in the hard bracts of the cones of firs and pines; $\frac{5}{13}$ in the cones of the Weymouth pine, $\frac{8}{21}$ in those of the Norway Spruce Fir.

Opposite leaves and whorled leaves are due to two, or, in the case of whorled leaves, more than two spirals proceeding up the stem simultaneously. In the decussate leaves of Lamium and Labiatæ, Chapter XIII. Fig. 285, we see two spirals with $\frac{1}{2}$ angular divergence, and a tetrastichous arrangement

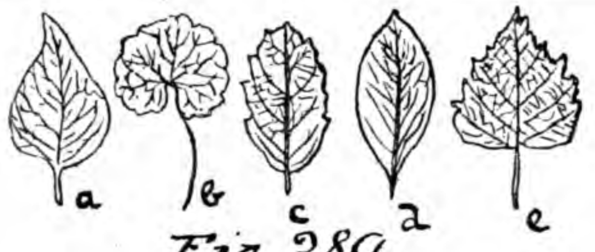


Fig. 289.

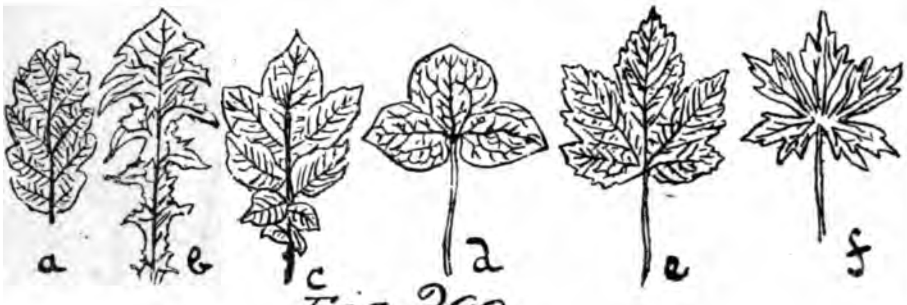


Fig. 290.

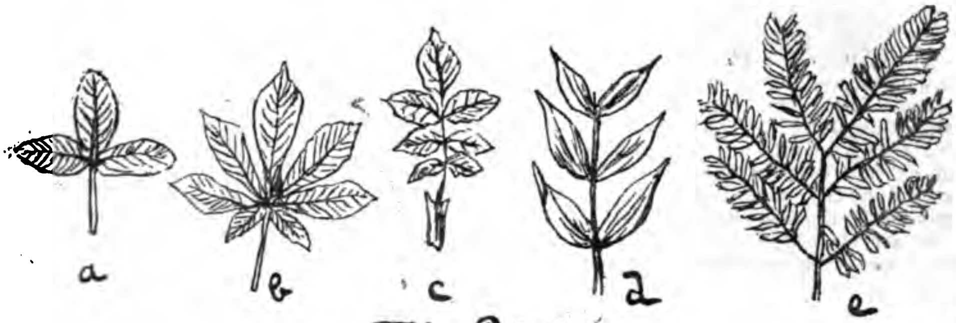


Fig. 291.

of the leaves. τετρα (tetra) in composition is four.

The parts of the leaf have again and again been met with in varying forms in the plants dissected and described. They are the petiole, the lamina, the vagina, most frequently presenting itself in the form of stipules. In Fig. 286, the leaf of the Lesser Celandine, a Ranunculus very closely allied to the Buttercup, shows all three regions.

Turning to our much used plan for describing a plant, the chief variations of "kind" of leaf (simple, compound, and their varieties), venation, shape, margin, apex, surface, have been met with in our practical work. But a summary of these chief forms and pictures representing them may be given here.

Kind. Simple—all the leaves in Figs. 287-290. Compound—all those in Fig. 291, of which *a* is ternate (Cytisus), *b* septate (Horse-chestnut), *c* is imparipinnate, with adnate stipules (Rose), *d* is paripinnate (tuberous Pea), *e* is doubly paripinnate (Acacia).

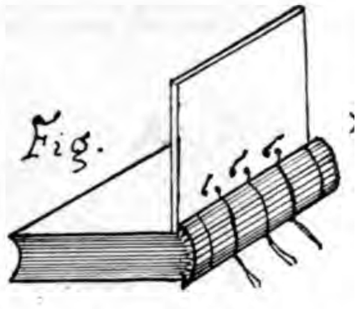
## HOW BOOKS ARE BOUND.—VII.

By "Practical Bookbinder."

### Lacing In—Cutting in Boards or Turning Up—A Wrinkle for Amateurs.

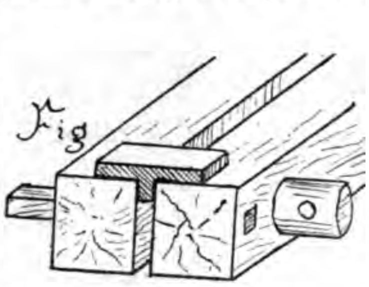
THE preparation of books which are to go into, or, more properly speaking, to be bound in, cases is much the same as is the case with ordinary jobbing work. This has all been already described. The various operations follow each other in the following order. When they leave the sewer they are end-papered; cut round, that is, the three edges glued up, rounded, and jointed, and after having been lined on the back they are put into the cases. Before describing the lining process, &c., we will go back to the books to which we are going to fit the boards. These have been jointed and the boards have been cut the proper size. When cutting the boards for a book, we take the book and look it over for the smallest page, which, having obtained, we take our size, allowing the merest shaving to be cut from it. I do not like the practice of cutting a book down; I always try to impress upon those whose duty it is to do the cutting to take as little as possible from the edge of a book. Strange it is that some binders seem to have a delight in trying to do the opposite of this. They whack off the margin most ruthlessly, and they think they have done a good thing. Oh! there is nothing so vexing to me as to see a good book cut down and left minus a margin. The margin of a book is like the framing of a picture. We don't like to see a fine picture in a mean frame, so neither should we have marginless books. Having this arranged, we proceed to fasten the boards to the book. This is called "lacing in." Six holes are made in each board close to bands or slips. The slips, which should be scraped out very fine before this, are pasted with the fingers, and passed through the holes into the inside of the board, and back again to the outside, and drawn tight. The book is laid upon the side of the press during this operation. Fig. 18 may help to explain this a little further. After both boards have been laced in, the slips are cut off sharp with the board, and beaten well with the hammer. The proper method of "knocking down," as it is called, is to put the knocking-down iron into the lying press with the flat sides across the ends, and taking the book in the left hand by the fore-edge, one of the boards is laid open upon the iron, and with the hammer the board is beaten where the slips have been passed through, until not a trace of a hole or lump is to be seen. This must be well done, otherwise the slips will show when the cover has been drawn on, which will not add to the beauty of
the book. Fig. 19 will show the sh
knocking-down iron, and its positi
press.

Books that have been treated in th
should now be pressed. They must
fully built in the press, and a sm
of tin or zinc placed inside the
well as outside. The greater the
pressure which can be given will hel
the solidity of the book. While in th
backs are "washed off," that is the co
which was given to the back before r
washed off, first by coating the back



paste and allowing it to steep a few min
scraping it with a blunt stick, and finall
it with a handful of paper shavings a
If this first coat of glue was allowe
on the back; when finished, the back
very hard and cracky, because it is ne
use more glue afterwards. The glue
between the sections, and that is reall
wanted, so it is, therefore, necessary to
glue off the top or the edge of the section
washing off books are left in the press t

We come now to the operation of cu
edges. These cannot be cut with a m
this case, as when the cutting is fini
board will be larger than the book.
tool is used for the purpose, called a
A plough is simply two square pieces
with a wooden screw passed through t
of each, and two square pins, or rod
act as stays; passing downwards thr
right hand piece of wood is an iron bolt,
at the top with a wing nut, which is ta
the bottom end a groove is provided for t
tion of the knife, which is a flat piec
ground to a point. On one side of t
press two strips of wood are screwed
plough, and when cutting the plough
between these, and it is wrought to and
operator, who grasps the plough with bot



and at every time he draws it towards hi
gives the screw at slight turn: this, o
causes the knife to cut little by little
entire edge has been cut. The head of
is placed in the press first, with the back
the operator, the board at the right ha
pushed down about one-eighth of an i
a cutting board is inserted between t
and the left-hand board. When t
has been cut the book is turned
tail treated in the same manner; w
of these edges have been finished th
should extend beyond the book about ⅛in
according to the size of the book or the
the binder. The book is now knocked
the bench and tied with a piece of cord
vent it becoming rounded until the for
cut. This is called "turning up," and
must be placed in the lying press and
edge cut in the same manner as the e
the plough; when this is done the
loosened and the back resumes its round
and the fore-edge is consequently

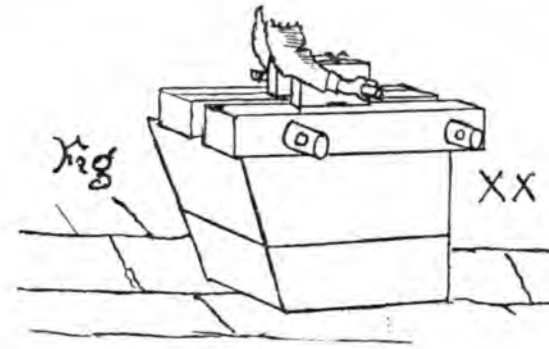


Fig XX

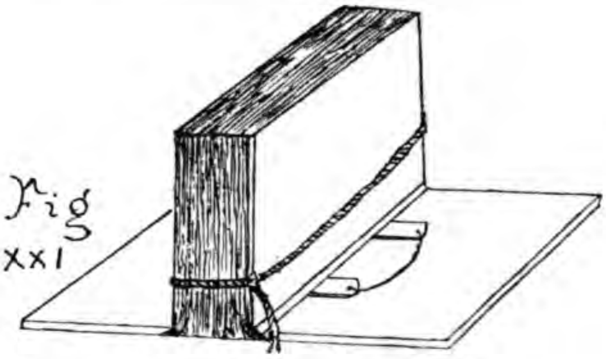


Fig XXI

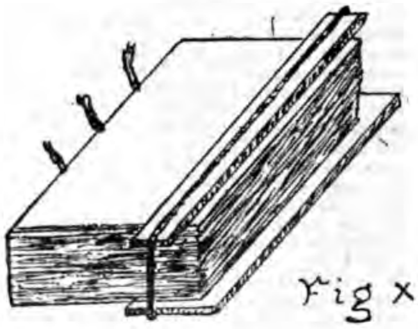


Fig XXII.

rill give an idea of press plough and the )f the hands when using it.

mateur bookbinder is sure to have no iculty in cutting the edges of his books; ɔt have a cutting machine, and if his ιot well filled he may not feel inclined ɪse a plough, although it is not an extra- y costly instrument. Yet he feels that cut the edges of his books, for he will em to have a respectable appearance. oks are bound with uncut edges, and )ple have a craze for this style of but ordinary magazines and periodicals hing by having their edges cut, and I ıat the ordinary amateur will do more of of work than he will of the more costly )ns, which require special treatment, and ould be left to the professional binder. ıg the case, I am quite sure that the wrinkle about cutting edges will be le to those of my readers who are on the for such.

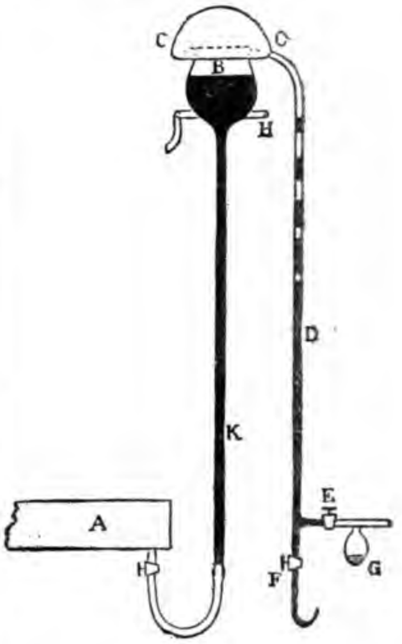
ɔok may be prepared for cutting in any ethods already described—i.e., it may be ı flat before it is rounded, or after it has nded and the boards fitted to it; in this course, it must be flattened, and tied up tting with the plough. Fig. 21 shows ied up in this manner.

ools which will be required for this ıre very simple, and consist of first two ces of flat wood, one of which must have ı, even edge; second, a piece of cord; shoemaker's knife (which is also used by ders), and a rough sandstone, such as is sharpen the scythe when cutting grass in est-field. These are all the tools which essary; the method of procedure is as —Square up the book, and having decided ch is to be cut off, mark with a pencil a line where the cut is to be made, lay one boards down upon the bench, and upon ce the book, taking care to allow the edge oard to project a trifle beyond the edge ook. Lay the other board, the one with the straight edge, on the top of the book with the edge even to the pencil-mark, and tie all up very tightly with the cord. This being done, arrange the book upon the bench with the edge to be cut towards the right-hand, and having sharpened the knife commence to cut by drawing it carefully down from top to bottom, using the board as a guide, and continue this process carefully until the edge is finished. During this process great care must be taken to keep the knife sharp and straight with the board; otherwise it will be liable to cut in if the book is a thick one. Although this manner of cutting is necessarily very slow, books can be very successfully treated by it if a little patience be applied to the point of the knife. It is a very ready means to the amateur, but it cannot be hurried, and the knife must be kept sharp and held at an angle of about 45°. Fig. 22 will give an idea of the arrangement of the book; the knife can be imagined.

## A MERCURY STILL FOR THE RAPID DISTILLATION OF MERCURY IN A VACUUM.*

WHEN mercury is distilled in a vacuum, in the usual apparatus, a large portion of it when vaporised, on reaching the internal domed surface of the bulb in which the operation is conducted, forms itself into minute spheres, which grow heavy and run down the inside of the bulb; and only a small quantity of the metal finds its way into the central tube, from which it is caught for use.

The advantage of the new form of vacuum mercury still, of which I venture to give an account, is that all the mercury which condenses in the head of the bulb is prevented by its shape from returning to the mercury from which it has been separated by heat. This is not the case in the mercury still of Weinhold, or Clark, or in those stills in which only the mercury which collects in the eduction tube is caught, as in the beautiful new form of apparatus devised by Messrs. Dunstan and Dymond, for the purification of small quantities of mercury (*Phil. Mag.* p. 367). In the former of these instruments, some portion of the mercury vapour condenses on the surface of the bulb and then falls back to the mass of mercury from which it has just been separated. The mercury still which is described in the following lines has been constructed with a view to obtain a more rapid yield of pure mercury than stills of this class have hitherto been capable of producing. The yield of mercury from the new form of still is about four times as great as that from one of the old pattern, the consumption of gas in each case being the same. The construction and method of using the still are as follows:—B K is a bulb and tube about 34in. long, supported on a stand not shown; the bulb has a ring-shaped channel, C C, round its upper end; into this channel a piece of "Sprengel" tube, D, is fused. This is furnished with two taps of glass, E and F; E is in connection with a water jet pump, F is terminated with a piece of bent tube. A is a cistern for holding the mercury which is to be distilled. H is a ring of gas-jets.



The method of using the still is as follows: The tap E is opened, F is closed; a water pump then exhausts the whole system, and the mercury to be acted on rises from the cistern A. The cistern being large and shallow, only a slight change takes place in the height of the mercury in the bulb, when the level of the mercury in the cistern changes. While the pump is exhausting, the ring of gas jets is lit, and in about ten minutes, in the case of the still in our laboratory, the mercury fills the tube D, any metal which comes over being caught in the bulb G. The tap E is then closed and F opened; the still then continues to work by virtue of the vacuum formed by its own mercury. It has been found necessary to place a gas regulator on the pipe which supplies the jets, as the change of pressure in the gas mains is considerable. An automatic arrangement, depending for its action upon the height of the mercury in the cistern, shuts off the gas when the surface of the mercury falls below a certain point. In using stills of this class the mercury before distillation should be carefully freed from moisture, as a minute quantity of water will often cause a fracture in the heated tube or bulb.

## QUARTZ FIBRES.

THE following is the substance of the Monday evening lecture delivered by Prof. C. Vernon Boys, F.R.S., before the British Association, to which we alluded briefly last week. He began by explaining that the physicist in making his measurements had often to deal with very small forces, which were sometimes measured by means of the direct pull they can exert, and sometimes by the twisting effect which they can produce when applied at the end of an arm acting as a lever. He illustrated these two methods, and then went on to say that it is often necessary to be able to detect and measure forces not larger than the weight of a millionth, or even a thousand-millionth of a grain. If these are used to produce a twist in a wire, the wire must be exceedingly thin in order that the twist may be measureable. A wire when reduced to one-tenth of its original thickness will only require one ten-thousandth part of the force to twist it by the same amount, and consequently we can measure forces as small as we please if we can only get wires thin enough. Formerly experimenters made use of metal wires, but these were soon replaced by fibres of spun glass, which can be got far finer. Glass, however, has one great drawback—in that it will not, when twisted, return to its original position after removing the twisting force, but acquires a permanent twist, and this renders it very difficult to use in delicate instruments. If we want finer wires we must turn to the single fibres obtained from the cocoon of the silkworm. These are so fine that in ordinary instruments the force required to twist them is so small as to be considered quite negligible. Some three years ago, however, Prof. Boys constructed an instrument (radiomicrometer) to measure the difference in the amounts of heat radiated from different parts of the discs of the sun and moon. In this instrument it was necessary to measure a force so excessively small that even a silk fibre was too coarse. He therefore endeavoured to obtain finer wires by shooting a very light arrow, which drew after it a very fine fibre of quartz from a piece of molten quartz held in the flame of an oxy-hydrogen blowpipe; much in the same way that an object quickly removed from treacle drags after it a tail of the treacle, though the quartz tail is infinitely finer. In this manner a thread of quartz can be obtained, which is not more than 1-15,000th of an inch in diameter, and which will show an appreciable twist with a force of a thousand-millionth of a grain weight applied at the end of a lever one inch long. The lecturer then went on to state various applications of the fibres, and showed several lantern slides illustrating the relative thicknesses of fine wire, spun glass, silk, and quartz fibres. He also created considerable amusement by an endeavour to show a spider trying with difficulty to crawl up a quartz fibre; the experiment, which was very successful, was meant to illustrate the smoothness of these fibres. In order to illustrate the extreme delicacy of the fibre, he showed very successfully how the radiomicrometer would show a very great deflection when exposed to the heat radiated from a candle some 80ft. from the instrument. He stated that a candle 250ft. away would still give quite a large effect. The power of the quartz to insulate an electrified body suspended by it was also shown, and Prof. Boys stated that this insulating power was almost perfect, even in an atmosphere perfectly saturated with vapour, although a glass fibre under these conditions would fail to keep an electric charge. To show the relative sizes of apparatus necessary for obtaining results by earlier methods and by using these fibres, he had a model of the original Cavendish experiment by which the intensity of the force of gravitation was determined; and his own modification of it was exhibited to the audience. The original experiment measured the attraction between two globes of lead, weighing respectively about 2cwt. and 2lb., and stood in a framework about 6ft. square; the lecturer's apparatus was all contained in a box about as large as an ordinary bottle jack, and measured the attraction between bodies of weights about 2lb. and a few grains respectively. Speaking of difficulties incident to the use of fibres, the lecturer mentioned and illustrated the tendency of a flat body to arrange itself in such a way as to offer the greatest possible resistance to a current of air. Now the twist of a wire is generally measured by the deflection of a spot of light reflected from a flat mirror attached to the wire. When any sound is made currents, or rather wave motions, are set up in the air, and the flat mirror tends to set itself across them. If the period of vibration of the suspended wire corresponds with that of the sound wave the effect on the mirror becomes extremely marked. These effects were very strikingly illustrated by three organ pipes, two of which did not affect the mirror of the radiomicrometer, while a third, intermediate in pitch between the two and "tuned" to the vibrations of the mirror, violently excited the latter.

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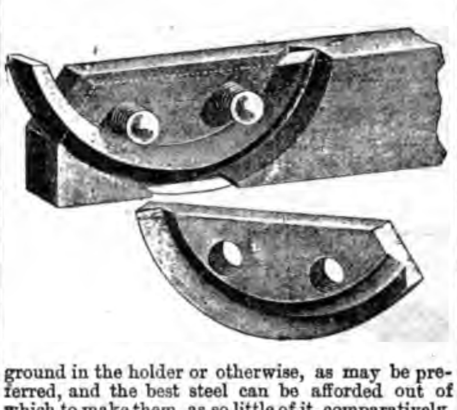
* By FREDERICK J. SMITH, M.A., Millard Lecturer in Mechanics and Physics, Trinity College, Oxford, in the *Philosophical Magazine.*

## NEW LATHE AND PLANER TOOL.

THE new lathe and planer tool, shown in the engravings annexed, is made by Berger Bros., of Brooklyn, N.Y., and as will be seen, cutter consists of a square rod of steel, bent to the arc of a circle, so that it conforms to a groove milled in the body of the tool and in the cap, which is shown detached, and is fastened in place by the two screws shown. When the cap is in place a cross-section of the groove in which the cutter is placed is square in form, and this adapts it to cutters round in section equally well. In the construction of this tool it has been the object to keep as near to the familiar diamond-point tool as possible, and, as will readily be seen, it is impossible to put any cut on the tool which will cause it to slip in the holder. The height and clearance of the tool can readily be adjusted, since raising it decreases the clearance, and vice versâ. Raising the point to compensate for what is ground off also increases the top rake, so that the tendency to lower the point in grinding is, to some extent, counteracted. Short lengths of cutters can be used by putting in a second short piece behind the one which does the cutting. Cutters can be ground in the holder or otherwise, as may be preferred, and the best steel can be afforded out of which to make them, as so little of it, comparatively, is used.



# BRITISH ASSOCIATION.

## ABSTRACTS OF REPORTS, PAPERS, &c.

### The Electrical Units.

THE discussion on this subject was opened by Mr. R. T. Glazebrook, in a paper comparing the various methods used and results obtained in the determination of the value of the unit of electrical resistance. He pointed out that the methods were divisible into three classes—(1) those in which a mercury standard was directly measured; and (2) those in which the resistance of a coil was measured and afterwards compared with a mercury standard. The question at issue was, he said, whether the results of various observers were sufficiently accordant to enable the British Association to recommend the adoption of a standard more accurate than the so-called "legal" ohm of the Paris Congress. This standard had never been legalised by the English Government, and it was perfectly open for them to propose a legal standard for the use of the Board of Trade in their standardising laboratory. He suggested that the true ohm should be taken as the resistance of a mercury column one square millimètre in section and 106·3 centimètres in length, this being the nearest value to the mean of the most trustworthy observations.—Prof. Rowland (Baltimore) explained that the value 106·32 which he had obtained in the first set of observations had been recently slightly reduced on repeating the experiments in the Johns Hopkins University. He thought the United States Commission, which likewise had never legalised the ohm of the Paris Congress, would support the proposal of a British Association committee. He also said that the United States Government were contemplating a bureau similar to that of the English Board of Trade standardising laboratory.—Lord Rayleigh questioned the expediency of expressing the ohm in terms of the resistance of a mercury column, inasmuch as no experimenter would make use of mercury in constructing a resistance unit. He also thought more attention should be directed towards attaining an absolute unit of current.—Prof. Barker (New York) emphasised Prof. Rowland's remarks, and promised to support the proposal of Mr. Glazebrook before the American Commission. He also expressed a hope that in return for these mutual agreements the British Association would endeavour to get the name of Franklin recognised and commemorated in connection with some electrical unit.—Sir W. Thomson repudiated any idea that might have arisen to the effect that he had supported the value of 106 centimètres mercury as the true ohm. All he did was to support the adoption of some universal legal standard for a period of ten years, and as only this one was mentioned at the congress he accepted it. He thought the time had come when an accurate standard could be agreed upon.—Mr. Preece thought it would be costly, troublesome, and useless to change the present unit. It was far more accurate than most ordinary instruments, such as a foot rule or a thermometer. He suggested raising the practical units of current and electromotive force each tenfold, so as to make the practical unit of current equal to the absolute unit, and to make the new volt equal to 100 million absolute units. The new value of the watt would then be approximately one man power, being 100 times its present value. The unit of resistance would, of course, remain unchanged.—Principal J. V. Jones read a paper containing some suggestions towards a determination of the ohm, and gave in detail an account of experiments he had undertaken, applying Lorenz's method. His results supported Mr. Glazebrook's suggestion, the number he obtained for the length of the mercury column one square millimètre section being 106·31 centimètres for a resistance of one absolute unit.

### The Buckling of Plates.

Mr. Bryan also read a paper on the buckling of plates, in which he described the working out of the analogues for a plane plate of the well-known conditions of stability of a straight elastic wire under axial force. The first case considered was that of a rectangular plate, supported but not clamped round its boundary, and acted on by different uniform edge thrusts in its plane applied perpendicularly to the sides and ends. The conditions of stability are found, and the most interesting point which they lead to is the determination of the number of corrugations produced when buckling takes place. If the thrust per unit length on the sides be less than half that on the ends, the plate will buckle into a series of undulations, whose number will depend on the ratio of the length to the breadth of the plate. In the case of an infinitely long strip, the corrugations will divide the strip into rectangles which will diminish in length as the lateral thrust is diminished, will become squares when there is no end thrust only, and will become closer and narrower when the lateral force changes sign and becomes a tension. This effect may be easily illustrated by wetting the middle of a sheet of thin paper, which is then stretched over two rulers. If, then, the rulers be pulled apart with increasing force, the wrinkles will become more numerous and finer. The undulatory character of the buckling is also analogous to the collapse into rings of a boiler flue. The paper also contained an account of an investigation of the stability of a circular plate clamped round the edges and acted on by uniform normal edge thrust in its plane. This kind of buckling is well illustrated in the circular lid of a canister whose rim is in a state of tension.

### Tension of Water Surfaces.

Lord Rayleigh, Sec. R.S., contributed a paper on "The Tension of Water Surfaces Clean and Contaminated, Investigated by the Method of Ripples." The surface of a liquid tends to contract, and if it is disturbed this causes a production of waves or ripples. The rapidity with which these travel depends on the intensity of the forces which are producing them, and thus the rate of propagation will be different if the surface is clean from what it will be if the tendency to contract is reduced by its being fouled by the presence of foreign substances. Lord Rayleigh has set water in motion, the surface of which was clean, by a method which he described, and has measured the wave-length of the ripples produced. The difficulty of the experiment consisted in the fact that in order that the formulæ might apply the waves must be extremely small, and therefore difficult to see. The means by which this was overcome were similar to those employed by opticians in detecting the extremely small irregularities in surface of nearly completed telescope mirrors. The result has been to show that the tension or tendency to contract of the surface is of somewhat smaller value than that which has been assigned to it. Lord Rayleigh said the ripples were rendered visible by a combination of Foucault's optical arrangement with intermittent illumination. Two frequencies were used, about 43 and 128 per second. The principal results might be thus summarised: The tension of a water surface reckoned in centimètre-gramme-second measure in the various cases was—clean, 74·0; greasy to the point where the camphor motions nearly cease, 53·0; saturated with olive-oil, 41·0; saturated with oleate of soda, 25·0. Prof. Rücker said that in the paper new features if the subject had been presented which completely upset ideas held by others.

### Chess Problems.

Lieut.-Col. Allan Cunningham, R.E., contributed a paper on a chess problem—namely, to find the number of different positions after two moves on each side. It stated that this was, in a mathematical sense, a fairly simple problem in combination, but the rules of chess introduce into it such a number of variations requiring separate estimation as to make the complete solution a pretty laborious task. Without great care in the detail there is much risk of omission, also of counting the same position twice, and of counting positions which cannot be found in actual play. On account of the great historic interest in the game of chess, it was worth while to publish the results, of which the followin is an abstract:—(1) Pawns only moving, 16,55 (2) captures by pawns, at least one piece moved, 347; (3) no captures by pawns, both sides move at least one piece, 19,441; (4) no captures by pawns, one side moves pawns only, the other side moves at least one piece, 35,438; grand total, 71,782.

### Identity of a Liquid and its vapour.

Prof. Ramsay, F.R.S., made a communication on the adiabatic curves for ether, gas, and liquid, high temperatures. He has studied the propert of the vapour of ether by measuring the velocity d in it, thereby using a method originally ed by Kundt. The main result of his experi- s has been to supply the scientific world with her means of determining the so-called critical : at which the properties of a liquid and its ur had become identical.—Prof. Rücker con- ed that the discovery was a distinct gain to the ament of knowledge on the question.

### Magnetic Susceptibility.

W. Thomson, LL.D., D.C.L., read a paper on Method of Determining in Absolute Measure Magnetic Susceptibility of Dia-Magnetic and ly-Magnetic Solids." His communication was ested from two directions on which the subject been treated. (1) Prof. Rücker's investiga- on the magnetic susceptibilities of basaltic , to which he was led in the interpretation of esults of the great magnetic surveys made by elf in conjunction with Dr. Thorpe, by which rkable disturbances due to the magnetisation he rocks and mountains were found; (2) cke's determinations of the magnetic sus- bility of liquids. The method proposed by uthor consisted in measuring the mechanical experienced by a properly-shaped portion ne substance investigated, placed with dif- t parts of it in portions of magnetic field, een which there was large difference of the etic force. A cylindrical or rectangular; or atic shape terminated by planes perpendi- to its length was the form chosen; the onent magnetic force in the direction to its h was equal to $\frac{1}{2}U(R^2-R'^2)A$, where U de- the magnetic susceptibility; R, R', the etic force in the portions of the field occupied two ends, and A the area of its cross section. odies of feeble susceptibility the best arrange- of field was that originally adopted by Faraday oushed so far recently by Prof. Ewing in the of giving exceedingly intense fields. One end prism or plate or wire was in the air between lat ends and conical magnetic portions; the might be in a place practically out of the field, the portion of the substance given were ex- ngly small it might be in the field, but in a of much less force than in the centre of the The measurement of the magnetic force of the was easily made by known methods best by uring the force experienced by a short element re carrying a measured current. This portion re should be placed in the positions occupied o ends of the plate or wire of the substance; in one position and then in the other. But the second position was in a place of sensibly n force, the single measurement with the nt of the wire in the first position sufficed.

### Spectra of the Metals.

of. Rowland (Baltimore, U.S.A.) read a paper e spectra of the metals. During the past year s undertaken the measurement of the wave- hs of the lines of nearly all the metallic spectra, as compared them all with the solar spectrum, ler to ascertain which metals were certainly nt in the sun. His results are embodied in resent communication. The object of the re- h was primarily, he said, to find out what sort ings molecules are, and in what way they te. This can be deduced from the wave- hs of the light emitted if we can find any rela- etween these wave-lengths. If the molecules heres we should have a series of bands getting ally nearer together towards the violet, and senting harmonies of one fundamental vibra- A spheroid or ellipsoid would give a similar ling, but not so uniformly arranged. He ed on a larger scale than in any previous ob- tions, his negatives being 20ft. long for the spectrum. He looked for and found many tions of the truth of the periodic law, which to the fact that similar chemical substances molecules vibrating in a similar manner. As les, nearly every line in the zinc spectrum corresponding one in that of cadmium; so ith calcium, strontium, and barium, and with ium, cæsium, and rubidium. In the case of l elements there is a band, consisting of three bright lines, which it is supposed corresponds rations along the three principal axes of the ule. But the agreement in the spectra of s metals does not extend to all members of oup. For instance, the spectra of beryllium agnesium do not resemble those of the other ne earths. Lockyer has supposed a funda- l basic line to exist which is common to all nts; but Rowland finds no trace of it. Any the solar spectrum which is common to two nts the latter considers to be so only by mere lence. Further dispersion would separate e into two. Some elements give no lines, in the ultra-violet—boron, for example. bly most elements have lines beyond the of the photographic plate. He gave a table nents which he considers to be certainly pre- the sun. He has doubts as to whether the m metals and uranium are present in the Among those not present are antimony, arsenic, bismuth, boron, gold, and nitrogen. On the other hand, many lines in the sun, such as $D^3$, correspond to no known element.—In the discussion which followed, Prof. Rowland, in reply to some questions, stated that he used the arc spectrum, and not the spark spectrum, as the temperature was more constant in the former. He found no variation in the position of lines at different temperatures.

### The Magnetic Survey.

Prof. Rücker read a paper containing the results of further work by Prof. Thorpe and himself in connection with the magnetic survey of the British Isles. He stated that in last year's report they found two centres of disturbance towards which the magnetic needle was deflected, one of these being in the sea off the west coast of Scotland and the other near Reading. These disturbances have been further examined, and Prof. Thorpe finds that the centre of disturbance in Scotland is the sea somewhere south of the Hebrides. The disturbance near Reading is really a little more north, and, indeed, very near Henley. The ridge or the line dividing places of east and west disturbance runs from Henley to Chichester. He has since learned that M. Mascart has found the same ridge in France, thus connecting the magnetic surveys of England and France. The causes of magnetic regional disturbance were then discussed. They may be due to either permanently magnetic rocks, or else to magnetic induction produced by the earth's magnetism. The belt of magnetic rock, 100 miles long, 60 miles wide, and 12 miles deep, which forms the principal disturbing source in England will give disturbances exactly of the order observed if we suppose it to be magnetised merely by the earth's magnetism. Moreover, any permanent magnetism would be very irregularly distributed throughout such a large mass of rock. He took 12 miles as the maximum depth, because below that depth the temperature would be too great for the existence of magnetism. M. Mascart described the existence of a continuation of the ridge referred to in the survey of Messrs. Thorpe and Rücker. He expressed an opinion that electric currents circulating round the earth are the cause of terrestrial magnetism in general. Sir W. Thomson asked whether all the disturbing forces would correspond in direction to those produced by the action of the earth; in other words, whether they were due to a north-seeking pole cropping up above the surface. To this Prof. Rücker replied in the affirmative.

### Report of the Estuaries Committee.

Prof. Osborne Reynolds, of Manchester, presented the report of the Estuaries Committee, from which it appeared that certain experiments had been tried with models during the past year, but no definite conclusions could yet be arrived at, and because this was the case, the authorities in Paris had for a time delayed improvements which they had intended to make in the navigation of the river Seine. At the close of Prof. Reynolds's remarks, the President said it was to be regretted that, according to the regulations, it was not permitted that in the sections any observations should be made, or else he should certainly have requested Mr. Vernon Harcourt to state his views with regard to the invaluable communication to which they had just listened. He (the President), however, was at liberty to state that in the opinion of Sir James Douglas that communication was distinguished by all the thoroughness which ever characterised whatever emanated from Prof. Reynolds. He felt that so great was the importance of this subject that he should make it his duty to press upon "the Committee of Recommendations" the importance during the coming year of further investigations in the same direction.

### A New Process of Manufacturing Wire Netting.

Mr. Golding stated that expanded metal was an article so dissimilar to other manufactures of metals as to require an arbitrary name, and the one he had given to it was but meagrely suggestive of the process involved in its production, and not of its qualities or appearance, as these were only understood by the fullest description, or by ocular or physical demonstrations and tests, but the name, suggesting the expansion of metal, did serve to draw attention to the fact that thereby some new product of metals had been made. Briefly stated, the process of making expanded metal was the employment of a machine which so operated on a sheet or strip of metal as to slash it at intervals in parallel lines, so as to leave uncut spaces, which served to maintain the connection between all the strands produced by the act of slashing. The method, he pointed out, by which this slashing, as well as the opening up of the sheet or strip into meshes, was performed, was peculiar, and one which made it possible to transform the sheet or strip of metal into a finished article at one operation; and to this achievement was due, he thought, the great value of the invention. A discussion followed, in which Mr. Jeremiah Head, Sir Jas. Douglas, Prof. A. Lupton, General Webster, Mr. Colam, and Profs. Barr and Smith took part, which terminated in the President heartily thanking Mr. Golding for his really valuable paper, and for the description he had given of the ingenious machine by which he carried on the manufacture in which he had been so singularly successful.

### Pneumatic Distribution of Power.

In the Mechanical Science section Prof. Alan Lupton read a paper on what is known as the pneumatical distribution of power, but otherwise as the utilisation of compressed air. Prof. Lupton based his observations upon the experience which had been derived from the working of the system in Birmingham. He remarked that the subject should be of peculiar interest in Leeds, because the local authorities had obtained an Act for the use of compressed air throughout the borough. He showed how the supply of air through a meter induced economy on the part of the consumers, and he gave particulars as to the use of the air in the propelling of tramcars, in the working of the electric light, for various domestic purposes, and in Paris for the emptying of cesspools. The power was suitable for large or small motors, and it could be cheaply and safely introduced in workshops, houses, and shops. It was a power that would do the heavy work of a mill-course or of iron-works, and the light work of the tailor, shoemaker, printer, hairdresser, and grocery; it would drive dynamos for electric lighting, and it had many other applications. In Birmingham, by the agency of three steam-engines of 1,000 horse-power, air compressed to a pressure of 45lb. above the atmosphere was delivered into pipes, which were laid like gas-pipes over four miles of streets. The works had only just left the hands of the contractors; but already there were 40 customers for air-power, some of them at a distance of one mile and three-quarters from the compressing station. The loss of power by friction in the pipes was so light that no ordinary gauge would show it—practically there was no loss of power due to this distance. The engines of the consumers varied in size from ½H.P. up to 50H.P. At one set of works they were now using about 100H.P., which drove four or five engines, fed blacksmiths' fires, supplied the blast of the cupolas for iron-smelting, and served several novel processes, economising labour and material, as had been discovered since the power was laid on. Some difficulty had been found in getting a good meter; but Mr. Abrahams had now invented and patented a meter that was correct within 1 per cent. There was now a demand for the power, which gave satisfaction to those who had tried it. Some people had actually moved into the district for the sake of the convenience of having power without having to erect a boiler and chimney. Comparing the mechanical results with the prophecies that were uttered in 1886, he mentioned that then it was alleged by some that the engines as designed could not be erected; but they had been now safely set to work. It had also been asserted by some that the loss of power in compressing was such that 25 to 30 per cent. was the *maximum* proportion of the original steam-power that could be used by the consumer's engine. The results, however, had entirely confirmed the statements of the engineers, Messrs. Sturgeon and H. Robinson. At one works he had visited the indicated horse-power of the consumer's engine was equal to 73 per cent. of the indicated horse-power of the steam-engines at the compressing station—a result which he considered very satisfactory. This result was partly due to the reheating of the air in a stove, where the sweepings of the workshop were consumed without costs. In consequence, he said, of these satisfactory mechanical results, the Air Compressing Company were about to extend their works. Compressed air could be used for working tramways under the patents of Hughes and Lancaster. Under this system a pipe was laid in the streets for the supply of compressed air to the cars, which cars carried the machinery for propulsion, and can ascend any gradient that a locomotive can mount, and take in fresh supplies of compressed air at every stopping-place, an operation which can be effected without actually stopping the car. An experimental car on this principle had been run on the Chester Tramway.

### Report on Vesuvius.

The report on the volcanic phenomena of Vesuvius was presented by Dr. Johnston Lavis, who, as a medical practitioner resident for many years at Naples, has had opportunities for making observations. The small lateral eruption of this summer from the south-west edge of the cone was described. Next the numerous new facts brought to light by the drainage works going on were described, as well as many new sections for 50 miles around Naples. The last and most interesting part of the report referred to the author's studies carried out for the contractors for the new main sewer, which will have to pass through the flanks of the Solfatara and under Mount Olibana, where there are difficulties to be encountered. The description several times through the strip. The buried rail is a rather imperfect bridge to the lines of force traversing it longitudinally, because its magnetic resistance is that direction is great, but this rail forms a very efficient bridge for lines passing through it transversely, owing to its lower magnetic resistance in that direction which includes the strip. The flow of magnetic force transversely is therefore that which effects the attraction of the strip, and may be represented as a series of magnetic stitches passing to and fro between the two sets of rails and the strip.

### A New Method of Photographic Dyeing and Printing.

Mr. A. G. Green read a paper, entitled "The Action of Light upon the Diazo Compounds of Primuline and Dehydrothiotoluidine: a Method of Photographic Dyeing and Printing," prepared by himself, Charles F. Cross, and Edward J. Bevan. In the early part of 1887 Mr. Green discovered that by heating paratoluidine (2 mols.) with sulphur (4 to 5 atoms) at 200°-250° C. a very complex amido base was obtained, which, on treatment with fuming sulphuric at a low temperature, was converted into a sulphonic acid, the alkaline salts of which were easily soluble in water, and had the peculiar property of dyeing cotton primrose yellow from an alkaline or neutral bath without the use of a mordant. Further, the amido compound thus fixed upon the fibre could be diazotised in situ by passing the material through a weak solution of nitrous acid, and when diazotised could be combined with various phenols and amines, thus producing a variety of different colours, which, being formed within the fibre, were all distinguished by great fastness to washing, &c. The soluble amido sulphonic acid was named "primuline" by its discoverer, and has found a very extensive employment in cotton dyeing; the colours produced from it within the fibre were called "ingrain colours." Although the chemical constitution of primuline base (of which primuline is the mono-sulphonic acid) has not yet been determined with certainty, there is no doubt that it is a condensed derivative of dehydrothiotoluidine, a body which always accompanies it in its formation, and that it differs from the latter in exactly the same way as dehydrothiotoluidine itself differs from paratoluidine.—Mr. J. Spiller said that Mr. Green had kept him informed of the progress he had made since he discovered primuline, and he (Mr. Spiller) had worked on the paper himself a good deal. He found that he was dealing with a material which was extremely sensitive to light. Indeed, he should be inclined to describe it as being quite as sensitive as the ordinary [illegible]. At one time he thought it would be worth while to endeavour to use it in the camera. [illegible]

### Coalfields in South-East England.

[illegible] coal-borings that would be needed in the search for coal, it was clearly well, as far as possible, to select sites where a good amount of work had been already done. The object of this paper was to point out that there were such sites, and that they were favourably placed for the search. Sites were then noticed, beginning at the south-east, near the only place where coal had yet been proved in the large tract in question, and working thence westward and northward.

### Reversions.

Miss Layard read a paper in opposition to the doctrine of reversion to a former type. She said that many of the apparent instances of reversion might really be traced to arrests of development or to sports; and when those cases which Darwin had withdrawn were abandoned, the theory of reversion was left almost unsubstantiated by fact. The most important point to be ascertained was the limit of time after which reversion to an earlier type became impossible. If no such limit existed, then it was a matter of surprise that reversion was not constant in man instead of occurring only in rare and exceptional instances.—Dr. Garson spoke at some length, and said that the question raised involved a great many complicated problems, and he remarked incidentally that it was a fallacy to consider that there were different groups of animals at different stages. It was a case of going down the sides of a letter V to the parent stem.—Miss Layard, in the course of a brief reply, said that the down on the human body and the long hairs on a delicate child were cases not of reversion but of arrested development. The hairs were not at all similar to the fur of the ape. If the fur on the human body was a vestige of the more perfect fur of the ape, on what animal originally did the down appear which had developed into the fur of the ape? One might suppose that the man with his down was the original progenitor of the ape.

### The Origin of Gold.

Mr. J. Logan Lobley, F.R.G., contributed a paper on the origin of gold. After pointing out that it was not the origin of auriferous veins, but of the gold itself, that was the subject of his paper, the author, from facts recently made known, showed that while geological evidence is against its igneous origin, all the gold of all the rocks may have been derived from aqueous deposition; that, in fact, all this gold may have been deposited by marine action in the same way as the materials of the aqueous rocks themselves have been. And, moreover, our unaltered sedimentary rocks, even of tertiary age, may contain an equal amount of gold in proportion to their bulk with that of those altered or metamorphosed Cambrian and Silurian rocks, which have hitherto been regarded as the earth's great treasures of the precious metal. The knowledge now possessed of secondary and tertiary auriferous veins in California controverts the Plutonic as well as the palæozoic hypothesis, and the discovery of gold in sea-water and of its precipitation by organic matter alters the position of the question from that it occupied in the days of Murchison and Forbes. If gold was originally derived from Plutonic sources it ought to be found among volcanic products, which come from the same deep-seated sources, and only differ from Plutonic rocks in being solidified under different conditions. But gold, although a most widely distributed metal, is almost, if not quite, unknown as a product of volcanic regions. This is strongly against its igneous origin, and consequently points to the gold of the palæozoic auriferous veins being derived by removal from sedimentary rocks in which it had been originally deposited.

### The Origin of Thorns.

Prof. P. Geddes (Edinburgh) contributed a paper on "The Origin of Thorns," and illustrated his subject by specimens as well as by drawings. He said the usual explanation of the origin of thorny plants was that independently given by Darwin and Herbert Spencer, and supported by Wallace and the majority of naturalists—that of mammalian selection. Spontaneous or indefinite variations toward thorniness are preserved and accumulated by the defence such plants present to the attacks of browsing mammals. Detailed evidence in favour of this view is not lacking—for example, the thorny flora of goat-infested hills, and the same principle is thus extended to difficult cases, the occurrence of thorny plants in New Zealand being explained by the supposition of the browsing habits of the extinct birds of that region. Prof. Geddes said he was led to abandon these views through more extended observations upon thorny plants, which reveal the existence of a more or less localised general contrast in vegetative habit between the thornless and thorny varieties in any species or allied species in any larger group. The thorny varieties or species show a diminishing vegetativeness than their thornless congeners, indeed, very frequently develop their thorns by the actual death of their growing points. In conclusion Prof. Geddes pointed out that the agency of natural selection, although very greatly diminished so far as the origin of spiny forms was concerned, remained of undisputed importance in determining their geographical range and local distribution. The subject thus furnished a convenient test case for the discussion of the rival theories of definite or indefinite variation, since the conception of variability as definite and constitutional instead of indefinite and spontaneous, may be similarly applied to the other case upon which the natural selectionist depends. The conception of constitutional differences in vegetative habit was even applicable to such a peculiarly difficult case as that of the origin of protandry and protogyny.

### Vulcanised Rubber.

Mr. W. Thomson (Manchester) read a note on "The Vulcanisation and Decay of Indiarubber." After a detailed explanation of the processes, he said that it is known that copper salts have a most injurious effect on indiarubber, and as copper is sometimes used in dyeing blacks and other colours, cloths so dyed are liable to decompose, and harden the rubber put into it. A peculiarity investigated by the author is that metallic copper placed in contact with thin sheets of indiarubber bring about oxidation and hardening of its substance, although no appreciable quantity of copper enters the indiarubber, whilst metallic zinc and silver have no injurious effect on the rubber. In answer to questions, Mr. Thomson said he had made experiments with the view of ascertaining the action of oils on cloth. He found that if the oil contained a certain amount of copper, which it often did, and it got on to the cloth, the action of the bleaching agents on the copper damaged the cloth. In the ordinary linseed oil there was an acid which rotted cloth. The smell of indiarubber was one of the characteristics of its decomposition. He had noticed that when a piece of blotting-paper was placed over the decaying rubber it became coloured by some of the emanations—a state of things he did not find in the case of good indiarubber. There was no doubt, therefore, that during the oxidation which produced the hardening certain volatile substances were produced. Rubber could best be kept under water, under glycerine, or in coal-gas. He had also placed rubber in a vacuum, and exposed it to sunlight for twelve months, and found it remained perfectly good. All oils, except castor oil, had a most detrimental effect on indiarubber.

### Unburned Gases from Stoves.

Mr. Thomson (Manchester) read a paper on "The Unburned Gases Contained in the Flue Gases from Gas Stoves and other Burners." He said the only burner in which he found that perfect combustion was effected was that of a paraffin oil lamp when the flame was not turned full on; but when the flame was turned full on the burned gas was liberated to the extent of 12 parts of carbon and three of hydrogen for every 1,000th part of carbon in the oil completely burned. The next nearest approach to complete combustion was in an Argand gas-burner. When the gas was not allowed to burn full on no carbon and one-quarter of a part of hydrogen was left unburned per 1,000 parts of carbon burned completely. When the gas was turned full on one-tenth part of carbon and 2½ parts of hydrogen escaped unburned per 1,000 parts of carbon completely burned. Next in point of producing perfect combustion was the Bray's ordinary flat flame burner, burning in the open air, when 12 parts of carbon and one of hydrogen escaped unburned per 1,000 parts of completely burned carbon in a heating stove with three luminous flat flame burners; 97 of carbon and 12 of hydrogen escaped unburned in a stove where eight Bunsen burners played on fancy ironwork in front; 146 of carbon and seven of hydrogen escaped combustion in a stove in which asbestos projecting from a fire-clay back was heated by 20 Bunsen burners; and in a stove in which the burned gas rises to the top of an iron chamber, and passes into the fire from the bottom of the chamber after giving its heat to tubes set in the chamber, through which cold air passes to be heated, as much as 226 parts of carbon and 28 of hydrogen escaped combustion per 1,000 parts of carbon completely burned.—The President said that it was most important to know whether carbonic oxide resulted from the burning of gas in stoves or from illumination. An extremely small quantity of carbonic oxide in an atmosphere breathed by people was highly dangerous. He spoke with some knowledge and experience of the fact, for some years ago he was very nearly killed by carbonic oxide. He was called in to investigate a case of poisoning, which afterwards turned out to be by carbonic oxide. A man was found dead in a room [illegible]ft. square, and he (Prof. Thorpe) attempted to reproduce the condition prevailing in the room by using a blowing engine. After it had been going for [illegible] minutes he entered the room, but he had only proceeded half a dozen steps when he felt his knees give way. He fell down unconscious. Some friends were fortunately near and rescued him.—Dr. Jacob said that Mr. Thomson's paper was a valuable one, but he thought the experiments might very properly be continued, for the amount of combustion which took place in an ordinary gas flame differed according to the pressure of the gas. Usually a burner intended to burn 3ft. of gas in a ime had 5ft. or 6ft. passed through it. lly speaking, people who paid £10 gas bills t £5 worth of light. He had that on the ty of one of the largest manufacturers of . The question so far as gas cooking-stoves ncerned was of such sanitary importance, would be worth while appointing a com- of the Association to investigate the condi- ider which they were used.

# SCIENTIFIC NEWS.

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Washington report for 1889 shows that ood work has been done with the instru- at the Naval Observatory of the United The large equatoreal has been used for observing double stars and the satel- Saturn, while the 9·6in. has been used ntification of stars, and two nights in each as been set apart for the use of visitors— r than 1,665 "permits" having been issued. Harkness, who has been working at the of the Transit of Venus in 1874 and 1882, out the sun's distance as 92,455,000 miles, probable error of 123,400 miles. Mr. assistant astronomer, has discovered a in Antlia, with a period of less than 12 the shortest yet made known.

). Gill, of the Cape Town Observatory, n elected a member of the Berlin Royal y of Sciences, and now ranks with Sir iry as the second British astronomer who ived the honour.

stated that M. Charlois, of Nice, has red two more minor planets, both on e night. If verified, they will raise the to 298.

attendance at the Leeds meeting of the Association has, to say the least, been a intment, as the total receipts were only The following "grants" were recom- :—To Sir W. Thomson, for seismological ena of Japan, £10; Prof. Carey Foster— l standards, £100; Lord McLaren— logical observations on Ben Nevis, £50; 'itzgerald—electrolysis, £5; Mr. G. J. —photographs of meteorological pheno- £5; Prof. O. J. Lodge—discharge of ty from points, £10; Prof. Liveing— olet rays of solar spectrum, £50; Mr. urray—seasonal variations of tempera- 20. Prof. Roberts-Austen—analysis of d steel, £10; Prof. Tilden—isomeric lene derivatives, £25; Prof. H. E. Arm- -formation of haloid salts, £25; Dr. —action of light upon dyes, £20. Prof. ch—erratic blocks, £10; Mr. E. Etheridge Phyllopoda, £10; Mr. W. Whitaker— logical Record, £100; Prof. J. Geikie— aphs of geological interest, £10; Dr. H. ard — lias beds in Northamptonshire, nd registration of type specimens of fossils, £10; Mr. H. Bauerman—vol- henomena of Vesuvius, £10; Prof. E. nderground waters, £5; Mr. J. W. investigation of Elbolton Cave, £25; . H. Flower—Marine Biological Asso- t Plymouth, £30; Prof. Michael Foster l Station at Peradeniya, Ceylon, £50; . C. Haddon—improving deep-sea tow- ; Mr. A. W. Willis—disappearance of lants, £5; Prof. W. H. Flower—zoology andwich Islands, £100, and zoology and of the West India Islands, £100; Dr. — nomad tribes of Asia Minor and n Persia, £30; Sir J. Douglass—action s and currents in estuaries, £150; Prof. —new edition of "Anthropological Notes ries," £50, and anthropometric labora- 10; Dr. E. B. Tylor—North-Western Canada, £200; Sir W. Turner—habits es of India, £10; Mr. G. J. Symons— nding societies, £25—total, £1,335.

gst statements made which deserve , was one by Prof. W. H. Perkin, jun., per on the constitution of the alkaloid , which he said was the most widely- ed alkaloid in nature.

letter to Sir R. S. Ball, referring to his itled "Starland," Mr. Gladstone says:— empted to mention to you an address by sen to the French Academy (of which he ber) which he was kind enough to give year, termed 'L'Age des Etoiles.' It e extremely interesting, but of course I udge of its merits. It uses more largely than your lectures the aid of spectral analysis in relation to the ages of the heavenly bodies. . . . When I first became Chancellor of the Exchequer I found that the Bank of England and the Treasury used the letter *m* as a convenient abbreviation for £1,000. For my own convenience I improved (as I thought) upon this by adopting *m* with a tail, very easily written, for a million, and, though financial demands rarely rise so high, I have gone a step further and thought of *m* inclosed by a circle as equal to a thousand millions or the French milliard. It would be more scientific to make this symbol stand for a million millions; but it is an extravagance suited only to astronomical distances. It occurs to me that symbols of this kind (replacing pounds by miles) might be of some use perhaps in writing such distances. Your book brings other subjects to my mind, and makes me think that the teachers of the uniformity of nature sometimes press rather hard upon us the common herd. If our moon does not revolve upon its axis, if the moons of Uranus (I wish it had been Ouranos) describe circular orbits, and those of Mars travel eastwards, a very elastic definition of this *uniformity* seems needed to cover such varieties."

Many different vegetable substances used as stimulating beverages in widely distant parts of the world have been shown to contain caffeine as their active principle. Only one substitute for tobacco has, however, as yet been discovered. This is the leaves of the Duboisia Hopwoodii—a shrub growing in Australia, the leaves of which are chewed by the blacks in the same way and for the same purpose as tobacco is chewed. The leaves contain an alkaloid (piturine), which is said by certain chemists to be identical with nicotine, but more probably is only closely allied to it.

M. F. Lobato has, it is stated, discovered platinum in some ores from Las Yedras Mines, Sinaloa, Mexico.

Electrically driven drills are being used in the U.S. Navy Yard at Brooklyn. They have been frequently employed in this country for making holes in positions difficult to get at.

From San Francisco comes the news that a Chinaman, Wong Ching Wah, has constructed a telephone which is superior to any in existence, and which, moreover, avoids, so it is asserted, any infringement of the Bell patent. Details are not forthcoming at present.

Amongst recent patents in the British Office we notice that M. Lugard, of Christiania, has taken protection for a mouthpiece for oil "wave-subduers" (10984, 1890), which claims an adjustable mouthpiece, in which the part A forms a capsule for the part B, and so regulates the efflux of the oil.

At a meeting of the Wellington Philosophical Society, New Zealand, lately, Mr. Hulke exhibited a specimen of a curious spider which carries its young upon its body, without the aid of a web or filament, until they are strong enough to run by themselves.

The Pike's Peak Rack Railway will be completed to the summit late this autumn. The construction of this road has been difficult, as only the acclimatised can labour at an altitude of 14,000ft., and the work of an ordinary navvy is said to be impossible until he has spent at least two months expanding his lungs so as to accustom them to the rarefied air. The roadway has to be made with the aid of burros, or small donkeys, as horses and carts were unavailable on the rugged and irregular lines of the snow-capped peak. Hundreds of feet above the timber line, immersed in clouds, rain, snow, and sleet a good part of the time, the work was continued during last winter. There has naturally been much trouble with employés.

**Cement for Iron Railings.**—For the cementing of iron railing tops, iron gratings to stoves, &c., the following mixture is recommended; in fact, with such effect has it been used as to resist the blows of a sledge-hammer. This mixture is composed of equal parts of sulphur and white lead, with about one-sixth proportion of borax, the three being thoroughly incorporated together, so as to form one homogeneous mass. When the application is to be made of this composition, it is wet with strong sulphuric acid, and a thin layer of it is placed between the two pieces of iron, these being at once pressed together. In five days it will be perfectly dry—according to the *Chemical Trade Journal*—all traces of the cement having vanished, and the work having every appearance of welding.

# LETTERS TO THE EDITOR.

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*[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]*

*All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

*All Cheques and Post-office Orders to be made payable to* J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

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## HOW MISTAKES ARE MADE—THE SOLAR SPECTRUM—ASSESSMENT OF TELESCOPES—OBSERVATORY FLOOR—FINDER—KITCHENER'S PANCRATIC EYEPIECE—FIXING A SUNDIAL—THE SOLAR PARALLAX FROM PHOTOGRAPHS OF THE TRANSIT OF VENUS—A NEW DEPARTURE IN THE ENDOWMENT OF RESEARCH—THE PRESIDENT-ELECT OF THE BRITISH ASSOCIATION—SOLAR "WILLOW LEAVES"—"LOCAL" (?) LUNAR ATMOSPHERE—ADJUSTING REFRACTOR—LOGARITHMS—GHOST IN TELESCOPE—BRIGHTNESS OF THE MOON'S LIMB.

[31597.]—Since writing letter 31530 (p. 33), I have got to the bottom of the mystery of the appearance of the figures 1° 22′ 51″ in letter 31472, as the dip of the horizon from the top of Snowdon; and as it is not without interest and instruction to the young computer, I may as well relate here how such an apparently inexplicable blunder was committed. The calculation of the dip is simplicity itself; for it is made, as I explained on p. 33, from the formula $\text{Dip} = 58{\cdot}82'' \sqrt{\text{height of eye in feet}}$. I always calculate originally on bits of waste paper (the fly-leaves of letters chiefly), and, if I have any object in preserving the calculation, copy details from these into a scribbling book. Now, curiously enough, I have turned up the bit of paper on which I made the first computation, and will reproduce it here verbatim: 3,571ft. (log.) $\dfrac{3{\cdot}5527899}{2}$

$$= 1\,7763949 \qquad \begin{array}{ll} 1{\cdot}7763949 & (\text{log. of } \sqrt{\text{of height}}) \\ \underline{1{\cdot}7695250} & (\text{log. of } 58{\cdot}82'') \end{array}$$

$$3514{\cdot}96'' \ (\text{log.}) \ 3{\cdot}5459199,$$

i.e., 58′ 34·96″. But I had made other calculations, relating to an entirely different matter, on the same sheet, and among them appear the figures 1° 22′ 51″, which I seem to have calmly copied into my scribbling book, and proceeded with as the proper quantity. Moral and Caution.—If engaged in multifarious computations, always tear up one set of rough calculations before proceeding to a different one. I have over and over again explained that the *latter* half of these letters is always written under great pressure, and the one to which I am referring offered no exception to the rule, the whole calculation having been made in a very great hurry indeed. Still, proper care should have obviated such a transparent blunder as that to which I am referring; though "Nemo mortalium omnibus horis sapit."

There are two or three points of great interest to the spectroscopic observer and the physicist in Mr. Ranyard's excellent paper in the current number of *Knowledge* to which the exigencies of space presumably prevented any reference in your "Scientific News" on p. 31. The first has reference to the duplication of the E line, and that at wave-length 5264·4, which both Angstrom and Kirchhoff describe as a line common to both iron and calcium, but concerning which the author of the paper says: "But the duplicity of the line in the solar spectrum suggests that possibly the two elements have not even a vibration in common." And then he goes on to add what may be most profitably studied by many who have been imposed upon by one of the pretty recently advertised "magnificent theories": "It has been customary with some speculative physicists to speak of two elements having a common line in their spectra, as if they were thus shown not to be elementary, and were proved to be built up of still more elementary substances, one of which was thus proved to be common to both of them; but the fact that some parts of two molecules have a common period of swing no more proves them to be identical than a violin is proved to be identical with a trombone because they are both capable of sounding the same note." Whence unprejudiced people will have but little difficulty in coming to the conclusion that the substructure of the hypothesis of the non-elementary nature of the elements is in all human probability merely insufficient dispersive power, and nothing else in the world. Again, in speaking of the G region of the spectrum, Mr. Ranyard says: "There are three or four narrow spaces in this region of the spectrum which look very like bright lines, and it is difficult to convince oneself that they are not brighter than the rest of the background of the spectrum. I am inclined to agree with Dr. Draper that they are actually brighter spaces in the solar spectrum." It would be curious if this should turn out to be really the case, after the loud asseverations that have been made that there may not, cannot, and shall not be any actual bright lines in the solar spectrum, and that any suspected ones must be the mere effect of contrast. I may say incidentally that the reproductions of Mr. Higgs's photographs are most beautiful.

In connection with the concluding paragraph of "Scientific News" (p. 32), it may not be generally known that the wiseacre or wiseacres of assessors at Harrow actually rated Colonel Tupman's equatoreal as *machinery!* The knowledge of the intention of the framers of the Statute under which such an assessment was possible, exhibited in this glaring case, was what our Joskins describe as "whoally surprizun."

"R. W. B." (letter 31553, p. 36) will assuredly find no practical inconvenience from the air currents which will ascend between the framing of the wooden floor of his observatory and the pier carrying his equatoreal pillar. Moreover, such a floor at a sufficient height above the ground to admit of a free circulation of the air beneath it will keep the observatory and its contents dry; a material consideration.

If Mr. Fairbairn (query 72279, p. 43) will go or send to Mr. Caplatzi, who advertises in these columns, he will probably get a finder for his telescope at about half the cost, and with a tithe of the trouble, which its construction at home would involve.

In reply to "T. D." (query 72303, p. 43), Kitchener's pancratic eyepiece did not differ in principle, though it did somewhat in external appearance from the terrestrial pancratics in use to-day. My own experience of it was gained in the days of my boyhood, when I used to observe with a 2¾in. Dollond, furnished, among a battery of eyepieces, with one of the original pancratics. It had three sliding tubes, like an ordinary pocket telescope, and I particularly recollect that there was rather a large black disc at the eye end perforated with the eye-hole. Its inventor (doubtless unintentionally) gravely exaggerated its advantages and ignored its defects, of which the rapid darkening of the field with increase of power was a notable one. Another was that as the two systems of lenses became separated all the minute particles of dust on the anterior one became visible; and the field gave one the impression of having been peppered. It was, in some respects, handy and convenient up to a moderate degree of amplification; but when it was attempted to employ it to produce high powers it broke down conspicuously.

"Ch. J. D." (query 72309, p. 44) had very much better fix his sundial by the aid of a good watch than by the use of the compass. Moreover, he seems to be unaware that longitude enters as an element into the variation of the compass as well as latitude. But for the present purpose I will suppose him to be *in* London in latitude 51° 30′ N. and longitude 20 seconds W., and to be going to adjust his dial on September 19th. The first thing to be done is to get true Greenwich Mean Time from the Westminster clock, or from one of those in electrical connection with the Royal Observatory, and to set his watch accurately by it. Now, on September 19th the equation of time is—6m. 18s., in other words, the sun is on the Greenwich meridian, or due south, at 11h. 53m. 42s. a.m. Greenwich Mean Time. But he will not come on to the London meridian until 20s. later, or until 11h. 54m. 2s., as shown by a clock marking G.M.T.; so that all your correspondent has to do is carefully to level his dial, and, beginning a minute or two before apparent noon, say at 11h. 50s., very carefully follow the shadow of the gnomon by turning the dial round; so that at 11h. 54m. 2s. a.m. by his watch the shadow shall rigidly coincide with the 12 o'clock line. The sundial may then be permanently fixed. If "Ch. J. D." prefers the much less accurate method of adjustment with a compass, the needle points at present (for his purpose) 17° 30′ west of north in London.

In an appendix to the Report of the Superintendent of the Naval Observatory at Washington, for the year ending with June, 1889, there appears a letter from Prof. Harkness on the reduction of the photographic records of the Transit of Venus of 1884, which must interest all astronomers who have followed that method of determining the Solar Parallax. The photographs, as will be remembered, were taken with horizontal photo-heliographs of some 40ft. focal length; and from the weighted mean of position angles and distances combined, as measured on the plates, Prof. Harkness finally deduces 8·842 ± 0·0118″ as the parallax of the Sun. It is noteworthy how very closely this approaches the value 8·848 adopted in the *Nautical Almanac*.

There is a widely diffused belief, well or ill founded, that the *Times* newspaper has been "got at" by the Ring at South Kensington, and hence its utterances on scientific matters are always more or less discounted, and taken *cum grano salis*. But, so far, the *Standard* has manfully resisted the wiles of the gang at Brompton, and has honestly and conscientiously maintained the dignity of British science. It was, then, with the most sincere and unaffected regret that I read a leader in the *Evening Standard* of September 9th on "The Endowment of Research," puffing up the most recent scheme of the Commissioners of the Exhibition of 1851 for pauperising students of science, and for inducing that spirit of cadging and scientific mendicancy in the rising generation of men proposing to devote themselves to its pursuit, which has made the very name of South Kensington stink in the nostrils of all who care for the purity and dignity of research, and of British science generally. In support of this last precious scheme, the article on which I am commenting quotes the approval of some of the most notorious self-advertisers in the kingdom, among whose names I am heartily grieved to find that of one really great man—I mean Sir William Thomson. I need not mention any of those who form the list on which the inclusion of Sir William's name sheds a certain air of weight and respectability. Suffice it to say that it is made up of men who puff and advertise themselves, either *in propriâ personâ* or vicariously, whenever the occasion offers. One crumb of comfort I derive from the perusal of the details of this last scheme; and it is this: that eleemosynary aid is only to be rendered to students "of those branches of science, the development of which is of special importance to our national industries." Surely this should exclude Brompton "astronomy"?

Everyone who knows Dr. Huggins, either personally or by world-wide reputation, will rejoice to hear of his selection as the President of the British Association for the meeting in 1891. To those who have followed the recent advances in the spectroscopical examination of the heavenly bodies, his address will assuredly not fail to afford the greatest interest and instruction. As is well known, some of his recent results, obtained with the aid and co-operation of his gifted wife, have been attacked in an acrimonious fashion; and had Dr. Huggins's presidency occurred during the time that this question was *sub judice*, he might well have felt somewhat hampered in his exposition of the existing condition of Spectroscopical Science. Now, however, that he has triumphantly refuted his assailant, and shown conclusively how that assailant's attack had its origin either in the employment of insufficient dispersive power, or of his incapacity to understand what he was looking at, Dr. Huggins will be freed from such restraint as the temporary doubt thrown on his results must have imposed on him, and will be able to deal with his own discoveries as irrefragable facts.

Mr. Webb (letter 31558, p. 56) is under a slight misapprehension as to the confirmation of the late Mr. Nasmyth's supposed discovery of "willow-leaves" in the solar photosphere by the astronomers whom he enumerates. They did so far corroborate Nasmyth as to testify to the existence of certain entities on the solar surface; but the consensus of opinion pointed to their being rather objects like rice-grains in aggregation, or more sparsely scattered, than the fusiform interlacing ones seen and drawn by the Penshurst astronomer—and by him alone.

Will "H. G. D." (letter 31570, p. 59) kindly explain how an atmosphere of aqueous vapour on the moon can by any conceivable possibility be "of a local character"? How is it to be limited, bounded, or circumscribed in vacuo?

Query 72315 (p. 67) strongly suggests the idea that in re-uniting the crown and flint glasses of his object-glass, "Wings" has placed the wrong surfaces in apposition. Nearly all the principal opticians mark the edges of their objectives when their component lenses have been adjusted so as to give the finest definition. Has the object-glass of "Wings's" telescope no such indicating marks?

In reply to "C. E." (query 72331, p. 68), Dr. J. W. L. Glaisher, in his "Report of the Committee on Mathematical Tables," presented to the British Association in 1873, gives an account of a set of forty-two tables by Parkhurst, published in 1871, in which the logarithms of numbers from 1 to 109 are given to 102 places, and the logarithms of numbers from 200 to 1199 to 20 places (from Callet), &c. Glaisher finds great fault with the get-up and printing of this book. Callet gives logs. to 61 places. I have myself never seen either of these works. I do not, of course, know what specific forms of calculation "C. E." is engaged upon; but it is very rarely that the computer needs more than 10-figure logarithms, and Sang's tables supply those. For myself, I always use De Morgan's edition of Schrön's Logarithms. They only extend to seven places, up to 99999, and to eight places from 100000 to 108000.

The ghost of "Hamlet's" (I was on the point of writing "father," but I mean) refractor, concerning which he puts query 72376 (on p. 69) has its origin in his eyepiece, and is caused by internal reflection from its component lenses.

Mr. Broughton, the author of letter 31476 (Vol. LI. p. 552), has sent a long communication to our Editor for transmission to me, with the apparent object of justifying himself against an absolutely imaginary charge of plagiarism, which he, with perverted ingenuity, finds in paragraph four of letter 31530 on p. 32. Let me assure Mr. Broughton that I referred him to Proctor's "Essays on Astronomy," not in the least because I thought he had appropriated the idea of our great lamented astronomical expositor from that work; but because I imagined—as it seems justly—that he was ignorant of it altogether. A diagram 23 years old accompanies Mr. Broughton's letter, and this I have returned by post without comment, inasmuch as I make it an inexorable rule never to enter into any private correspondence whatever in connection with matters which appear in these columns, where I choose to be known—and known only—as

**A Fellow of the Royal Astronomical Society.**

## THE PERSEID RADIANT.

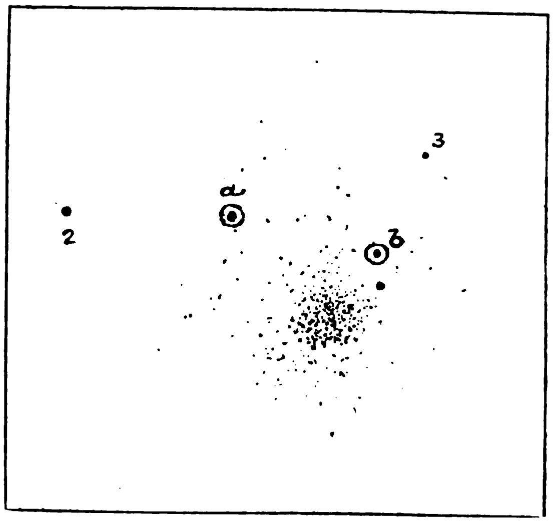
[31598.]—I think if Mr. Denning can show that during some forty nights the point from which the majority of the meteors emanate moves steadily eastward, the shifting of the radiant must be considered proved, although occasional meteors may still reach us from point which the radiant passed in its earlier stages.

Mr. Denning has, no doubt, unpublished observations on the subject, and is more conversant with the observations of others than I am, and I therefore do not desire to offer any decided opinion on the point at issue. I only say that Mr. Denning's published catalogue does not, in my opinion, establish the shifting of the radiants. It does not show a steady movement of the maximum shower towards the east on every night. On the contrary, there are several gaps, and at certain points the radiant seems to turn back (though this, of course, may arise from a distinct shower). Thus I do not find any position recorded between 11° + 48° on July 11-[illegible] and 19° + 51° on July 19, while during the interval I find positions noted at 5° + 52° and 7° + [illegible], with one at 6° + 53° on July 12. The question, I think, therefore, stands for further observations on the following points:—1. Can the gaps in Mr. Denning's catalogue be filled up by actual observation? 2. Do meteors from the earlier position continue to come after the supposed radiant has shifted beyond them?

Great Malvern, Sept. 12. **W. H. S. Monck.**

## THE VARIABLE STARS (TRUE AND FALSE) NEAR 5 M LIBRÆ—JUGGLING WITH THE FACTS.

[31599.]—In the *Astronomische Nachrichten*, No. 2986, Prof. E. C. Pickering communicates a note by Mrs. Fleming confirming the variability of the two stars near the cluster 5 M Libræ, which I first pointed out in a letter to the "E. M.," Vol. LI. page 378. This note contains a careful discussion of seventeen photographic plates taken of this region from March, 1888, to July, 1890, with three different photographic telescopes. The resulting light ranges and magnitudes are as follows:—For the star S. preceding the cluster (marked *a* in chart), a variation of 1·9 mag. is found, from mag. 9·7 to 11·6, and for the star immediately following the cluster (marked *b* in chart) a variation of 2·9 mag. is found from 9·3 to 12·2, while the comparison stars used (marked 1, 2, and 3), which are constant, are of magnitudes 9·8, 11·[illegible] and 12·2 respectively. These comparison stars will be useful for future determinations of the light-range of the above remarkable objects. The occurrence of two variable stars so close to one of the finest globular clusters in the heavens as to be involved among its outlying stars that branch forth curve-like in all directions, and their nearness to each other is almost unique, there being but one known similar instance—that of the compressed cluster 80 M, with R and S Scorpii in its immediate vicinity. In April and May, 1890, Mr. Common photographed this cluster several times with his great reflector, and communicated his results in a note (*Monthly Notices*, R.A.S. Vol. L. page 517) in which he calls attention to five "new variables," photographed on the night of May 15. Now had these "stars" any real existence they must have been seen on the night previous, when I charted that region with a 4¼in. refractor, and saw nothing corresponding to them, though their magnitudes are given as 9·5 and 10. As the other plates show no trace of them, and as the Harvard photographs are also absolutely silent respecting them, we may safely conclude that these five "stars" are no stars at all, but are possibly due to imperfect photographic plates. This, however, does



ıat the photographs are otherwise unre-
they will doubtless form a useful record
ɔearance of the cluster at those dates.

ıference to this matter there is a mislead-
ıent in the current issue of *Nature* (Sept.
endeavours to show that the objects
ıhed by Mr. Common, and the variable
Prof. Pickering's note, are identical, and
r. Common belongs the honour of having
them. The first statement has already
:oved, and the second is equally fallacious,
Common nowhere refers to the two real
in his note with the possible exception of
general statement (which *Nature* quotes)
ght apply to any of the numerous stars
outside the cluster, as it refers to none in
, while my own observations were pub-
ıe time before Mr. Common's, and dealt
these two particular stars. It is not with
to self-glorification that I write, but that
should be told. The way my name has
ressed and Mr. Common's introduced, and
"worked" accordingly to mislead and
is strongly to be deprecated by every
orker in the realms of science. All who
to see the original statement in the *Ast.*
. 2986, will at once perceive how the
been juggled with by certain interested
the periodical above mentioned.

, Sept. 5. **David E. Packer.**

'he accompanying chart is identical with
on the night of June 9. The two variables
ed in little circles, and two of the com-
ars are numbered. The 9·8 mag. compari-
situated 18′ or 20′ S. of cluster, and pre-
star 5 Serpentis, hence it is not included.

## SUNSPOTS.

]—Mr. Duke, in his letter on p. 33, speaks
of spots having been seen on the disc of
n September 1st. The spots to which he
eared by rotation early in the morning on
August 26th. I observed them first at
were then close to the sun's limb, and
of three spots. By 10.30 a fourth had
ıt close to the others. The group were
by waves of faculæ 50,000 miles long.
principal spots were 12,000 miles apart.
dnesday at 10.30 the number of small spots
ısed to more than 20. The group at this
e 50,000 miles long, and 40,000 miles

hey had arrived to the centre of the sun's
had undergone many changes. At this
tember 1) they presented a most remark-
arance.

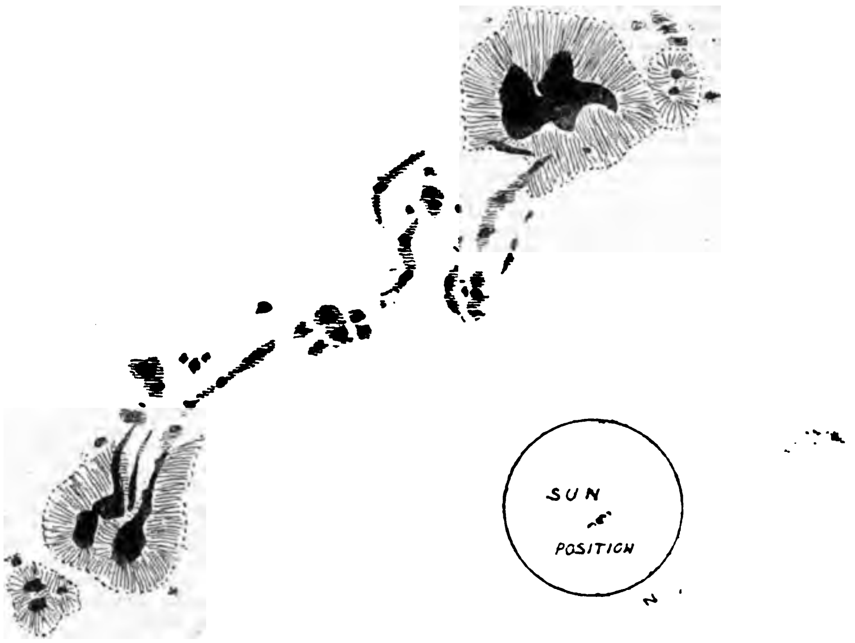
principal spots were upwards of 112,000
ıder, and were surrounded with brilliant
f light. The spaces between and around
e covered with small spots. The photo-
s seen in several places presenting signs of
turbance. The whole group presented a
licated structure. The large eastern spot
d by a fine bridge of faculæ, and brilliant
f facula projected over the umbra of the
oot.

time the group had reached the western
he minute spots had disappeared, and the
h its follower was nearly all that remained.
rvations made early yesterday morning, I
western spots had disappeared by rotation.
ning at 8.45 I observed another spot had
during the night to the left of the eastern
the south of the old spot was a wisp of
, and on its west side was a broad bright
To me this solar group of spots has been very interesting, from the fact of my being able to trace its origin to three small spots.

September 9th. **J. Webb.**

[31601.]—I beg to inclose copy of group of sunspots, sketched on August 31, 1890. I sent a copy to a friend, and a contributor to your "E. M." He advised me to send one to you, as it might be interesting to your readers and astro. amateurs. I am a constant reader, and if this is of any service to you and them, I shall be pleased to know that I may be stimulating others to do same.

**R. A. Lawson.**



## OCCULTATION AND ECLIPSE OF JUPITER'S SATELLITE No. III.—THE B.A.S.

[31602.]—The above phenomena were well observed on the 13th inst. in Portland. The emergence of the satellite from behind the body of the planet was very clearly seen. The disc of the satellite was plainly dichotomised, definition at the time being excellent. After the lapse of 29 minutes the satellite entered the dark shadow of the planet, when it was perfectly invisible. Prior to doing so it was very interesting to note the gradual diminution of its light as it entered and passed through the penumbra. The emergence from the umbra was not seen owing to the low altitude of Jupiter at the time. The above phenomena are recorded to stimulate the possessors of moderate telescopes to take full advantage of the remarkably clear skies with which we are favoured during the passing month, nearly as many first-class observing nights being recorded by the present writer in August and September as the whole of the previous part of the year.

Permit me to say that I fully agree with "F.R.A.S." in his remarks concerning the great desirability of bringing the subscription and fee of the B.A.S. quite within the means of the intelligent artisan; but the point of his argument will appear blunted to his keen apprehension when he remembers that only 4s 6d. more would be required to bring the enrolment money up to the round sum of £1, an addition which but very few of the class he refers to would feel to be a burden, but which might materially aid in its aggregate in keeping the balance of the society on the right side. The mechanic who is desirous of joining an astronomical society is almost sure to belong to that admirable class who have reserved resources in some savings bank which can hardly be better used than advancing his scientific knowledge and advantages. I am very glad "F.R.A.S." is frequently referring to the B.A.S. in his ever-welcome letters, in which his criticisms are not the least valuable portion; but I fail to see that the word "society" can ever seem to militate against the historic and world-wide R.A.S., to which all British and foreign kindred institutions will ever defer. The B.A.S. can only be (as designed) supplementary to the R.A.S. Its highest ambition is to become complementary to the chartered institution. I should not have written the above, only "F.R.A.S." has done me the honour of inserting my name in his fortnightly epistle. **W. R. Waugh.**

## JUPITER.

[31603.]—While observing the planet Jupiter on Monday evening, Sept. 8, between the hours of 8 and 8.30 p.m. with my 3in. refractor, I noticed a meteor of a ruddy colour transit the western limb of the planet in a southerly direction. Not having seen such a phenomenon before, I should be glad to know if any of your correspondents saw the phenomenon, and what were its effects.

**G. George Leedham.**

20, Blacks-road, Hammersmith.

## TO "F.R.A.S."—AMATEUR'S OBSERVATORY—MICROSCOPICAL AQUARIA—VICTOR MUSTEL.

[31604.]—Will "A Fellow of the Royal Astronomical Society" have the kindness to inform me where I may obtain copies of Miss Brown's two books, "In Pursuit of a Shadow" and "Caught in the Tropics," and the price? In consequence of what your correspondent said of the former some time ago, I ordered a copy from my bookseller here, but he could learn nothing of it. I made inquiries about it when in Liverpool, and although an officer of the Liverpool Astronomical Society was present in the bookseller's shop at the time I made the inquiry there, I could obtain no information.

Perhaps "F.R.A.S." and some others of your readers could give me some useful hints as to the fixing up of a small observatory which I have in contemplation. I am purposing building a house, and it occurs to me that whilst I am about it I might as well have a small observatory built to it, from the roof, of course, entered from the inside of the house. Under such circumstances astronomy seems scarcely so frigid a recreation as when pursued out of doors.

What I want to know is a useful size and shape for a 4½ refractor, or perhaps a reflector of 8in.; how best to deal with the walls and roof, and of what they are best made, how much should be glass, how framed and glazed, and generally what to avoid? I take it that in such a telescope-house a refractor would be of better use to me than a reflector.

Many months ago a correspondent asked for information as to keeping microscopic life in aquaria, and great was my disappointment that his inquiry elicited no response. For years I have endeavoured to keep Microzoa, but without any really successful result. Polyzoa and Rotifera may be kept a month or two, but the end is the same — their disappearance and leaving the field, or rather the tank, in possession of Entomostraca, which thrive abundantly. In one bell-glass aquarium I had Melicerta swarmed, literally in thousands, growing from weeds from the surface of the water and the sides of the glass; all at once they disappeared, leaving no trace. A plan I tried this year seems to be answering at present. In April last I obtained, from a likely-looking pond, a quantity of Myriophyllum. I brought it home in a glass jar (one of those in which honey is sold, some 5in. high and 3in. in diameter). Last month I found it is Melicerta, well established, but not in profusion, and it seems to be doing pretty well. Beyond Melicerta, however, nothing seems to flourish but Entomostraca. There was no life visible on the Myriophyllum for some days after I had placed it in the bottle, and as the bottle lid has been kept tightly screwed down the rotiferon obviously must have been introduced in the shape of eggs. Looking at the animal so reared, one could not but wonder whence it obtained the beautiful colouring of the bricks forming its tube.

That there must be some method of keeping up the supply of the rotifers in a tank is obvious from Hudson and Gosse's "Rotifera." Several species there described as new were found by the authors in their own window tanks. Unfortunately, they give no details as to their rearing and feeding.

It is somewhat curious, that living in a midland county, I have found it much more easy to keep alive marine microscopic life. Polyzoa and Hydrozoa will live for months in a small glass jar, or even an ounce quinine bottle, kept closed. The three great requisites when collecting are, first to sternly resist every temptation to crowd the bottles, next to see that the water is absolutely pure and free from all contamination, and, lastly, that the vegetation upon which the animals have their habitat is healthy, growing, and not bruised. Two or three stems of seaweed upon which life is established form a most interesting subject for examination with the platyscope. The life is changing continually — one species giving place to another, but all of exquisite beauty.

Many of your musical readers will grieve to know that Victor Mustel, "the Palissy of music," is now no more. He died early in the year from an attack of inflammation of the lungs. At the age of 21 he was employed as a shipbuilder, and his principal possessions then were a wife and two children. His accordion getting out of order, he set to work to repair it for himself, and from that beginning, by very slow and painful steps, he ultimately rose to the high position in the world of musical art which he held at the time of his death. Life with him was a constant struggle with poverty, and not long before his death he wrote me that he feared he should be compelled to give up the manufacture of his instruments for want of sufficient sale. Times were bad, English trade was bad, and it was in England that he found by far his best market.

Happily the manufacture of his instruments will not cease. Judging from the magnificent specimens of his sons' workmanship, which I saw when last at Metzler's, it is obvious that V. Mustel's sons have inherited their father's artistic and musical capacities.

Their latest instrument, the organ and celesta combined, is a perfect specimen of musical and mechanical art. **Country Solicitor.**

## LARGE METEOR.

[31605.] — Last evening I witnessed a very splendid meteor about 7.15, when the sky was remarkably clear. It started about 1½° slightly to the east of Polaris, and became extinguished about midway between θ and 23 Urs. Maj. Its motion was slow, gliding steadily throughout its track, for about 15 seconds. The nucleus was as nearly as possible the size of Jupiter, and as brilliant. As soon as it disappeared I turned for sake of comparison, and my impression of size was confirmed when looking at that planet. It fell, leaving a beautiful trail of light, in length about the distance between the "Pointers." Its visible path was equally luminous from end to end, and about as bright and wide as the nucleus itself. The colour was slightly orange. The nucleus and, on either side for some distance therefrom, the path was edged with a fringe of colour of rather a rusty hue.

Southampton, Sept. 15. **S. S.**

## THE REFLECTING TELESCOPE— B 648.

[31606.]—It is not possible at the moment to say with certainty that the letter (31560), signed "A Friend of Tenebris," is written by the friend referred to in my account of "An Evening with a Reflector"; but fortunately this does not matter. If we *are* both referring to the same occasion, we should differ a little in our estimate of the atmospheric conditions. I felt hopeful of the night because it was, as I said, "still and promising," and though it is only at the eyepiece we can critically judge, from my experience, I should say a refractor-user would have found it a fair one, at least.

Let me thank M. Gaudibert for pointing out B 648 to us. We succeed with it nicely on a fine night, but make the distance twice Mr. Burnham's measure in 1878·5 (0·60). Mr. Linscott will deserve our gratitude if he succeeds in closing our tubes. I wish him all success. **Tenebris.**

[31607.] — When "Tenebris" (letter 31562) quotes me as saying "there are very few nights when a 4in. aperture will not give good star discs," I do not think he acts ingenuously when he interpolates the word "refractor." He thus imputes to me what I did not write. I meant what I wrote, that 4in. aperture will give good discs, &c. As he asks when could 80 or 100 to inch be used on a 4in. mirror, I will just say that I find 4in. mirror aperture will give me excellent disc on 95 per cent. of the nights stars are visible at all, and that powers of 80 and more to the inch can be used with fine results on such aperture on the very same percentage of nights.

As to the film being good, it has to deteriorate very much before it interferes with the power per inch; I have never seen any falling off in definition from dulling of the film. Mine has now been silvered 2½ years, and I have no intention of resilvering at present.

I certainly thought "Tenebris" was comparing very different-sized instruments; but I did not imagine a 2¼in. refractor was the chosen vessel for casting down reflecting telescopes. I think argument useless when statements of incapacity are founded on such dry bases: but, as I ask why it is unfair to compare the two, I should like to explain it is not unfair—it is simply useless. The reflector, *if in adjustment*, would leave a refractor so much smaller nowhere in the race. I will ask him to reverse the sizes: he will then find the mirror give neat images, and the refractor fail in producing star discs. No large instrument will so often give neat discs as a smaller one, simply because the air tremors are not collected from so large an area, nor magnified enough to be visible.

I imagine "T." has not mastered the adjustment of reflector, and only occasionally hits on an approach to it, or he would not so often find it disgust him. I have never felt any disgust, and can assure him that the last eight nights out I have easily seen δ Cygni double with 9in. mirror. I only once tried 6¼in. stop, and then the *comes* was touching the first diffraction ring. Would a 9in. refractor do any better? I will ask how often he can see *comes* to Polaris with 1½in. stop on his refractor? It is generally visible with that aperture on my mirror. I certainly fail to see why there should be any difficulty in measuring double stars with a reflector, and once put in adjustment it ought to remain so, if it has not to be carried about a great deal.

I have found reflectors often used carelessly. Once I found one with only half the mirror visible in flat; another time, one with a flat so thinly silvered that the reflection from back surface (which was polished) again penetrated silver, and gave a second image of everything. Also a flat in use on a 12½in., which reduced it to 9in., as flat was too small. Still another rested on an iron disc, ground to fit back of mirror, and here a drop of water had caused a little patch of rust and spoiled definition. "If the less cumbrous arm *would* do all the work of the other," says "Tenebris." There is much virtue in that "if." **H. E.**

## THE TELESCOPE.

[31608.]—I can understand how "R. W. B." got "complete disarrangement of the readings of his circles." An amateur has not the experience needed for good equatorial work, and seldom has the tools requisite. Equatorial tubes, whether they are for large or small telescopes, must be set in a good lathe, and have their bearings fixed on the tube and all turned out of the solid; thus the mechanical and optical centres agree. Yet, let this work be done ever so skilfully, there may be a slight change reading if the tube is revolved into opposite positions, but nothing to interfere with finding objects—certainly a "derangement," as "R. W. B." says, is impossible. I may tell him that the revolving eye end is not a good plan at all, seeing the plane changes position with respect to the mirror. The revolving tube is the proper way, and if the work is done well there can only be a very unimportant motion round the cradle—a known and constant quantity.

Miss Brown has informed me that she finds the base, and not the instrument, has altered. I am quite sure her declination cannot get out or alter through want of solid or true work in the stand or any part. I have often experience of the base altering, especially on clay soil; the ground does move with the changes of the weather and seasons. If the users of the reflector will reflect, they will see that if they allow the plane reflector to get out of its normal adjustment, it must alter the reading of both circles. If the flat is loose enough in its cell so it can shift slightly, they notice the position of an object in the finder and eyepiece is slightly changed, the reading of the circle (which ever is effected) will alter slightly also. The flat should not be set tight, and it should not shift when the cell is tapped with the finger when looking to its adjustment through the adjusting-piece, the insertion of a piece of paper will prevent it thus moving. Of course, the mirror must also have its screws up tight. The screws of the flat mount must be set up tight after the adjustments are made. These are the only ways Miss Brown's telescope can go out of adjustment.

To give an illustration, how necessary it is to see that the optical adjustments are secure, and how, if they are not, the readings of the circles alter.

I have just set up an 8½in. equatoreal for a gentleman who is about to retire from official life, and, wanting something as an occupation and "hobby," after due inquiry, was advised to have a reflector. He knew nothing about the reflector, his only instrument being a small refractor. After setting it up for him and explaining it, I left him to get it into equatorial adjustments. This he did very intelligently, without help. But presently I get a letter describing troubles. The "object was not always in the finder, and shifted so that finding was difficult." "The readings of the circles puzzled him by being so discordant among themselves." After failing to get things satisfactory, and on the verge of regretting his choice of telescope perhaps, wrote, "I'll not touch it till you come." I went to him, and, as the most likely place to find the cause of his trouble, went straight to the eye end of the telescope, and found he had been manipulating with the plane's adjustment, and had neglected to clamp the screws up firmly. I put this matter right, put it on a star; he went to his circles, and, to his satisfaction, the verniers read off the star's place as he had once got it to do.

The best way, when a constant and important use of the circles is made, is to turn the tube to the west side of the stand, with the eyepiece pointing east; the circles and driving-screws are all near and handy, rotate the tube as little as possible, or not at all, and the readings will be as constant almost as a transit instrument. **G. Calver.**

[31609.]—I am glad now to be able to think differently of the letter of "Tenebris." My thanks are due to him for his generous reference to my humble endeavours with regard to the progress of the telescope.

While regretting I should have had cause to suspect him of unfairness and bias, "Tenebris" must admit that his careless and partial letter was the cause of it. My feeling was that of nearly every one who have replied to him, including his "friend," for he manifested no care or regard about particulars and conditions such as constitute an open and fair investigation. As I pointed out some of these points, I need not repeat them; but I see now it was more for want of care on his part.

I think "Tenebris" will admit that, again that the discussion, to say the least, leaves the reflector in a very satisfactory position.

I am well acquainted with feeling in the "inner circle" and the trade jealousy against this popular telescope in some quarters; but so long as the reflector is honestly up to its pretensions, and tends to the advantage of amateur astronomers and the science made popular, one is perfectly justified in defending it against unfairness.

**G. Calver.**

## THE MECHANICAL PARADOX.

[31610.]—Referring to Mr. Hardie's "Paradox" (letter 31547, p. 35), it is easily explained when we remember that we must add the various turning effects operating on each wheel to obtain the actual result. Thus, independently of C (Fig., p. 35) one rotation of D causes A and B to make one rotation each in the same direction; and independently of D one rotation of C causes them each to make two revolutions but in opposite directions. Now the effect of the epicyclic arrangement is to impart these two turning effects simultaneously, and then adding them we see that one wheel must make three actual revolutions, and the other only one. In my opinion, the thoughtful application of Pro Goodeve's formula (given in my answer "W. E. H."), effectually clears any doubt fro the question. The investigation involves t applications of the equation. First disregard der C as first wheel and B as last, the the train being 2. This determines the ›f rotations of B. Then regarding B as ıl and A as last, the value of the train ., the second application determines the ›f rotations of A.

.clined to think that there was a malicious in the eye of Mr. "Theorem" as he . query No. 72265 (geometrical demonstra- › the custody of Her Majesty's post-office, required solution is forthcoming it solves ıs question of trisecting an angle. I have ıderstood it to be an established theorem ə is no geometrical construction for trisect- gle, though I have never seen the demon- If this is so, the theorem propounded untrue, and it would be exceedingly .g if someone would demonstrate, and at time show, the amount of the error. It me that it must be a very near approxima-

**A. J. W.**

.]—Suppose $r$ = radius of small circles. one rev. of link D, centre of B travels ıtre of A travel $6\pi r$. Now a wheel of rad. l on a straight line for a distance of $2\pi r$ volve once; and if rolled for a distance of uld revolve three times. If we bend our line into a circle, it will from the rim C, from the respective centres, still travel the :ances, $2\pi r$ and $6\pi r$, the number of revs. ain unaltered, viz., once for B and three A. As A and B turn in opposite directions ırence to each other, they turn four times. .so true in first case cited by Mr. Hardie, urns twice, but in opposite directions.

**W. E. H.**

.]—The solving of this problem is very Assuming the radii to be C = 60, and A or then from centre of C to centre of A will $\frac{0}{2}$ = 45, and 45 ÷ 15 (= radius of A or B) lutions. Or, in other words, the centre of nove around B at a velocity three times han centre B, the two being connected by equal to 3 radii of A.—Q. E. D.

**Mechanicus Redivivus.**

## SAP IN TREES.

.]—The evidence that water will rise in ' capillary action, is that trees contain s extremely fine tubes in which water se to a great height owing to their fineness. r to prepare fine glass tubes (by softening of ordinary tube in a flame and rapidly the two halves apart), in which water will :he height of 2ft. or more. (See Stewart 's "Practical Physics," Vol. I.) In the e flame does not draw up the oil, but it from the top of the wick, when the oil capillary action to take the place of that ıs been removed. With regard to osmosis, te number of membranes would not *prevent* l rising, but would *impede* it.

ps Mr. Reeves would inform me what kind · there is at the root, as he says that it is d.

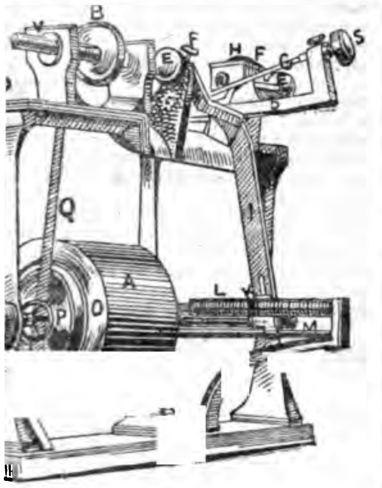
**W. H. S.**

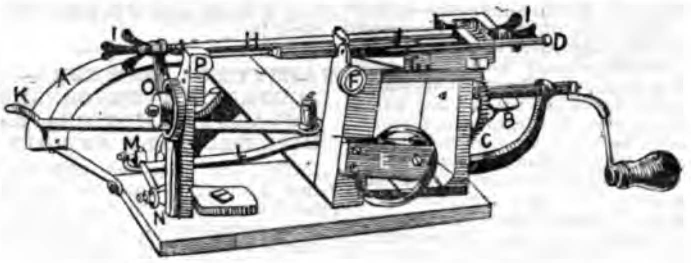
## LATHE MATTERS.

.]—I send you photographs and descrip- wo small lathes, hoping some reader will be tell me the use of them. Fig. 1 A is a wheel with band running to B, which . the bearing, V; E E is two centres hold- cking frame, D, carrying a cutter spindle; another pulley wheel carrying a hollow ; N is a spindle working on centres, and, t, had a wheel on it; O is a brass plate, with pulley, P, working together with A; lever Q binds O to A, and when out, as in picture, revolves without A. It is a splendid made machine, and it came to me with a stock of die sinker's tools.

Fig. 2 is another. A division plate, A, extending to B; C is a cog-wheel driven by handle gearing into two small cogs driving the spindles, H, and D E is a wheel with a spring, with a cord running over F to G, pulling D down to P. H works in the centre, I I, and carries a cutter; K is a pointer fitting in holes of plate A and moves O, and so moves H through M and N. The plate A has 150 holes, and only moves H ⅜in. if pushed right round. I should like "F. A. M's" opinion of them.

**Frank.**





## DRILL SPINDLE.

[31615.]—Many must, I am sure, have been greatly benefited by the very admirable papers recently given us in these columns upon tool-making. I have read them with very much interest, and not without gaining some valuable instruction. In the last paper upon the "Drill Spindle" there are two or three wrinkles I should like explained, if not too much to ask of the writer. 1. In heating the spindle for hardening, it is suspended by wire over the fire; is this an ordinary smith's fire?—if so, how does he heat the ends sufficient to harden without the middle hardening also? 2. When the spindle is hardened and fitted in the collars, how is the nose trued up? 3. After hardening, how is the hole for drills rebored? If the writer will furnish us with these wrinkles—for wrinkles they are, no doubt—personally I should be very grateful. I believe there is more in the treatment of steel from the centring to the hardening than perhaps some would be inclined to believe. **W. P. W.**

## MOTOR FOR CYCLE.

[31616.]—I have read with great interest the various ideas with reference to this subject, and should, therefore, like to add my opinion to some of them. Mineral oil engines would not, I think, be very pleasant company on a country road, because of the "burnt mutton-chop" odour that usually hangs like a halo around them.

Small steam-engines are also out of the question, because of the tremendous attention which they would require. With regard to letter 31545, which proposes to get forward motion from a fearful and wonderful system of springs and connecting rods, placed under the saddle, I fail to see how it is to be done. Perhaps the writer has in his mind a kind of Dutch roll as performed on the ice.

May I point out to Mr. W. T. Pierce, 31542, that with the ordinary crank there is most leverage when the leg is well bent, namely, when the crank begins to come down, and as it nears its lowest point, and when, according to him, the leg is exerting its greatest power, because nearly straight, you get the greatest forward motion of the machine by the least downward motion of the foot. How would it answer to have an electric motor, that could be run as a dynamo, using it with storage batteries? The wasted power in going down-hill might be utilised in charging the batteries, by the electric machine acting as a dynamo. The force stored might aid one up the next hill by running the dynamo as a motor. But in all probability this would add so much to the weight of the cycle that you would require a traction engine to draw it along the level ground.

**Bogleboski.**

[31617.]—I was very glad to see "A. B. C.'s" letter (No. 31582) this week; it contains more common sense than several we have had on this subject lately.

If an interchange of ideas of a steam-driven cycle is made between engineers, something will soon be done.

"A. B. C.'s" engine seems to me to be just the thing required. With all deference to him, I would suggest that the boiler be of a sufficient size to run for a considerable time without feeding, which I think would be best performed by an injector, as a feed-pump on the engine would be a nuisance.

A rather knotty point is the getting rid of the exhaust steam. Condensing is, I fancy, out of the question. It therefore must be either admitted into the atmosphere direct, or sent through the feed tank. This latter course will probably find most favour.

The exhaust pipe might be led through the feed tank down to within an inch or two of the ground, and the nozzle turned in such a direction as to direct the steam at a slight angle on to the ground; assuming that the steam was expanded well in the l.p. cylinder, there would not be much steam remaining after it issued from the pipe. Certainly there would not be enough to constitute a nuisance. The fire should not give any trouble if, as "A. B. C." suggests, oil is used.

In this case a constant supply could be turned on from a reservoir to the lamp, and a very slight adjustment occasionally would keep the pressure regular. I hope "A. B. C." will give us more particulars of his engine, and also that someone may be found who is in a position to put the thing into practice, as I am persuaded that a trial is only necessary to lead to some useful result. With reference to the boiler advocated by "Ulsterman" (No. 31584), I think if he were to make experiments, he would find that this style of steam generator is not suitable for a cycle. It requires a tremendous amount of attention to keep the steam pressure anything like regular, and we want a boiler that requires the minimum of attention. "Beasley's" idea (No. 31579) is rather rich. Does he not see that it would be much more economical of power to apply his power direct on to the cycle without interposing a compressed-air motor?

This is, I take it, what he means. The compressed-air apparatus would create no power but probably waste 25 per cent. of it. **J. H. H.**

[31618.]—I am rather surprised, as will be many of "Ours," to find such ideas coming from an old hand like "Jack of All Trades," in letter 31544, especially after we have had such an authority as "Petrotryke" on this matter, who, I am sure, has been *sat on*, and that with a vengeance.

"Jack" begins by saying other correspondents are dull or going dotty, simply because their ideas differ from his and that of his colleague "Petrotryke." What a pity that he and "Tryke" are not brothers! Had this been so, our steam-engine would no longer be a disgrace to us. But how does he propose to remedy the matter? I think it is akin to the novel engine we had a week or two ago. How does he come at the conclusion that half of the power is wasted in a cylinder with only one piston? He says, for instance, "you put steam into it at one end at so much pressure per square inch, and the piston recedes. Is not the same pressure upon the cylinder cover?" Decidedly so. True, but take off cover, and then what? or, as he says, put in two pistons, and then you get exactly (practically) the *same work* as one piston for a given quantity of steam. Make the cylinder with one piston larger or a greater length of stroke, and you may gain; but do not forget you must use proportionately more steam, the same as pulling in two or more pistons. The illustration of the wedge is simply a division of the power of the wedge if both sides are movable; but make one side fast, and then you get the whole force on the loose side. The same thing applies in the cylinders with one or more pistons. Some of "ours" may see into "Jack's" theory with half an eye, but I much doubt some seeing it with two whole eyes.

We have had a good deal of talk about motors for cycles without any real advantages being shown. But, if I may venture, I will make a suggestion. Why not use compressed air as a propelling power, which could be collected when descending steep gradients instead of applying the brake to destroy this power. The machine frame could be utilised as an air-chamber, or, if fitted to ordinary machines, a small steel chamber would answer the purpose with cylinder, &c. Will "Nun. Dor." or some of our able correspondents give an opinion, and I will write further. **G. G.**

## CYCLE CONSTRUCTION.

[31619.]—W. Timbrell Pierce's elliptical chain-wheel (31542) is not by any means a new idea. A Mr. Holloway, of Westminster Bridge-road—then maker of "Dart" cycles—exhibited a tricycle at the 1887 Stanley Cycle Show, held at the Aquarium, fitted with two equal elliptical chain-wheels; but the reason why we hear nothing of the idea now, no doubt, is because the wheels being equal—as they must be—the minor axis of one with the major axis of the other being uppermost at the same time, and vice versâ, to run properly would mean level gearing, and this, with even wheels of 48in. diam., as was the popular size in 1887 for tricycles, would be found far too slow a speed. Then, again, the chain would have to be taut, causing friction and hard running. I believe Mr. Holloway did patent this idea, as also other new ideas shown at the same time, his spring crank giving a long downward stroke a maximum of power, with a short upward stroke giving a minimum of muscular exertion, and also his central hub driving arrangement—all shown at the same time. As to this Tunbridge gentleman—looking in my *C. T. C. Gazette*, I see a copy of his letter, and he is an old and practised rider—which would mean he has acquired the knack of always keeping the top half of his chain taut with even pedalling—a great thing for the cyclist—and that he is of the ripe old age of 79 years, and I should suppose would not be now in the habit of riding very fast, for with the crank chain-wheel elliptical, and the axle-wheel round, with an uneven pedaller and a fast rider, or climbing a steep gradiant, the poor chain would get a straining that would soon mean death to it. I always look with pleasure on the grey-headed cycling veteran, and hope the Tunbridge gentleman referred to finds much advantage from his elliptical chain wheel; but it will not do for the "scorching" contingent. **F. A. Venning.**

## MOTORS FOR CYCLES, AND CYCLE CONSTRUCTION.

[31620.]—I have read with interest the correspondence presently going on on the above subject. I do not say that it would be a difficult matter to fit a steam-engine—for the steam-engine seems to be the favourite—upon three wheels with a saddle conveniently placed for the "stoker"; but you would then have to call such a machine by its right name—viz., a locomotive, and not nickname it a "tricycle," for it occurs to me that there would not be much of the present graceful appearance of the tricycle left when thus fitted up. Then these machines would require an Act of Parliament all to themselves before they could be used, and there would be great risk connected with them, arising from the inexperience of hundreds of cyclists in the management of steam-engines. W. Timbrell Pierce, in letter 31512, p. 35, suggests the use of elliptical wheels as an improvement in the construction of cycles. By the use of one elliptical wheel on the crank-axle only, the pitch chain would be very unequally taut at different points in a single revolution. By the use of two elliptical wheels placed as W. Timbrell Pierce proposes, this unequal tautness would be obviated, but they would cause a very unequal and unsteady motion in the cranks. There is another objection to their adoption, and that is that they require to be of equal size, thereby making it impossible to "gear up," consequently "W. T. P." would have to go back to the old high wheels before he could get speed. It is this gearing-up which makes cycles difficult to drive, especially when going up the hill. For this reason I would also like to make a suggestion, which, if adopted, would I think make hill-climbing much easier. I have already said that it is this high gearing-up which makes cycles difficult to drive; but by the addition of a second and slower speed, hill-climbing would then be less difficult. There would be two pairs of pitch-chain wheels, and two pitch chains. The wheels on the crank axle would require to be kept within the bearings, and run loose on the axle. Those on the hubs of the cycle-wheel would be keyed on firmly. A small clutch would be placed on the crank-axle between the wheels which could be turned to any side the cyclist wished by means of a lever, which, in the case of tricycles, could be placed in any position, but in the case of safeties it would stand vertically alongside the seat support, and be held in position at the top by means of a spring and suitable notches.

The cyclist would use the quick speed while running on the level. When he came to the foot of a hill he would change the cycle to the slow speed, and he would be enabled to climb the hill easily. In the case of tricycles, there would be no difficulty in changing the speed; but, in that of safeties, it would require a little practice to enable the cyclist to do it without dismounting.

There is one difficulty, however, in the adoption of two speeds, and that is the unequal wearing of the two pitch chains, thereby causing one to hang slacker than the other. This could be obviated by making the chains exchangeable. By using pitch chains, wheels of such proportions as to necessitate chains of equal length and pitch, and making one link in each chain easily opened, they could be exchanged in a few minutes. This would not require to be done often, only when one began to hang a little slacker than the other. In this way, I think, they could be kept pretty equal in tension. I shall be pleased to see the opinion of cyclists on this suggestion. Perhaps "Nun. Nor." will be giving it rough usage if he takes it in hand.

Sept. 10. **W. G J.**

## NASMYTH'S HAMMER — CUGNOT'S LOCOMOTIVE—THE CONSERVATOIRE DES ARTS ET METIERS, &c.—DENT'S DIPLEIDOSCOPE, AND ITS USE.

[31621.]—In connection with the reference to James Nasmyth, in letter No. 31558, p. 55, I may refer to an article in the Paris *Figaro* of 16th July, on the invention of the steam hammer. The article is too long to give *in extenso*, but the gist of it is this: That the inventor was the French engineer, François Bourdon, who died in 1865, and who in 1839 first thought of attaching directly to the piston of a steam cylinder a mass of iron to serve as a forge-hammer. That Bourdon then submitted a model to several engineers, including Mr. Bonting, the Engineer-in-Chief of the P.L.M. Railway, who published an account of it. That in 1840 the hammer was constructed, having a lift (or "fall") of 2 mètres, and a weight of 2,500 kilos, and was patented by Schneider, of Creusot, 30th September, 1841. That it was not till 1842, and after he had seen this hammer at work, that Nasmyth constructed his own.

I give the facts and dates as stated, and should like to know what credit is to be given to the statements made by the *Figaro*. Some little time ago it was mentioned in the "E. M." that Cugnot's original locomotive was in one of the Paris Museums, so I went in search of it, trying first the Museum of Cluny, and then that of the Arts et Métiers. At last I found, not the locomotive itself, but a small and quite modern model of it in one of the cases in the latter museum. The model, of course, had but little interest, but the collection amidst which it occurs is worth a long journey to see.

The innumerable specimens of mechanism, machinery, and models are enough to send a mechanic into fits, they are so fascinating and so exquisitely constructed, and I may add so conveniently arranged and displayed. I noticed especially the copying lathes, if I may so term them, and their various "derivatives" and varieties. Many of the machines invented by Vaucanson are also there, but I cannot attempt to mention even a fraction of what I saw. There was a fine reflecting telescope (in apparently excellent preservation) by Short, and a few refractors also. If any reader of this is tempted to visit the museum, I am sure he will thank me for having urged him to do so, especially if he is an "English Mechanic."

I wish some possessors of a Dent's dipleidoscope would kindly tell me whether they can use it? Theoretically one should see two reflections of the sun, which gradually approach each other and coincide as one disc at mid-day. Practically I see *three* suns all in a row, which never coincide at all; but end in an indistinguishable glare of light of no particular shape. I, of course, use smoked glass to look through. I have Dent's pamphlet, but this does not help me. The instrument, I believe, is no longer on sale. **A. S. L.**

## BEE-STING AS A POISON AND AS A MEDICINE — MEDICAL ABBREVIATIONS.

[31622.]—I believe that bee-poison is chiefly formic acid, which would be neutralised by the sodium carbonate in the saliva. Dilute formic acid, say 2 per cent., may be used instead of vinegar.

Why do not the medical profession use the proper chemical symbols, instead of such unintelligible contractions as hyd., calc., &c.? **W. H. S.**

**Coca in Bolivia.**—The cultivation of *Erythroxylon Coca*, as carried on in Bolivia in the present day, does not appear to differ from that which prevailed previous to the conquest; and the province of Yungas de las Paz is that which, since the Spanish occupation, seems to have supported the most considerable plantations. All the slopes of the mountains, below an elevation of 7,000ft., are literally covered with them, and the traveller has continually in view the factories, or *haciendas*, where the leaf is prepared. The first gathering which takes place in a coca plantation is at the expense of only the lower leaves of the shrubs, and it is therefore called *quita calzon* (*quita*, to be rid of, and *calzon*, pantaloon). The leaves of this gathering are larger and more coriaceous than those of subsequent collections, and also have less flavour. They are mostly consumed on the spot. All the other gatherings go by the name of *mitas*, and take place three times, or, exceptionally, four times per annum. The most abundant harvest is that occurring in March, that is, immediately after the rains; this is the *mita de marzo*. The most scanty is that which takes place at the end of June or beginning of July, and which is called *mita de San Juan*. The third named *mita de Santos*, is made in October or November.

# REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the titl and number of the query asked.*

[71439.]—**Aniline Colours.**—Certainly, I know how to analyse colours, but to ask me to write a complete scheme is too large an order. I do not remember the question, but there are many chemical questions asked in this paper that are not worth answering, as the querists are ignorant of the first principles of the science. Sm.

[71729.]—**Bourdon Gauge.**—The tubes for these are made of a special brass. I have heard it called by several names, as lateen or Latimer brass, tipping, clogging brass, stencil brass, and native brass—the latter from its being originally made from the native blend of copper and zinc lapis-lazuli. It is of a steely nature, and will stand brazing, and fire will not render it so soft as ordinary brass. In the olden times, when umbrellas were made of whalebone, this used to be clipped around the material where the shoulder joints came, to hold the pins for the same fork-end, and keep the ribs from splitting. It was used for welts to take the nails that the fronts and heels was nailed on to in French and other clogs; and, silvered, was used for stencil plates. It was used very much for the barrel of the Swiss toy drums for children, and I had a quantity by me for years that I had given to me by a toy dealer—some old, damaged stock. To know the size tube you require for such a job, we must know the size hoop. If the ordinary size, about 6in. in diameter, then a ⅜in. tube of metal 25 B.W. gauge, brazed neatly with silver solder, filled with pitch, and passed through rollers and flattened, so that the hole is reduced to ⅛in. wide. Bend into shape, then melt the pitch out; but before you melt the pitch out, well burnish it, and do not over-heat it. To extract the pitch, drop in hot water. A little tallow with the pitch will toughen it, and you must not attempt to bend cold. The best for high pressures are made with 2, 3, 4 tubes, one inside the other, not a tight fit, and a solution of indiarubber in mineral naphtha is put between them. I was not aware that Schaffer, of Budenberg, made bourdons. His was a steel corrugated diaphragm, faced with tin-foil, with a solution of rubber between. Steel hoops will not do. Jack of All Trades.

[71902.]—**Centrifugal Pumps.**—A trial of some of Messrs. J. and H. Gwynne's centrifugal pumps is described on p. 389, Vol. XX., *Mechanical World*. The indicated horse-power was from 1·8 to 5·62 times the W.H.P. (or theoretical power due to water lifted). A diagram is given on p. 30, Vol. XLV., *Engineering*, which shows at the be efficiency 1H.P. = 1·61 times W.H.P. Another on p. 130, Vol. XLII., *Engineering*, shows 1H.P = 1·4 times W.H.P. at best efficiency. Glatton.

[71929.]—**Oil and Gas Engines.**—A petroleum engine made by Messrs. Hartly, Arnoux, and Fanning, of Stoke-upon-Trent, is stated on p. 49, Vol. III., *Practical Engineer*, to have developed over three brake H.P. at a rate of ·166 gallon petroleum per brake H.P. per hour, and ·125 gallon per indicated H.P. per hour. Specific gravity of the oil ·821; average pressure over 50lb. per sq. in. The Priestman engine on p. 561 of the same volume is stated by its makers to use 1·2 pint (or say ·15 gallon) per brake H.P. per hour. An engine driven by compressed air carburetted by petroleum is mentioned on p. 469, Vol. XX., *Mechanical World*. Consumption is given as 1lb. per H.P. per hour for small engines, and ½lb. for large ones. It is (or was) made by Messrs. Wright and Charlton, Barnsley. On p. 746, Vol. XLIX., *Engineering*, trials of petroleum engines give 1·21b. petroleum per brake H.P. per hour; with a Priestman engine developing 4·6 brake H.P. At ½-power the same engine required 1·98lb. per brake H.P. per hour. Brown and May's engine developed ·98 brake H.P. and used 2·9lb. oil per brake H.P. per hour in addition to 2·7oz. for the igniting lamp. 14oz. should be deducted for oil left at end of trial. This last result is very loosely expressed, and I think it must mean that, allowing for everything, the consumption was 2·46lb. per brake H.P. per hour. Thus:—Trial lasted 1·666 hour,

$$1\cdot666 \times \cdot98 \times 2\cdot9 = 4\cdot73\text{lb.}$$

Add for igniting purposes.. ·169

4·899

Deduct 14oz. at end of trial.. ·875

4·024lb. used by engin

$$\frac{4\cdot024}{\cdot98 \times 1\cdot666} = 2\cdot46 \text{ per brake H.P. per hour.}$$

Glatton.

[71989.]—**Slag.**—The "L. D." seems to ignorant of the fact that in Hyd. cum Cret, the ch is to bring the mercury into a fine state of divisi

Sm.

]—**Clock- Wheels** .(U.Q.)—I should mateur Clocky," if making an eight-day consult "Britten's Watch and Clock- andbook," where I think he will find all on he requires. The number of teeth in directly proportional to their diameter, and is easily calculated if diameter is given. impossible to give diameters, pitch, or teeth without knowing size of frame, pendulum, and distance (if driven by he weight has to fall. Lantern pinions special dividing machine for drilling, but ave the pinions made solid by a pinion- suit the wheels? If "A. C." will adver- ldress, or ask again, I shall be pleased to ight. DANOIS.

]—**Chain-Mail Cloth** (U.Q.)—"A. J." several suits of chain mail at the Military n, Chelsea, and most gunsmiths in London squares of chain-mail cloth as burnishers ets, &c. B. HARCOURT.

]—**Gas Furnace.**—If "Improver" the back volumes, why does he not send r and Co., Warrington, for a catalogue leas from that? The question really is of s furnace to be made, and does he mean ants to heat a crucible, or what does he a furnace 2½ft. square? Is that on plan it mean cubed? Another thing "Im- will have to attend to, and that is the " of the gas, for some is capable of giving ; units than other district makes, and he ay where he is located. S.

]—**Ornamental Ironwork.**—The best al ironwork is hammered out by the smith il, but parts may be cast. The iron is hot, so how can it be worked on a "pitch There are several tools used, but the is the hammer, and most important is the uses the hammer. Ornamental ironwork well—that is, if wrought work is meant a large amount of practice, and the very f the pitch block betrays a lot. T. M.

]—**Stain for Pine.**—I should think that vith permanganate of potash or bichro- otash would suit: but it will be necessary p the oil with hot solution of soda first. nate gives a nice brown tint to most bichromate, after exposure to the light, eper tint. Can be varnished afterwards. give this as a suggestion, as I have not auri, which is rather a resinous wood. NUN. DOR.

]—**Dyeing Leather - Work.**—Leather ed with the anilines; but the old-fashioned reen was to pass the skins through Saxon subsequently through a decoction of roots. In the case suggested by the should try the aniline greens. NUN. DOR.

]—**Beef.**—Sweat is not dew produced by of the body acting upon the colder air uld not produce dew); but is a secretion eat glands. See Huxley's "Elementary y," p. 119. W. H. S.

]—**Kauri Gum.**—In New Zealand a ed "Jockey Club" is used to mend s of gum. Chloroform is a most active nd it penetrates so deep as to make the . Boatmen mix kauri-gum dust with and apply it hot with a brush to boat I have before asked in the "E.M." for n as to what is commercially used in this nd America, and shall still be glad of the n. Can some one tell us what is the nciple in Jockey Club scent that dissolves n? Alcohol, oil, &c., will not dissolve it. akes it show cracks on the surface. T. F. S. T.

—**Phonograph.**—The recorder is a very ge, the reproducer is a fine needle with a e end the same size as the gouge. W. H. S.

— **Electric Bell and Battery.**— cells give off such a small quantity of do not think 50 in a bedroom would be . W. H. S.

—**Tobin's Tubes.**—These supply fresh atically, but only act as inlets, and do not the vitiated air, which must be done by a rotary cowl, or ventilating gas-lamp, which, when used in conjunction in's tubes, always insures a constant fresh air circulating through the apart- LEVER.

— **Razors.**—If the querist is really f making himself thoroughly acquainted ethod of sharpening razors, he had better utler and receive instructions under his ; otherwise, if he goes trying a razor on will be apt to take the edge off it. The ical course generally available is to have op and a small bottle containing a mix- mphor dissolved in spirit of turpentine, to be applied to the strop from time to time as it becomes impaired. This same mixture applied to files and drills will make them cut glass with facility. W. C.

[72192.]—**Clock-Mending.**—Mr. Garrard's answer is quite right, but I think the "Amateur Clocky" will better be able to do the calculation after the following method: The intermediate wheel uses 24 teeth to drive the minute hand round once. Hence—

$$\frac{24 \times 63 \times 56 \times 2 \times 30}{7 \times 7 \times 8} = 12{,}960 \text{ vibrations}$$

per hour. By converting it, this number of vibrations will be too slow. We must have about 18,000 vibrations. We will suppose the new escape-pinion we intend to use to be 6 and wheel 15 teeth.

$$\therefore \frac{24 \times 63 \times 56 \times x \times 15 \times 2}{7 \times 7 \times 8 \times 6} = 18{,}000.$$

$$\text{Hence—} \quad \frac{18{,}000 \times 7 \times 7\ 8 \times 6}{24 \times 63 \times 56 \times 15 \times 2} = 17 \text{ teeth.}$$

However, 17 teeth is a rather awkward number of teeth to use in a wheel as driver, so I should propose to double teeth in wheel, and also in pinion.

$$\therefore \frac{24 \times 63 \times 56 \times 34 \times 15 \times 2}{7 \times 7 \times 8 \times 12} = 18{,}360 \text{ vibra-}$$

tions per hour. DANOIS.

[72192.]—**Clock-Mending.**—I see by the train that you had better retain the old escape-pinion, unless you are equal to mounting the new escape-wheel upside-down, and re-colleting the cylinder. But the wheel you must use will, I am afraid, be inconveniently small, as it must have only 25 teeth with an escape-pinion of 9, and its diameter must consequently be only a trifle over two and a half times that of the pinion. You must, however, use a large pinion. If you can mount your escapement upside-down, you had better do away with the old escape-pinion and replace the next wheel by one of 120 teeth working into a 'scape-pinion of six. This will require a weak hairspring—an advantage with a large balance. The diameter of wheel in this case will have to be barely 20 times that of pinion, and you must use a small pinion. The method of calculating is simple. If you use an 18,000 train, as is usual (i.e., 18,000 ticks per hour or five per second), then the product of all the drivers, starting at the centre wheel, divided by the product of all the followers, and multiplied by twice the number of teeth in the escape-wheel, must be equal to 18,000. Thus, in the first case (I see you rightly recognise that the wheel driving the centre wheel and pinion of 8 is an idle wheel in this calculation):—

$$\frac{24 \times 63 \times 56 \times 25}{8 \times 7 \times 7 \times 9} \times (15 \times 2) = 18{,}000.$$

And in the second case, where you will see I have suggested a 16,200 train, i.e., 4½ ticks per second—

$$\frac{24 \times 63 \times 120}{8 \times 7 \times 6} \times (15 \times 2) = 16{,}200.$$

A. J. W.

[72212.]—**Scroll Chucks.**—I have tried several of the small ones, and find Cushman's "Jeweller's Chuck," at 20s., exquisitely true, and it grips well. The chuck must be fitted perfectly true and steady on spindle nose, as the least eccentricity quite spoils its value. I fitted a steel nose-piece on lathe spindle, turned it taper to fit chuck, leaving a flange, through which three steel screws pass, the points entering the outer ring of the shank of the chuck. The flange bears well against collar of spindle. T. F. S. T.

[72223.]—**Solution for Cleaning Brass.**—I suppose it is a solution of oxalic acid you are hunting for. But if you want to know the way to clean and polish brass, here it is:—Take a piece of flannel about 9in. square and damp it with paraffin oil. Now dust it well over with very fine Bath brick made by rubbing the brick with No. 0 emery cloth. Rub your brass with this, and clean off with a piece of cotton waste, finishing with a second piece, which should be clean and dry. The above gives a brilliant polish to engine and other exposed brasses, and is retained for a respectable period. R. McLAREN.

[72233.]—**Tisane**—"aux quatre fleurs" is an infusion of the following seven dried flowers:—Mauve (Malva sylvestris), Guimauve (Althææ officinalis), Coquelicot (Papaver rheas), Violetta (Viola odorata), Tussilago (Tussilago farfara), Pied de Chat (Gnaphalium dioicum), and Bouillon blanc (Verbascum thapsus).

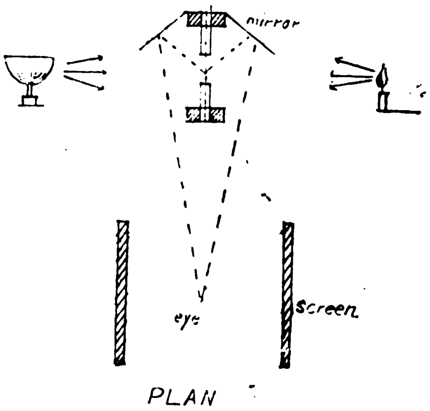
Paris. NO SIG.

[72233.]—**Tisane.**—I am sorry I cannot give you the English for "Pied de Chat" (not "Patte de Chat," as you have it), but the botanical name is Gnaphalium dioicum, L. This tisane is the one known as "Tissane aux Quatre fleurs," and is used for stilling coughs and in chest complaints. The recipe I gave you is from the "Formulaire Magistral." Another before me omits the three latter ingredients. There is no Tisane aux quatre herbes, but the above is often popularly so called. If it will do you any good, you may reckon this answer as "coming from the other side of the Channel," as the writer is a member of the Faculty of Medicine of the University of Paris.

Plymouth. B.Sc.

[72233.]—**Tisane.**—"Patte de Chat" is the "Antennaria dioica" of Hooker in the "Student's Flora," the Gnaphalium diojcum of others, and Englished "Mountain Cudweed" or cat's paw. SOLANUM.

[72243.]—**Candle Power.**—I think the querist will find the following form of photometer, due to Dr. Letheby, the most useful:—Three equal circular discs of fine tissue paper are cut, say, from 3in. to 4in. in diam. Two of these have each a small circular hole (¾in. to ½in. diam.) cut concentric with the edge. The three discs are pasted together, the perforated ones being on the outside. They are mounted in a frame, and used in a similar manner to the grease-spot photometer—viz., the distances of the lights on either side of the disc are adjusted until the thin central portion looks neither brighter nor darker than the remainder of the disc. It is a great advantage to be able to see both sides of the disc at once, and for this purpose two slips of ordinary looking-glass are placed at an angle of 45° to disc; the observer on looking into these with the edge of the disc presented to him, will see by reflection both sides of disc at once. Perhaps the accompanying sketch will make this clearer. The screens are to protect the eyes from the glare of the lights. S. S. R.



[72250.]—**Calculating Brake H.P.**—You must run the wheel so that the friction between it and the strap supports part of the weight. Then the difference in pounds between the weight and that recorded by the spring balance measures the friction in force-pounds. This result multiplied by the lineal velocity of the rim of wheel then gives the work in foot-pounds. Therefore—

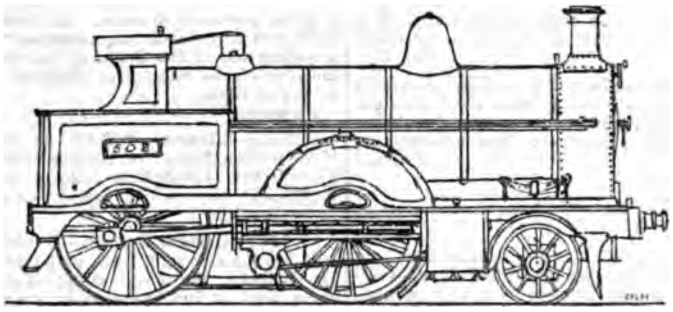
$$\text{H.P.} = \frac{(P - p) \times N \times \pi d}{33000}$$

Where $P$ = weight in pounds.
$p$ = weight in pounds registered by spring balance.
$N$ = number of revolutions of flywheel per minute.
$d$ = diameter of flywheel in feet.
$\pi = \frac{22}{7}$ approximately. A. W. J.

[72259.]—**Viol d'Amour.**—I am unable at present to give the details for which "Caldemone" asks, but will endeavour to do so at an early date. My knowledge of the instrument is limited to what I have read of it. The statement that the metal strings passed under the neck is from Berlioz. Others say, and I imagine more correctly, that they were under the finger-plate. I hope to be able shortly to obtain more precise information as to the construction of the instrument. C. J. TAHOURDIN.

[72263.]—**Japanned Wire.**—Cannot the querist dip the wires in the japan instead of using the brush, which leaves the wires "streaky"? It must be understood that the wire must be thoroughly clean—not necessarily what is understood by "chemically clean," but "clean" in the ordinary sense. The japan will coat it regularly enough then. Perhaps his "japan" is not properly prepared. He can find the required information in back numbers, or he can dissolve asphaltum in turps, and dip his wires in that: a few experiments will teach him more than a page of writing. SELIM.

[72265.] — **Geometrical Demonstration.**— This theorem is only approximate. DB is not exactly equal to DH; if it were, by a reversal of the process, we would have an easy way of trisecting any angle exactly by ruler and compass only—an impossible feat. L.



[72269.]—**Donkey Pump.**—I send a small sketch of No. 503 "Dreadnought," L. and N.W.R.
C. F. DENDY MARSHALL.

[72268.]—**Turning Spirals in Wood.**—If you have no spiral lathe, you must set it out in the following way:—First, turn wood plain and true in a common lathe; now divide circumference by 3; then run the three lines from end to end. Set compass 2in., 3in., or 4in. apart, according to what pitch you want your spiral. Now draw a line from first point of compass to second point on second line, from second point to third point on third line, and so on to end. The more you divide the more strands you get. What you can see through is cut in deeper. BATHO.

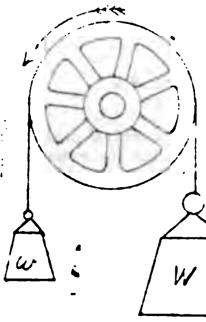
[72270.]—**Calculating Brake Horse-Power.**—If a belt be hung over the pulley or fly-wheel with unequal weights on the ends (the greater weight acting against the direction of motion) (see sketch), the required weight will be found after a few trials, and must be adjusted until they take up a position of equilibrum, when the correct speed of the engine is attained. Then the difference of the weights × the circumferential velocity in feet per minute ÷ 33,000 = brake H.P.,
or—

$$\frac{(W - w)\,v}{33000} = \text{Brake H.P.}$$

where $W$ = large weight,
$w$ = small „
$v$ = circumferential velocity ft. per minute,
or—

$$\frac{(W - w)\,\pi\,d\,n}{33000} = \text{Brake H.P.}$$

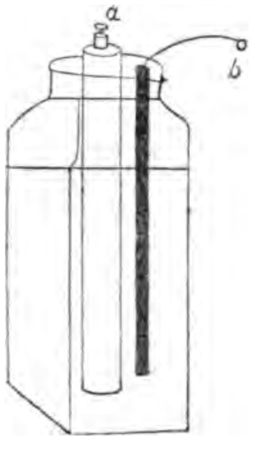
where $W$ = large weight.
$w$ = small „
$n$ = Number revs. per minute.
$d$ = diameter of pulley in feet.
$\pi$ = 3·14159. HALF AN EYE.



[72271.]—**Tempering Drills.**—Look here, Mr. "Amateur," you will never learn the art of tempering from questions and answers in such a paper as the ENGLISH MECHANIC even. You must practise. Heat your tools to a dull red, as it appears in the dark, quench in water or oil, and then draw down the colour by heating again on a slab of hot iron until you get the required tint (you do not say what the tools are for), and when you get that quench at once in water. For many purposes drills would be tempered "blue," but what is known as "straw" colour would be preferred for others. Look up your back numbers. R.

[72275.]—**Photo-Micrography.**—An ordinary objective may be used, but an apochromatic one and a projection eyepiece would be better if you had not a limited purse. An achromatic condenser is necessary, and if you use limelight, direct sunlight, or any powerful illuminant, it would be best to absorb the red and yellow rays with a cell containing sulphate of copper and ammonia in excess. If you use a cover-glass the liquid will be held by capillary attraction. W. H. S.

[72276.]—**Battery Life.**—So long as your battery has a liquid in it, it ought to work. When the liquid has evaporated, take out A and B from C, and wash each three (i.e., A, B, C) in warm water. After doing this, dissolve a ¼lb. of salamoniac in half a pint of water for each battery, which will cost (at retail price) 2d. per element. Presuming this done, perform as follows: Put A B back into C, and fill C with the dissolved salammoniac, about two-thirds, and connect wires as before. This is a rough sketch. H. J. HOOK.



[72278.]—**Division of Land.**—Take the figure given in question 77278, on page 43, of last week's number, and letter it A B C D, so that A B = 70′, and A D = 24′ 6″, then from the point A in A B towards B set the following distances:—

A 1 = 11·672 feet
A 2 = 22·707 „
A 3 = 33·079 „
A 4 = 42·93 „
A 5 = 52·331 „
A 6 = 61·34 „

And from the points thus obtained draw perpendiculars to A B, cutting C D. The figures A B C D will be divided into seven equal parts. I have assumed that the angles at A and B are right angles. APPORTIONMENT.

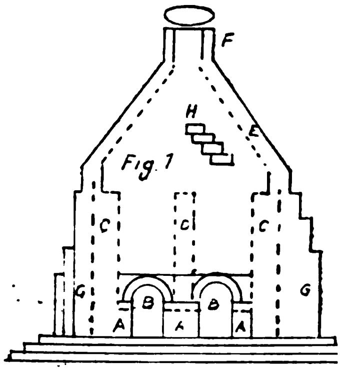
[72279.]—**Finder.**—A finder for a telescope of any aperture up to 3in. is, to say the least, superfluous. After a few nights' practice it will be found quite easy to pick up all objects of interest in a 2⅜in. without a finder. S. S. R.

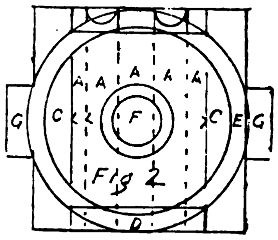
[72280.] — **Acute Rhinitis** — Is this what Dickens called the "American disease"?—chronic choryza. Maughan (New York?) issues a book with his nasal syringe, in which several recipes are given that might help "Athlete." T. F. S. T.

[72281.]—**Moulding and Casting.** — I was once told by a "'cute" moulder that for those very fine castings, made in Dresden, of butterflies, &c., he used to climb to the beams just under the foundry roof, and gather the fine sand that had flown up, and was deposited there, using this to face his moulds with. T. F. S. T.

[72282.] — **Home-Brewed Beer.** — William Cobbett, in his "Advice to Young Men," or in his "Cottage Economy," gives information about this.
T. F. S. T.

[72284.]—**Cement Kiln.** — You will find the following suit you; but you must cut your pug up rough, that it may lie open for the fire to get through it:—Fig. 1 is a conglomeration of face elevation and section, which will, I have not the least doubt, be understood, and the one, Fig. 2, is much of a muchness of a ground plan and top. In Fig. 1, A A A are brick benches, running along each side of fire-holes, B B, which do not run right through, only to the back wall to D, which is the door for charging C C. Can be made up with covers to double wall inside and out, G G, buttresses E, conical dome F, chimney ○ round. The same letters refer to the same parts in Fig. 2, and from benches to top of C I should make 12ft., and the ground plan inside 8ft. or 10ft. square; and going to burn it, I should build over from as shown at H, with bricks, or lump chalk stone for lime, and when a foot above the put my cement material, coarsest first, and it, and fine upon the top, and a layer of bri the top, 1in. apart. In firing with wood, green, you will have a pretty clinker; but i soluble silicate of lime, that your cement very strong, as wood firing for lime-burnin good fat lime. JACK OF ALL TI





[72287.]—**Fiddle of Neil Gow's.**—Se article in the *People's Friend* for Sept. 8, 18 name was Niel. R. McL

[72294.]—**Algebra.**—Has the querist s and Knight's "Higher Algebra?" S.

[72294.]—**Algebra.**—To work out this it is necessary to use the expression giver sum of the squares of the first $n$ natural nu viz., $\frac{n(n+1)(2n+1)}{6}$. This can be thus:—We notice that $x - 2$ is the thir hence $x - (x - 1)$ or 1 is the $x$th term; tl the sum of 12 terms = the sum of $x$ terms of terms after the 12th—

$$= \frac{x(x+1)(2x+1)}{6} - \frac{(x-12)(x-11)(}{6}$$

This expression when worked out comes to-

$$12x^2 - 132x + 506,$$

which is the same result as that obtai squaring every term and adding them.
C. F. DENDY MAR

[72298.]—**Gearing Safeties.**—Multip meter of driving wheel in inches by the nu teeth in the pedal cogwheel, and divide number of teeth in the other cog-wheel. gearing in inches. C. F. DENDY MARS

[72298.]—**Gearing Safeties.**—Rule: I the diameter of driving-wheel (in inches) number of teeth in bottom bracket chain-wl divide by number of teeth on hub of driving thus—30in. driving-wheel with 9 teeth on 17 on crank-axle = 56⅔, i.e. 56⅔ gearing.
F. A. VEN

[72301.]—**Paper-making.**—The white co cylinder is caused chiefly by a small percei the size drying on its surface, also by su used for loading, &c. The best method tha seen employed for cleaning it off is by first r the bulk of the coating with a steel scrape must not be pressed too hard against it; th with No. 1 emery by pressing steadily ag cylinder while revolving, after which fi across the frame covered with a piece of and saturate with paraffin and sweet oi takes some two or three hours to do properl think "Machineman" will never grudge t again if he once sees the result. AITCI

[72304.]—**Vine.**—The vine will not r fruit out of doors one season out of ten in of the British Isles, and the one referre Hampton Court is under glass. With a li tection, ripe grapes can be grown in Engl even those grown without protection can l into "wine," which is simply a saccharine fermented until it becomes alcoholic. flavours of the grapes grown in the wine-

ınnot be obtained, but very decent stuff
›tained from the ordinary garden grapes.
HORTUS.

]—**Carbonic-Acid Gas.**—At the ordinary
ıre it requires 54 atmospheres to liquefy
C, or 32° F., 35 atmospheres will suffice.
l freezes by its own evaporation at −70° F.,
. It is liquefied either by generating in a
ıpace or by a compression pump. A solu-
e solid in ether, allowed to evaporate pro-
ımperature of −150° F., or nearly −100° C.
d may be kept in a closed, strong vessel;
must be kept in a closed vessel at a
ıre of −70° F., or −57° C. W. H. S.

]—**Skin.**—Such a case as "W. A. L."
could only be diagnosed and prescribed
ctually seeing the patient. Therefore I
vise him to consult a medical man.
INNOMINATE.

] — **Skin.** — Such symptoms as those
›y your wife not unfrequently accompany
rms of indigestion. Fresh air and exer-
lemented by a tonic, would probably do
he administration of a good saline aperient
o, I think, prove beneficial, and would at
time tend to relieve local irritation of the
ıd face, by causing determination of the
›ther parts of the body. J. WEST.

]—**Cigarette-making.**—Cigarettes are
made, I believe, by hand. I do not know
t of the world you are in, but if you are
London you can always see them made
'he makers are generally girls, and are sup-
ı a piece of brown paper, measuring about
n., with which they roll them. I do not
ıat the average number turned out per
ı, but have been told about 60, as to the
his I cannot say. The edges are fastened
h starch paste. J. PAWSEY.

] — **Telephones.** — See Article I. of
›nes: their Construction and Fitting,"
peared in the "E.M." of May 16th. It
rial which pole of the magnet comes oppo-
iaphragm. A set of diagrams will appear
›ove-mentioned articles shortly, showing
us ways of connecting-up telephones, in
ı will find the connections you want.
F. C. ALLSOP.
ıeen Victoria-street, E.C.

]—**Adjusting Refractor.**—Perhaps you
the convex lens, which might cause
rings. W. H. S.

]—**Dynamo.**—How have you coupled
ımo, in series or in shunt? If the former,
ınce of the lamps is too great. Try what
ı get by coupling the field-magnet wires
the brushes and then taking the current
ush pillars. Perhaps also you are driving
r. Such a machine as yours must have an
speed of about 3,000 revs. per minute.
S. BOTTONE.

]—**Oil-Stones.**—Washita stones are the
ıvourites. A petroleum oil sold for the
t oil-shops. SM.

]—**Oil-Stones.**—The best stone to use for
ınd broaches is the Arkansas stone. Its
is certainly high, but a good piece once
ill pass down from generation to genera-
rkey stone is not so expensive, and is also
riety for your requirements. The best oil
ive oil. Sperm oil for lathe bearings, if
ı oil may be rendered thinner by the ad-
paraffin for smaller surfaces and more
ıachinery. J. WEST.

]—**To Mr. Allsop.**—The best job is made
a relay and local battery at each end, but
e most expensive method. Would not
bells do? This would come much cheaper.
tenzie indicator will not act properly with
ı it is the make-and-break of the circuit
ll that causes the indicator to give out the
With magneto bells a sounder indicator
unnecessary, as your own bell would not
ss the other was ringing also. If you use
ou will require from four to six cells at
according to the construction of the relays.
the earth wires to the water pipes.
F. C. ALLSOP.

]—**$CO_2$.**—You appear to think that liquid
be handled like water. It can only be
by pumping it into a metallic vessel that
y withstand a pressure of 40 atmospheres.
SM.

]—**Medical Coil.**—I answer the latter
›ur query first. I believe that the proper
ın of electricity is of very great benefit in
heumatism; but I also believe that it must
istered under intelligent medical advice.
ts, mind. No man who can cure anything
adies' complaints to a rupture, by elec-
ı of any use, except to draw off super-
ıney. When you remember that the very
in which the current flows decides for good
you will appreciate the force of what I write. A battery of about a dozen lifting bichromate elements will, if applied by means of suitable metal electrodes, covered with flannel and moistened with brine, give good results. But do not quack yourself. Go to the best hospital doctor you can find, and do what he advises. S. BOTTONE.

[72325.]—**Surveying.**—You will get the best methods of triangulation in Yolland's "Account of the Measurement of the Base of Lough Foyle" (Longmans), and in the "Aide Mémoire of Military Sciences," conducted by officers of the Royal Engineers, also in Government Blue-books issued from time to time on the surveys of this country and of India. "Frome's Method of Conducting a Trigonometrical Survey," 16s., you will find useful also. For surveying and theodolites (practically the latter are all the same pattern) get "Merritt's Land and Engineering Surveying," 12s. 6d. (Spon).
Plymouth. B.Sc.

[72329.]—**Aluminium.**—Wash it with a little weak acid. SM.

[72329.]—**Oxide of Aluminium.**—Use dilute caustic-potash solution; it slowly acts upon aluminium. W. H. S.

[72330.]—**Lighting Towns by Means of Oil.**—"Anti-Gas Monopoly" can obtain the information he requires by applying to Messrs. Bailey and Son, of Poole, where oil was successfully used; also to Mr. Penn, 40, Westberry-street, Wandsworth-road. It is more economical, and gives a better light. F. M. B.

[72330.]—**Lighting Towns by Means of Oil.**—The population of Wimbledon is 25,000, its area is 3,220 acres, its public roads (all of which are lighted) are of a length of 32 miles, its rateable value £170,000, the number of street lamps is 532. All the lamps are lighted by means of oil, and are alight from sunset to sunrise all the year round. This mode of lighting has been in operation for nine years. The lamps used for 350 of the street lights have ordinary 1⅜in. flat-wick burners, with a square tin reservoir, and a chimney, known as the Pine. These lamps cost complete 6s. 6d. each. The lamps in the principal streets have mitrailleuse burners, or those of Defries and Co.; the reservoirs are of glass, chimneys similar to those used with duplex lamps. The oil used is best petroleum, Tea Rose brand, for which the price now paid is 5¾d. per gallon. The oil supplied under a contract for one year. All work in connection with the lighting is done by the Board's men, nine of whom are employed constantly thereat. One foreman of lighting, who executes all the necessary repairs. The *inclusive* cost of lighting is £2 6s. 8d. per lamp per annum, the necessary repairs included in that sum. The price of gas is 4s. per 1,000 cubic feet, and, taking the consumption at 18,000 cubic feet per lamp per annum, gas would cost £3 12s., and lighting, cleaning, and repairs £1, total £4 12s., thus the saving to the ratepayers is upwards of £1,000 per annum. Any further information would be given by
FOREMAN STREET LIGHTING,
WIMBLEDON LOCAL BOARD.

[72331.]—**Logarithms**—There are such tables in existence. If "C. E." will communicate with me, I shall be happy to lend him "Callet's Tables," in two volumes, or any others he may desire.
C. PURCELL TAYLOR, D.Sc.
26, Marchmont-street, London, W.C.

[72331.]—**Logarithms.**—I do not wish to forestall "F.R.A.S.," to whom this question is addressed; but in case his reply should be that logarithms to more figures than seven are scarce and difficult to be obtained at the present day, "C. E." may be glad to know how easily he can calculate them for himself by aid of the tables I referred to in my answer to query 72228, page 65. These tables (Gray's) consist of 12-figure logarithms of the numbers 2 to 9, 1001 to 1999, 1000001 to 1000999, and so on. Now all numbers (by simple division, explained in the book) can be resolved into some of these factors, the logarithms of which, on being added together, give us the logarithm we want. To take a very simple instance in order to illustrate this—let us require the logarithm to 12 places of 2468246824682468. This equals 2 × 1234 × 10001 × 100000001. Taking the logarithms of these, we get—

| | | | |
|---|---|---|---|
| Log. of | 2 | is | 301029995664 |
| ,, | 1234 | ,, | 091315159697 |
| ,, | 10001 | ,, | 000043427277 |
| ,, | 100000001 | ,, | 000000004343 |
| Logarithm required.. | | | 392388586981 |

This is absolutely correct to all of the 12 figures; but there may sometimes be an error of 1 in the last place. Mr. Gray says that, in the course of a pretty extensive use of these tables, he had met with only a single instance in which there was so great an error as two in the last figure.
T. S. BARRETT, F.S.S.

[72332.]—**Cement for Cistern.**—Common black rosin and tallow, equal parts melted and well mixed together, and applied when hot over the leaky part several times, I have known to answer for several years. SOMERSET LAD.

[72332.]—**Cement for Slate Cistern.**—If your cistern is a slate one, you had better empty it and block the leakage with concrete. From a sanitary point of view "putty" is bad; of course, you must permit the concrete to become solid and hard before re-filling the cistern.
FREDERICK DAVIS.
86, Newington Causeway, S.E.

[72332.]—**Cement for Slate Cistern.**—White lead 1, red lead 1, thin with linseed oil, is in general use here. Take the tank to pieces, clean off the old cement, and give all the joints and grooves two coats of the red lead. When putting together again, fill all the grooves and joints with the cement, and screw up.
Plymouth. B.Sc.

[72333.]—**Lithanode Cells.**—Peroxide of lead ($PbO_2$), mechanically and electrically prepared by a patented process, and formed into dense, conducting plates, is known as "lithanode." It is of a dark brown colour, and has a more or less crystalline structure. In the manufacture of our pocket and portable accumulators we use this material exclusively for the positive plates, on account of its lightness, high electrical capacity, and the absence of local action. Contact is made with platinum foil clamped to the surface of the plates with ebonite bolts and nuts. CATHCART AND PETO.
57B, Hatton Garden, E.C.

[72333.]—**Lithanode Plates.**—There are two forms of lithanode cells. Firstly, those in which the lithanode (which is peroxide of lead compressed into the form of plates), is placed in a cell as a negative along with zinc as a positive. Secondly, those in which two plates of lithanode are placed in juxtaposition along with dilute sulphuric acid, and then partially decomposed by means of an electric current passed through them. These latter are true "accumulators." They are used as all batteries are, for supplying current electricity. A very good variety of the former class is made by Messrs. Cathcart and Peto, as a "standard" cell.
S. BOTTONE.

[72338.]—**Pyrogallic Acid and Smoking.**—Although, no doubt, you have seen my name in connection with the above, still I am far from recommending anyone to try it. You are quite right in supposing pyro to be a poison—it is a poison and a very dangerous one too. Before experimenting I should like to hear the Doctor explain who first claimed to find it out. Citric acid may be used; but it, as you say, produces unpleasant sensations and, as far as I can trace, is likely to cause a disease of the throat. Perhaps if the learned gentleman above mentioned should happen to read this, he will have the kindness to send full particulars for the benefit of those interested. My belief is that if a bent briar be kept thoroughly clean, nothing can beat it. J. PAWSEY.

[72342.]—**Iron Piping.**—You may use clay pipes, but do not use lead. Iron in water is not likely to affect iron pipes; why should it? SM.

[72342.]—**Iron Piping.**—Do not use black iron pipe, as I have known pipes up to 3in. diam. to be filled with rust within 10 years in localities where water contains iron. If you use iron pipe have it double galvanised coated; the best and cheapest article from first to last expense would be lead pipe, which would last a whole family life-time.
SOMERSET LAD.

[72344.]—**Clarke's Gas-lighter.**—Unscrew the ebonite case and dry well before the fire, taking care not to over-heat the ebonite, also clean the points where the spark should appear with a small piece of fine sand-paper. H. H. HEADWORTH.

[72344.]—**Clark Gas-lighter.**—There is no "charge" to lose, as the machine, which is a modified form of the Wimshurst, excites itself directly the cylinder is caused to rotate by pressing the button. But the insulation may be defective, the brushes may have become displaced, or the connection to the top, where the spark passes, may have been broken. I reproduce a former reply of mine, which may prove of service to you. "There are two pieces of tinfoil bent into the shape of segments of a circle; these are at opposite sides of the diameter of the circle. These act as field plates or inductors. Between the field plates is an ebonite cylinder, which can be made to rotate rapidly by pressing on a button. The cylinder has eight pieces of metal foil fastened to it to serve as carriers. As in the Wimshurst machine, there is a pair of neutralising brushes attached to a cross conductor, and a pair of brushes connected to the field plates; and lastly, a pair of collecting brushes, which lead up by means of wires through the stem of the instrument to the opening where the sparks are required." You will find full details in Gray's "Electrical Influence Machines." S. BOTTONE.

[72345.]—**Dry Steam.**—You must increase your steam space. SM.

[72345.]—**Dry Steam.**—As dome would greatly prevent spray, it would be best to remove plate instead of perforating. I do not know of any better method than chipping. W. H. S.

[72347.] — **Teeth.**— Your plate turned black probably owing to the formation of oxide of copper, due to excess of that metal in your alloy. It is not considered wise amongst the competent members of the dental profession to use any gold plate lower than 18 carat. The jeweller must have been mistaken in his valuation of your sister's plate. A dentist's plate would differ in appearance from jewellery of the same carat, owing to the plate not having been "pickled." Here are two recognised dental alloys for 18 carat gold plate: formula 1, 18dwt. pure gold, 4dwt. fine copper, 2dwt. fine silver; formula 2, 20dwt. gold coin, 2dwt. fine copper, 2dwt. fine silver. J. West.

[72348.] — **Chemical Analyses.**—I conclude you mean sodium thiosulphate, not hydrosulphate. The simplest plan for determining the iodine in iodides, or bromine in bromides is by Volhard's method, viz., precipitation with $\frac{N}{10}$ silver, and ascertaining the excess of silver with ammonium thiocyanate, using ferric alum as an indicator. Reduce the chromate by $Am_2S$, boil, filter from chromium hydrate. Sm.

[72348.]—**Chemical Analysis.**—Yes; but bromine in bromides is more easily estimated by precipitating with nitrate of silver solution, and then calculating the quantity of bromine from the bromide of silver produced. Remove the chromium from the solution as hydrate (before testing for acids) by precipitation with ammonia solution and filtration. The filtrate can then be tested for acids. If the chromium is combined as a chromate, it must be reduced before adding ammonia, with $SO_2$ or $H_2S$. F. T. S.

[72352.] — **The Banana.**—Your fruit is the shaddock, pomeloe, or pumilo (the "u" sounded as in rum), one of the orange family—the Citrus decumana of botanists. It is a native of China, and was taken to the West Indies by a Captain Shaddock. A smaller species, Citrus Paradisi, is a "forbidden fruit," but is in no way allied to the poisonous fruit mentioned in my note 31550. The pumilo is a very good fruit when fresh. I have met with the best at Amoy in China, and in some of the West Indian Islands. Solanum.

[72353.]—**Medusæ** (or Acalephæ) are commonly known as sea-nettles or jelly fish. They are transparent discoids or spheroids, the margin being furnished with filiform tentacles. Sm.

[72353.]—**Fresh Water Medusæ, Botanic Gardens, Regent's Park.**—The Medusæ are really the class of beings commonly known as jelly fish. The medusa, which is found in great abundance in Regent's Canal, is the hydra or fresh-water polype. The hydræ inhabit ponds, ditches, and slowly running streams, and the common hydra (H. vulgaris) is specially abundant in Regent's Canal, where it may be captured as it clings to its favourite plant, the common Anacharis. Of all the minute forms of animal life the fresh water polype is perhaps best calculated to arrest the observer's attention. Its small size and low organisation, when compared with its power and deadly properties, render it an object of the greatest interest, if not of admiration. Its low organisation and want of complex structure make it alike indifferent to harsh treatment or severe mutilation. We can remove the head from one hydra and graft it on another with comparative impunity. Also dividing one of these minute creatures simply means two instead of one; and, to crown all, we can institute a month's fast without causing our little prisoner any apparent inconvenience. The hydra obtains its food by means of its powerful stinging properties. Clinging to the under surface of a leaf its tentacles stretch out in all directions, and from these tentacles proceed the poisonous filament so disastrous to surrounding organisms. The polype does not hesitate to attack creatures much larger and more highly endowed with life than itself, and it rarely fails to secure in its deadly grasp the unfortunate victim of its choice. When examined under a microscope of moderate power, the creature is seen to consist of a soft cellular substance jelly-like in nature, in the form of a tube. This tube is possessed of the power of almost unlimited change, both in form and colour. One end is furnished with a sucker-like base, which serves as an organ of attachment, the other gives origin to the ever-varying tentacles. The hydra possesses but one orifice communicating with its interior. Like plants, these organisms are multiplied in three ways—by cuttings, buds, and covered seed which germinates apart from the parents. They are very partial to light, move but slowly from place to place, and though possessed of such deadly power seldom exercise it, save as a means of obtaining necessary nourishment. J. West.

[72353.]—**Fresh-Water Medusæ.**—There are several creatures rejoicing in the name of medusa, but the true one is a polype that is of the order Polypifera. It has a sea-water cousin or actinia—this also belongs to the Polypifera; but the fresh-water polype is typicalised by the hydra, sub-class Hydrozoa, the actinia belonging to the Actinozoa; both are most beautiful creatures, and well worthy of study. I will not fully describe them, but a few points of anatomy may not be uninteresting. A peculiarity is they are possessed of two muscular layers, one arranged longitudinally, the other transversely; this gives them the power of contracting or elongating almost indefinitely—i.e., comparatively speaking. They may be cut in a number of pieces, and each part will re-develop into a perfect hydra; they have no particular digestive apparatus, but appear to absorb the nourishment from their prey by pressure. It is said they partially paralyse their prey by a number of minute filaments called ctenidæ; but this is open to doubt, being, I think, sheer muscular force. Whilst staying at Folkestone during the past month, I found several fine specimens of Actinia mesembryanthemum; but although I have tried many times to keep them in confinement, I never succeeded for more than three months. Many of the species are most lovely, exhibiting glorious colours in the tentacles. Many of the sea polypes have an external horny integument, but the fresh-water variety found in our ponds consist of merely a muscular foot with spreading tentacles—the average size about three-fourths of an inch in length. They have no particular parts to the body, excepting a central cavity at the base of the tentacles. The food is seized by the tentacles and pushed into this cavity. The nourishment is extracted and the excrement ejected by the same opening that it entered by. These creatures propagate in several ways, chiefly by gemmation and by fission. The actinia are oviparous, and also propagate by gemmation and fission. Any further details I can give the correspondent I shall be most happy. Biology is a most fascinating study and amply repays any time expended upon it.

Frederick Davis.

86, Newington-causeway, S.E.

[72354.]—**Resistance of Induction Coils.**—There are many things to be taken into account in deciding the best resistance of the primary coil for a microphone, such as the resistance of the microphone and the number and resistance of the cells. The Blake microphone has a higher resistance than the Gower, and should thus have a higher resistance primary coil. Theoretically, were the two coils changed, the results would not be so good, but, practically, I doubt if there would be much difference for ordinary purposes. F. C. Allsop.

[72355.]—**Freckles.**—Bathe the face with tepid water every night at bedtime, and then apply the following lotion to each individual freckle:—Take of hydrarg. bichlor 1gr., P. amygdalæ alb. 1oz., aquæ ad 8oz. Fiat emulsio sec. artem. Any chemist will prepare it for you. *It is poison.*

Frederick Davis.

[72355.] — **Freckles** — Casually reading the answers to correspondents in the *Young Ladies' Journal* for July, 1880, I came across the following prescription for freckles: "Scrape a tablespoonful of horseradish in half a teacupful of sour milk, and let it stand for twenty-four hours, then rub on the face two or three times daily." Now, sour milk has its distinctive aroma, which is not of the sweetest; but if "Fred" has no objection to this, he might try the prescription. Personally, I think I should prefer the freckles. C. J. Tahourdin.

[72356.]—**"E. M." Receiver.**—When an induction coil is used, the receivers are wound to a higher resistance, generally between 70 and 80 ohms. The resistance stated for the "E. M." receivers, in "Telephones; their Construction and Fitting," is that best suited for the receivers when used as a transmitter and receiver. F. C. Allsop.

[72357.]—**Violin Strings.**—I give mine a rub with vaseline, and can keep them at pitch for three months sometimes.

Plymouth. B.Sc.

[72357.]— **Violin Strings.**—Slacken the first string after playing. Damp ought not to cause it to smash, since it lessens the tension; but unrelieved strain certainly will. Again, the bridge may be too high, so that force is needed to depress the string to the finger-board, causing a continual jerking of the string, which would injure it. Caldemone.

[72357.]—**Violin Strings.**—Use a silk string—these strings as a rule last much longer, although not giving quite such a fine tone. I think "Young Fiddler" will get over the moisture trouble when his hand is more used to exercise, which is a constant strain on the muscles of the hand until thoroughly practised. H. H. Headworth.

[72357.] — **Violin Strings.** — To "Young Fiddler."—If you will put your hands in a basin of water as hot as you can bear it each day, you will be surprised at the result. You must get a sheep's bladder, blow up very thin, then cut it open, well soak it in almond oil, and keep your strings cased up in it, then they will resist the perspiration from your hands. E. Dyson.

[72357.]—**Violin Strings.**—Oil your strings once a week with pure almond oil. Take a piece of silk and rub off all the rosin from your strings, and then apply the oil with the finger. Get the oil well underneath the string, and don't forget to oil on the other side of your bridge. Before playing again, be careful to wipe the strings well, or your bow will, of course, suffer. The almond oil will nourish and protect the gut, and a soft, rich tone will add value to your instrument, and well repay the extra care entailed by the greasing.

J. West.

[72357.]—**Violin Strings.**—If only "Young Fiddler" will persevere, he will find the perspiration will most probably disappear. Violin strings should be kept in a tin "string-box," which can be had at a violin shop. Silk or acribelle E strings are usually recommended for performers with perspiring hands. Gut, however, gives the best tone. In choosing gut strings, avoid those of a yellowish cast—they are old; avoid also those in which the twists are visible. In some strings the ends can be seen to taper off much thinner than the rest of the string; such strings are useless for correct playing. Get your strings clear and transparent. Gut strings, if new when bought, improve with being kept for a month or so. If "Young Fiddler" is a novice, he probably breaks many strings in his attempts to tune. In tuning, the peg should not be twisted about anyhow, but before altering he should consider whether the string is flat or sharp, and alter accordingly. The strings are not to be let down after use, but must be kept tuned up to the proper pitch. Semi-Pro.

[72358.] — **Medical Coil.** — It is not usual, though perfectly possible, to subdivide the primary into sections, as described by you. I have had several coils to repair in which there was no secondary at all; and in these the primary was subdivided as described; but in those in which a secondary coil was inserted, it was the secondary which was sectionised and brought out to the studs.

S. Bottone.

[72359.]—**Metropolitan Railway Locos.**—These engines were designed by Sir John Fowler, built by Beyer, Peacock and Co., and supplied to the following companies:—Metropolitan, Metropolitan District, North Western, and, I think, the Midland and South Western. A sketch of a North-Western one appeared in the "E. M.," No. 128, for Oct. 11, 1889. They are fitted with a Bissell bogie truck and large side tanks, into which the exhaust steam is discharged when working in the tunnels. The chief dimensions of these engines are as follows:—Cylinders, 17in. by 24in.; boiler mean diameter, 4ft.; length, 10ft. 3in.; inside firebox, length, 6ft.; width, 3ft. 2in.; mean depth, 5ft 2in.; tubes, 164; diameter 2in.; outside boiler pressure, 120lb. per square inch. Heating surface: tubes, 903; firebox, 111; total, 1,004sq.ft.; capacity of tanks, 1,250 gallons; diameter of driving wheels, 5ft. 9in.; bogie wheels, 3ft.; weight, 45 tons.

C. F. Dendy Marshall.

[72360.]—**Brighton Engines.**—Of the numbers given, 158, 324, 433, and 500 are blanks; 314 and 474 have no names; 121 is Verona; 177 used to be Hayling, now broken up; 453 used to be Ryde, now also broken up. C. F. Dendy Marshall.

[72360.]—**Brighton Engines.**—No. 121, six-coupled goods, I don't know name; 177, an old four-coupled engine called Hayling, now [illegible]; 453, Ryde, extinct; 474, old six-coupled [illegible] named. Nos. 158, 314, 324, 433, and [illegible] are, I believe, vacant numbers at present, at all events, I have not seen engines bearing them.

Brixton. Locomotive.

[72362.] — **Building Safety Bicycle.** —To "Norfolk."—If you are a mechanic and used to brazing, I should say build your own frame. If you will advertise your address, I shall be glad to help you. E. Dyson.

[72363.]—**Constituents of Plants.**—The best work upon the subject is "Dragendorff's Plant Analysis," translated from the German by Mr. Greenish, one of the examiners of the Pharmaceutical Society. Frederick Davis.

86, Newington-causeway, S.E.

[72363.]—**Constituents of Plants.**—Your best plan would be to start with inorganic chemistry. After studying this subject for a time and thereby obtaining an elementary knowledge of gases, metals and non-metals, also of the various combinations [illegible] the same; you would then be in a favou position to turn your attention to the prof study of botany and organic chemistry. Previ armed with your inorganic chemistry, I thin would find the other two delightful studies hand in hand in a most pleasing and harmo manner. I have not mentioned any special ma from the long list of works on chemistry botany, as each teacher and lecturer will be f to hold his own preference. J. We

[72365.]—**Exploding Glass Cones.**—Yo how can this be done—viz., projectiles or glass cones are thrown into the centre of a from a bank a quarter of a mile distant; b do not state how you intend them to be thr by hand or gun; another thing, you say nes are made of very thin glass and are th liquid," by which, I presume, you have e already made, or you wish to possess glass ed with liquid, and as there are so many liquids I am again at a loss to know how you. Again, in another part I read "that re them to break or explode when they water so as to discharge the contents." ely, you must have some motive for all it binding that the contents shall be dis- immediately it touches the water? Write d give us some idea of what you want it no doubt we shall be able to meet your

J. PAWSEY.

.]—**Leclanche Cells.**—If you have cells ent sizes arranged in series, they are as only as if they were all of the smallest size.

SM.

.]—**Leclanche Cells.**—It does not matter e cells are arranged, but I should say it best to have them all of the same size. ll be no loss of current by the cells being as you say. A. B. T.

.]—**Leclanche Cells.**—It matters but what order you arrange your three cells, rcuit they will give power equal to three Always arrange your cells of equal size, mall cell introduced into a battery seriously s its larger companions. J. WEST.

.]—**Leclanche Cells.**—It is absolutely al which of the cells you put in the middle ends, since the resistance of the series, e current, will be the sum of all three, you may arrange them in series. And as lest cell has the greatest resistance, it at the current will be pulled down by the of that smallest cell. S. BOTTONE.

.]—**Leclanche Cells.**—In uniting single together to form an intensity arrangement, ld be taken to use batteries whose negative are of equal size. If this is not attended ower of the series will be reduced to what be were all the batteries the size of the ne. The absolute power of any galvanic ll other things the same, depends on the he surface of the negative element. You see for yourself whether you are right or uniting a larger battery to two smaller he same size. J. PAWSEY.

] — **Eserin Lotion — Cataract.** — s" can set his mind at rest with regard to oma, and I should advise him to trust to nd ophthalmic surgeon, and follow his plicitly. INNOMINATE.

.]—**Cataract—Eserin Lotion.** — Cer- p the lotion when your present medical ys so. The eserin lotion was, to say the , a curious prescription in any of the cir- es you detail.

th. B.Sc.

]—**Electric Gas-lighter.**—The gas is and off by an electo-magnet, the vibrating of which rotates the valve round. In orm there are two sets of magnets, one of ens and the other closes the valve. There ry coil in the circuit to increase the spark. urners can be worked off the Electric Bell I have some that have been in use for the years without a failure. They are an invention, the patents of which are believe, by the Electric Gas Igniting Co., , U.S.A. F. C. ALLSOP.

een Victoria-street, E.C.

]—**G.N.R. No. 18.**—This is a mixed gine, coupled in front. Driving wheels, ; cylinders, 17½ by 24; weight, 31 tons heating surface, 843sq.ft. The Plutonic, a ine to the Pacific, was illustrated in the No. 1264, June 14, 1889, and No. 1270 for 1889, and full particulars in No. 1262, 1889. C. F. DENDY MARSHALL.

]—**G.N. Railway Locomotive No. 18.** sions of the Pacific:—Wheels: Diam. of 4ft. 1½in.; central and trailing, 7ft. 1in., tires to all wheels. Wheel base: leading driving, 8ft. 5in.; centre driving to rear 9ft. 8in.; total 18ft. 1in. Cylinders: high diam., 14in.; low pressure, diam., 30in.; all cylinders, 24in.; distance apart of ssure cylinders, 6ft. 6in. Boiler: Length , 11ft.; diam. outside middle ring, 4ft. 3in.; of plates, ½in.; height of centre from level 7ft. 10½in.: length between tube plates, ; number of tubes, 225; diam. (outside), oiler pressure, 175lb. per square inch. surface: tubes, 1242·42sq.ft.; firebox, ft.; total, 1401·52sq.ft.; firegrate area, t. Weight of engine in working order on wheels, 14 tons 10cwt.; on low-pressure wheels, 15 tons 10cwt.; on high-pressure heels, 15 tons 10cwt.; total 45 tons 10cwt. gth of engine over buffer beams, 28ft. 8½in.; er foot-plate, 8ft. 3in.; height of top of chimney from level of rails, 13ft. 1½in. The engine is provided with one of the L. and N.W. standard type of tenders carrying 1,800 gallons of water and 5 tons of coal (more, if necessary), and fitted with Ramsbottom's apparatus for picking up water whilst running. Weight: empty, 12 tons 1cwt.; full, 22 tons 10cwt.; weight of engine and tender in working order, 68 tons. NORTH WESTERN.

[72374.]—**Silver Plating.**—See back numbers. You must first copper your solder. SM.

[72377.]—**Umbrella Stand.**—Saw it. You can make a saw of a bit of sheet iron nicked with a file; use sand and water. SM.

[72378.]—**Guessing a Person's Age.**—I did not see either of the two ingenious puzzles mentioned, but I happen to possess an arithmetic by Dr. R. Wormell, on p. 290 of which occurs the following mathematical puzzle: "A, wishing to know the age of B, told him to add the year in which he was born to 35, to multiply the sum by 100, and to add to the result 42 and the number of the month in which he was born; then to multiply by 100, and to add 87 and the day of the month. When B gave A the result, which was 735,204, A knew the age of B. Explain how he found it from the number." Answer: "Subtract the numbers added—viz., 354,287, and of the remainder, the first two figures give the year, the next two the month, and the last two the day of the month. AUTOLYCUS.

[72383.]—**Mathematical.**—Representing by $x$ the part of the pole first broken off, and by $a$ the part remaining in the ground (which is assumed to remain upright), we have by Euc. I. 47

$$x^2 = a^2 + 27^2 = a^2 + 729 \quad \ldots\ldots\ldots (1)$$

On the second break $x$ becomes $x + 8$

$a$ becomes $a - 8$

and the base, 27ft., becomes $x$

And by Euc. I. 47

$$(x + 8)^2 = (a - 8)^2 + x^2$$

$$\text{or } 16\,x = a^2 - 16\,a \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$\text{whence } x = \tfrac{1}{16}\,(a^2 - 16\,a)$$

$$\text{and } x^2 = \tfrac{1}{256}\,(a^4 - 32\,a^3 + 256\,a^2) \quad \ldots\ldots (3)$$

Equating (1) and (3)

$$a^4 - 32\,a^3 = 186624$$

$$\text{or } a^4 - 32\,a^3 - 186624 = 0$$

$$\text{that is } (a - 36)\,(a^3 + 4\,a^2 + 144\,a + 5184) = 0$$

Dividing by the second factor—

$$a - 36 = 0 \text{ and } a = 36$$

$$\text{and } x = 45$$

Whence the total length of the pole is 36 + 45 = 81ft., a somewhat phenomenal length! The second factor does not give a practical answer, so far as I can discover. C. J. TAHOURDIN.

## UNANSWERED QUERIES.

*The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.*

Since our last "Danois" has replied to 71985; B. Harcourt 71992.

71827. Block Boiler Composition, p. 431.
71838. L. and S.W.R. Compounds, 431.
71841. Machine for Sawing Stone with Endless Steel Wire, 431.
71852. Circular Saw Management, 431.
71862. Brown Sugar Goods, 431.
71865. Agglomerate, 431.
71869. Gramme Dynamo, 432.

72030. Paper-making, p. 520.
72038. Hinge Joint, 520.
72040. L. and Y.R. Locos., 520.
72041. Weather Forecasting, 520.
72045. Cutting Tissue-paper, 520.
72055. Earwigs, 520.
72056. Eccentric, 520.
72064. Goathland Mile Incline, 520.
72065. Limits, 520.

**A Remarkable Railway.**—The most remarkable short line of railway in the world is probably the submerged railway at Onton, near Bilbao. It runs down an evenly sloping shore in double line to a distance of 650ft., and has been constructed by a Spanish engineer for the sole purpose of facilitating the shipment of iron ores. The only car is a massive iron tower on wheels, in the shape of a pyramid, rising 70ft. from the track. Upon the platform of this tower the ores are placed, and thus they are conveyed to the vessel; the pyramidal car, whose wheels are always under water, returning automatically as soon as its cargo has been mechanically shot into the ship's hold.

NOTHING keeps out moths so well as paper; if every housewife, when she puts away her furs, pasted up all the crevices and round the lid of the box with paper, she would find her furs intact when unpacked.

## QUERIES.

[72386.]—**Level Power from Windmill.**—I have a Halladay windmill 22ft. wheel, 5H.P. Will someone kindly inform me how I can obtain an even power from this, for working a cream separator, and other dairy machinery, or electric light? Can it be done by pumping air into a reservoir from which an engine could be driven? —if so, what kind of air engine would be suitable? Would it be possible by cooling down the reservoir to utilise the exhaust air for refrigerating purposes? The mill is a geared one driving a line shaft, and is principally used for pumping water.—ARGENTINA.

[72387.]—**The Gases.**—Will some of "ours" who understand the above kindly tell me of a convenient and effective method of collecting and analysing boiler-flue smoke? The mercurial test answers all that is required. As I do not fully understand that method, I should esteem it a favour if some of "our" scientific friends would assist me by giving the method in full, or any other they may think suitable, our present system, being unsatisfactory. —ANTI-SMOKE.

[72388.]—**Self-acting Cylinder Drain Cocks.** —Some months ago I saw these advertised, but cannot remember if it was in Germany or in England. Has anyone heard of such things?—if so, what principle do they work on?—A. F. SHAKESPEAR.

[72389.]—**L.C. and D.Ry.**—Can anyone supply me with the names and numbers of any or all of those engines that formerly had names? I believe most of them have been rebuilt since, and have only numbers now. I used to see a lot about six years ago.—LOCOMOTIVE.

[72390.]—**Cement for Glass and Tinfoil.**—Will any reader give a good cement for fastening tinfoil to glass? Must be a non-conductor of electricity.—W. F. CROTTY.

[72391.]—**Making Smooth Round Edge on Glass Plate.**—Can any reader tell me how to get a smooth round edge on glass plates? I am making a Wimshurst machine, and after cutting the sheet-glass into round plates with the diamond, they have rough square edges. I want to give this machine a highly-finished appearance, and should like to round the outer edges of plates, and polish them like the top of a tumbler glass. I have a screw-cutting lathe turned by power if one should be required for the above.—W. F. CROTTY.

[72392.]—**Dentistry.**—I should be very glad if some reader would give me a little information about dentistry? What is the average premium to learn? Which are the best works on the subject? What examinations have to be passed? Are pupils compelled to go to study at a college? I have mastered "Sewell's Dental Anatomy and Surgery," and have extracted teeth largely for a year or two. I am at present working in the mill, but have studied physiology and hygiene for eight years.—DENTAL.

[72393.]—**Magic Squares.**—It is stated in answer to query 72141, p. 39, that even squares can be made nasik, as well as those with odd roots. I am aware that evenly-even squares (i.e., roots divisible by 4) can be nasik; but I always have been told that this could not be done with the oddly-even (i.e., roots 6, 10, 14, &c.). Is this right?—INQUIRER.

[72394.]—**L. and N.W. Express Compounds.**—Will some reader kindly give dimensions of both classes of above?—TABIC.

[72395.]—**Heat from Electricity.**—About two-thirds of your readers have no need to know the terms, &c., used in this science, and yet are much interested in knowing the practical results obtainable from electricity in plain English terms and measures. As the Americans keep trying to heat, cook, weld, &c., by it, at what cost can it be done?—i.e., how many cubic feet of water will from ½H.P. up to 6H.P., keep at the boiling point? Or to bake a 4lb. loaf of bread, or to weld a ½in. or 1in. bar of iron? As by such data all may infer about what other results can be got.—ONE FOR ALL.

[72396.]—**Dressing for Leather Belting.**—Would someone inform me the best dressing for leather belting? —CINDERFORD.

[72397.]—**Teeth-Stopping.**—Teeth-filling for largish cavities. Dentists' opinions differ, and some say platinum, and others tin and silver, and some charge the best price and put the worst. My owner wants me filled with the best amalgam to stop firmest in and last longest. Will anyone oblige by telling him and others in similar doubt?—OLD TOOTH.

[72398.]—**Hygrometer.**—I find a sort of red scum form on the muslin of a wet bulb thermometer a week or ten days after it is put on. Boiled and filtered rain-water is used for moistening the bulb, and the muslin and wick have also been boiled in the same. A sort of mist also appears on removing the muslin to adhere to the glass bulb, and it is not easy to remove it. Can any reader tell me the cause and remedy for this defect?—R. H. A.

[72399.]—**American Organ.**—I have an American organ which has been in constant use for nearly ten years. When it is played now, an unpleasant rattling sound can be heard, not very loud, but loud enough to be disagreeable. Can any reader tell me the cause of this, and also the way to remedy it?—ROGO.

[72400.] — **Proportional Galvanometer.** — Can any reader kindly supply me with a few hints on the construction of the galvanometer shown on page 72 of Prof. Ayrton's "Practical Electricity"? I want to know the proper dimensions and positions of the coils and needle, also the quantity and gauge of wire to use, so that it will be as sensitive as a good Lineman's detector?—STUDENT.

[72401.]—**Electric-Bell and Battery.**—I wish to work one bell from three separate rooms, a press button in each, and only one Leclanché bell for the whole three rooms. Can I do this?—if so, how do I connect the wires, the bell, and battery, with each other?—A. B. T.

[72402.]—**Problem in Heat.**—Will anyone kindly answer the following problem, giving the working? A hollow steel cylinder, when at a temperature of 60° Fahr., measures in external diameter 1in., internal diameter 8in. What will be its diameters when raised to a temperature of 200° Fahr.?—HYTHE.

[72403.]—**Photographic.**—Will some reader kindly inform me of trustworthy and thoroughly white medium for spotting prints in photography, as I sometimes find black spots will show on some brands of paper, however carefully manipulated?—S. J. Gannon.

[72404.]—**Dynamo.**—I have charge of a 200-light Elwell-Parker dynamo, and which runs at 1,000 revs., and when starting to run, I have to take the governor belt off and let the dynamo run a great deal faster before it will give any current. When once the lights are started, I bring her back to her proper speed, and all is right until I stop and want to start again. Please say what is wrong?—Dynamo Tender.

[72405.]—**Demagnetising Steel.**—This is becoming of more and more importance for us watchmakers, and it seems that the methods adopted are not always successful. In query 71723 I gave an account of my troubles, but the reply I received was of no value. The cause of my failure I, after further consideration, ascribe to the magnet being too small, or the revolving speed too slow (I am not able to state the revolving speed now). But this is only a suggestion, and I should be very much obliged if any of our scientific electricians will be kind enough to give their opinion on this subject. I see some other watchmaker has experienced the same trouble, and it was also set as a question in the Honours paper in the City Guilds Exam. in watch and clock-making this and last year.—Danois.

[72406.]—**Telephone Connections.**—To Mr. Allsop.—Will you kindly give a sketch for the universal telephones to connect three stations together, say, stations A, B, and C? I want them to work same as they do in the signal cabins on the railway—that is, one ring, say, to call the attention of station A, two rings for station B, and three rings for station C. Shall I require relays for the bells? The lines are about half a mile from each other. If relays are required, what resistance should they be? I do not want to fit them on the exchange system. The telephones will be fixed in the top room in one of the buildings, and I think the warmth of the room will cause the batteries to creep over the side. Will they give as good results if I fix the batteries in the basement as they would if I fixed them under the telephones? Kindly accept my thanks for past information.—Bernard.

[72407.]—**Reflectors and $O\Sigma^2$ 216.**—Will Mr. H. Sadler be so good as to tell us the distance, position angle, and magnitudes of the double star $O\Sigma^2$ 216, and $\beta$ 162? Both are on Mr. Cottam's star-chart. I see both with 300 linear on a 12½in. Linscott, and on a With of same diameter, 550 e.p. shows the $O\Sigma^2$ 216 better.—Bramley.

[72408.]—**Varnishing Drawings.**—Can any reader kindly give a good method of varnishing drawing? I find a difficulty in keeping the colours from starting when I apply the sizing. Is there anything else which forms a better stay to the colours than size?—Draughtsman.

[72409.]—**Ventilation.**—Can any reader give me the best and cheapest method of ventilating a room, some 20ft. square, which is heated by hot-water pipes? I want a method that, while thoroughly ventilating the room, will leave it perfectly free from draughts?—Aitch Jay.

[72410.]—**Wall's Bleaching Process.**—I have been trying to bleach some bone-fat by the above process, using exactly the same quantities of sulphuric acid, bichromate of potash, and salt, and taking care as to the temperature as specified; but I cannot, after the operation is completed, get all the water to separate from fat, and the liquor is of a bright yellow instead of a green as stated. Perhaps some of your kind readers who have worked the same process will be able to put me right. I can take a handful of the fat and press water out of it, but it will not separate itself as it should do.—Fat.

[72411.]—**Wasps.**—What is the most humane mode of destroying wasps?—H[illegible].

[72412.]—**Dryers.**—I wish to know what chemical substances are the best dryers for linseed oil and hemp-seed oil?—Aitch Jay.

[72413.]—**Optical Illusion "Stella."**—Can any of our friends explain how to make the illusion which is known as "Stella"? It is on exhibition this season in Blackpool. When the showman pulls the curtain on one side, you behold a young lady's head and shoulders on a small board which is hung in chains, and sometimes the figure is resting on two brass rails.—F. W. B.

[72414.]—**Transparent Clock.**—Some time ago I saw a clock in Lewis's shop, Manchester. I could see nothing about the clock only a glass plate with the figures on and the hands. It was suspended by two cords from top of doorway. How was this clock worked? Was it done by electricity? An explanation will greatly oblige, as I intend making one if I can get particulars.—F. W. B.

[72415.]—**Locomotive Colours.**—To R. Brock. May I trouble you once more? 1. What are the body colours of the G.N. of Scotland Ry., Highland Railway, and Hull and Barnsley Railway? 2. Picking-out colours of Highland, H. and B., and N.E. Railway locos. 3. Names and number plates of N.R.R., N.E.R., G.N.S.R., Highland, and H. and B. Rys.?—Loco. No. 2.

[72416.]—**M.S. and L.R.**—I should like sketch with chief dimensions of the new M.S. and L.R. side tanks, 574–579 class, 1889. A sketch of one of these really fine locos. could not fail to prove of interest to our railway readers.—Loco. No. 2.

[72417.]—**Photography.**—I have a magic-lantern (Newton's best, 4-wick refulgent). I want to use it in the coming winter for showing microscope slides. I have good objectives belonging to my microscope, and I understand that I can make use of those without buying fresh ones. I should be content if I could get a disc of 4 or 5in. diameter, with a clear picture. Will some kind friend experienced in lantern matters tell me if this can be done, and also direct me how to do it? Also, will anyone give a few hints as to painting slides—photographs? I have colours and medium from Barnard and Son which have been recommended, but success has not come yet. A few lessons would willingly be taken in order to acquire the *modus operandi*.—R. E. V.

[72418.]—**Compound Oscillating Paddle-Engine.**—I am desirous of making a set of patterns for an engine, similar to the one I recently inquired about, but should like more modern valve gear (the gear on the engine was similar to that used on the *Great Eastern's* paddle-engines, plus link-reversing motion). I am given to understand that in modern engines the valves are separated from the cylinders; but I can't make out how that can be. The engines of the Dutch steamers, *Prins Hendrik* and *Princess Marie*, on the Queenbro and Flushing line, appear to be made this way, however.—A. F. Shakespear.

[72419.]—**Selenite.**—To "our" Mineralogists.—Will some of my friends tell me which is the nearest place to Carshalton, Surrey, where I can find the transparent variety of selenite in tolerable abundance? I have some fairly good specimens which I am informed came from Alum Bay, Isle of Wight. I was told that the beach is covered with these crystalline modules—is this so? Are there any other similar deposits nearer to hand?—S. Bottone.

[72420.]—**Extracts from Herbs.**—Will some friend please give me the practical details of extracting from herbs and plants? I may say I am able to make any appliance necessary, if I had instructions. Are the roots or leaves boiled or crushed? I have tried boiling dandelion, but failed to get what I want.—W. Thomas.

[72421.]—**North Eastern Railway.**—Could any reader (I should be obliged to "St. Aubyn," if he could) give me a sketch of either of the following engines, with or without tender:—Mr. Fletcher's 7ft. four-coupled express, or Mr. Worsdell's 6ft. 8in. four-coupled express?—Loco. No. 2.

[72422.]—**L.C. and D.R. and N.S.R.**—I should be glad if some reader could give me a sketch of L.C. and D. four-coupled 6ft. 6in. bogie express, by Mr. Kirtley? Also, could any reader give me a sketch with chief dimensions of N.S.R. express engine—"John Bramwell Moore"?—Loco. No. 2.

[72423.]—**Dynamo Armature.**—Will some one kindly tell me if the following plan would answer?—To have the wire for armature wound as in the drum form, but on a reel, the armature being of the Siemens H pattern, but fixed, the wire only to revolve. Would the magnetism of the armature be stronger, as it should become saturated the same as the field-magnets?—H. A.

[72424.]—**Accumulator.**—Could Mr. Bottone or any other reader inform me how to connect a small dynamo to an accumulator which I have made myself, and which consists of ten plain lead plates, 7in. by 4in.? This accumulator will work well from batteries; but when I connect it with the terminals of small shunt-wound dynamo, I cannot collect any electricity on the plates. Also what quantity of electricity should the above-mentioned plates hold, and could you tell me how to make a simple accumulator if this one will not work with dynamo? Dynamo in good working order.—G. A.

[72425.]—**Phonograph.**—Will "Cave Diamond" oblige by giving the various modifications in the latest phonograph, re composition of wax, you referred to on page 535?—Phono.

[72426.] **Autumn Leaves.**—Would anyone kindly tell me the best way to preserve autumn leaves for winter decorations?—A Lady.

[72427.]—**Electrical.**—To Mr. Bottone.—I want to work a 12-volt dynamo as an electro-motor. What battery power will it take, and how can I make a sensitive governor for the above?—J. W. W.

[72428.]—**Bookbinding.**—Could "Practical Bookbinder" describe some simpler method of cutting books than by machine? I would not require a high-class finish, but just to make the book presentable.—Caledmone.

[72429.]—**Accumulator.**—I should feel obliged if Mr. Bottone or other of our able electricians will kindly inform me what is the least weight an accumulator can be made to work an electric motor of 1H.P. for one hour?—Motor.

[72430.]—**Barlow Lens.**—Could any reader inform what the above is like? Does it give good results with Huyghenian eyepieces, and is it better than higher e.p.s. for microscope?—W. H. S.

[72431.]—**Model Pumps.**—Mr. A. F. Shakespear mentions (31521, page 14) that model force-pumps can be worked by a donkey engine without a flywheel. Will he kindly describe the best form either as a model or a more serviceable tool? In my case, steam varies from 50 to 100lb. pressure.—F. T.

[72432.]—**Photograph Lens.**—Would Mr. Bottone kindly inform me why Grubb's landscape lens has a sliding tube in front? I presume it is to allow the distance of the diaphragm from the lens to be varied; but what is the utility of this in practice? An explanation would oblige.—Photo.

[72433.]—**Stringed Instruments.**—I beg to thank Mr. Tahourdin for his full and very explicit reply (72193). It would be of great interest to musical amateurs among your readers if he would favour us with a few notes upon stringed instruments. I find it very difficult to get reliable information even among professional musicians upon the following points. The strings, although in many cases retaining their power to resist the tensional strain of the instrument, lose after a certain time their capacity of exciting sound vibration. They are then said technically to have perished. What is the cause of this, and can it be delayed or prevented? The wire covering of the C and G strings of violoncellos become loose after a varying period of use. Some professional men advise the use of oil to prevent this, but in my experience this oozes out again, and the result is anathema.—A. W. Dorby.

[72434.]—**Black Glaze.**—To "Pottery Tech."—I have a recipe for the above, and among the ingredients are black manganese, tinture tin, and black muracuers. Can you tell me what are the proper names of the last two?—W. J. P.

[72435.]—**Sting of Wasp.**—Will any reader oblige by saying whether a wasp is capable of stinging more than once? The sting I understand is barbed, and when the wasp does sting, its sting is said to break in the flesh. Does the wasp live after having stung? If so, does the sting grow again, or does it simply poison with the sting and then replenish it? A thorough explanation will oblige.—Simpleton.

# ANSWERS TO CO[illegible]

*** *All communications should be addressed [illegible] of the* English Mechanic, 332, Strand, W.C.

## HINTS TO COR[illegible]

1. Write on one side of the paper only, [illegible] for illustrations on separate pieces of paper. [illegible] to queries, and when answering queries put [illegible] as well as the titles of the queries to which [illegible] refer. 3. No charge is made for inserting letters or replies. 4. Letters or queries asking for [illegible] manufacturers or correspondents, or where [illegible] articles can be purchased, or replies giving such [illegible] tion, cannot be inserted except as advertisements [illegible] question asking for educational or scientific [illegible] is answered through the post. 4. Letters sent [illegible] spondents, under cover to the Editor, are not [illegible] and the names of correspondents are not given [illegible] quirers.

*** Attention is especially drawn to Hint No. [illegible] space devoted to letters, queries, and replies is [illegible] the general good, and it is not fair to occupy it [illegible] tions such as are indicated above, which are of [illegible] vidual interest, and which, if not advertisements [illegible] selves, lead to replies which are. The "Sixpenny [illegible] Column" offers a cheap means of obtaining [illegible] tion, and we trust our readers will avail themselves [illegible]

The following are the initials, &c., of letters [illegible] to Wednesday evening, Sept. 17, and unacknowledged elsewhere :—

A. H. Richards.—H. Moore.—Sulphur[illegible].—Y. [illegible] W.—J. R. T.—Leno.—D. H. T.—J. P[illegible].—[illegible] J. Jackson.—B. T.—L. L. R.—F. Y.—[illegible] R.R.E.—Marcasite.—Gosh.—Le[illegible].

B. Bolt. (We have not expressed any opinion [illegible] "treatment of bands," and you do not specify [illegible] on which the "paragraph" appeared. We [illegible] your remarks that you mean leather bands [illegible] information concerning their treatment [illegible] the back volumes. It has been frequently [illegible] those who understand leather belts [illegible] for driving machinery, clean them regularly [illegible] water, soda, and soap, and whilst wet dress [illegible] castor-oil, or what is known to the [illegible] oil. See p. 559, Aug. 22, for instance. [illegible] tures of treacle, rosin, and sundry other [illegible] a band slips—presuming you mean a leather [illegible] evident that it is not properly adjusted, or [illegible] great a task.)—F. Spalding. (Please see "[illegible] Correspondents" above. We do not [illegible] The illustrations of several G.N. engines [illegible] in back numbers, and the parts of the [illegible] have been described recently.)—J. T[illegible]. [illegible] recollection of what you mean. Give [illegible] the date, and we may be able to find [illegible] (The milk is heated in a vacuum pan, and [illegible] much of it, driven off. Sugar is added. The [illegible] apparatus referred to has been described [illegible] again. One part glue, four parts glycerine, and [illegible] to colour. Dissolve the glue, and add the [illegible] dients.)—L. S. (Try the Finsbury College [illegible] street, E.C.; but it is doubtful whether any [illegible] held on such a subject.)—Motor. (You [illegible] a lawyer. You should have "protected" [illegible] tion first. Probably no reply has been [illegible] Orion. (If you mean Dick's "Celestial [illegible] Griffin is the publisher; but ask Mr. W[illegible] seller, Essex-street, Strand, W.C.)—John M[illegible] "Hints to Correspondents" above. The [illegible] was illustrated in No. 1276.)—Edward [illegible] (Why not use paste, if you don't like gum?)—[illegible] scopist. (Why not look through indices? [illegible] the work referred to will be republished [illegible] Brass Finisher. (We really cannot say [illegible] from your description; perhaps not even if [illegible] The subject is of little interest to readers.—[illegible] Blackwell. (The paper will be published [illegible] course in the Report of the British Association [illegible] perhaps the Secretary can let you have [illegible] now.)—An Inquirer. (Better get the [illegible] Directory; but as to the drawings, you [illegible] look for them in the technical papers.)—[illegible] bers. (See any of the textbooks, or refer to [illegible] volumes. Metals can be "welded" by the cur[illegible] but as to keeping up bodily heat by means of [illegible] wires in garments, that is extremely doubtful.)—J. Ellis. (We cannot repeat directions for grinding [illegible] polishing specula every week. Mr. Wassell's [illegible] commenced in Vol. XXXIII. and extended to XLIV. They practically exhausted the subject.)—W. S. T. (The query has been frequently answered. To get rid of the small red ants put chloride of [illegible] carbolic acid in their haunts.)—Careful. (D[illegible] understand what you mean by spiral springs for [illegible] teeth.)—Indore. (Diagrams of the L. and N.W. [illegible] pounds in Nos. 1228 and 1227, and in other num[illegible] As to the other engine, the same type has been [illegible] trated, if not the locomotive named.)—W. Fa[illegible] (Please see indices. Refer to that published last [illegible] or refer to one of the little manuals on screw-cutt[illegible] —W. G. Burns. (We do not know how many [illegible] motives and stationary steam-engines there are [illegible] Great Britain and Ireland.)—A. B. T. (Post [illegible] 1s. 3d. Repeat numbers when ordering.)—J. Q., [illegible] minate, Sigma. (In type.)

**Every Man and Woman** wishing to be [illegible] manently strong and well should wear one of Harness' Electr[illegible] Belts. They are delightfully comfortable to wear, and spe[illegible] vigorate and exhilarate the entire frame, completely exterm[illegible] disease from the system. Thousands of testimonials prove [illegible] remarkable curative value in nervous and rheumatic affections, kidney, and other organic disorders, &c. Pamphlet and consu[illegible] free. Those who cannot call should write at once to the M[illegible] Battery Co. (Ltd.), 52, Oxford-street, London, W. (the larg[illegible] only complete Electro-Medical Institute in the world).—[Advt.]

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he English Mechanic
D WORLD OF SCIENCE AND ART.
*FRIDAY, SEPTEMBER* 26, 1890.

## BOTANY FOR STUDENTS.

EDWARD AVELING, D.Sc. Lond., Fellow of Univ. Coll., Lond.

### hapter XXIV.—The Leaf (*continued*).

ENATION.—Parallel-veined, Fig. 292. The left-hand is a reed, the right-hand ily of the Valley leaf.

eticulate, Fig. 293. The left-hand ni-nerved or feather-veined (elm), the t-hand palmi-nerved or palmately-ed (maple).

hape. Needle-shaped or acicular, Fig. *a* (pine)—*aciculus*, a strong bristle; ar *b* (yew); lanceolate *c* (willow); ob-; *d* (edible chestnut); elliptical *e* (bird-ry); oval *f* (nettle), and *g* (beech); ded *h* (aspen); ovate, Fig. 288 *a* rry), wedge-shaped *b* (cowslip); spathu-*c* (daisy); cordate *d* (lime); reniform iolet); sagittate *f* (convolvulus); hastate lock); obcordate *h* (wood sorrel).

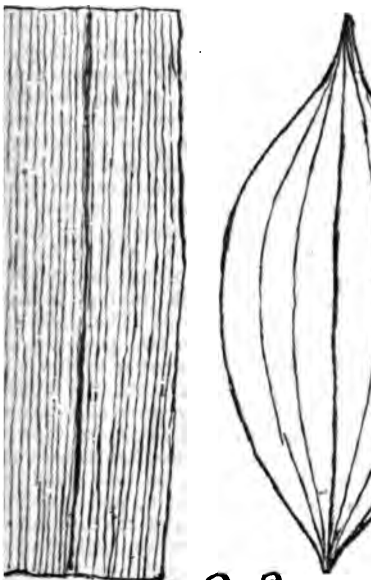


Fig. 292.

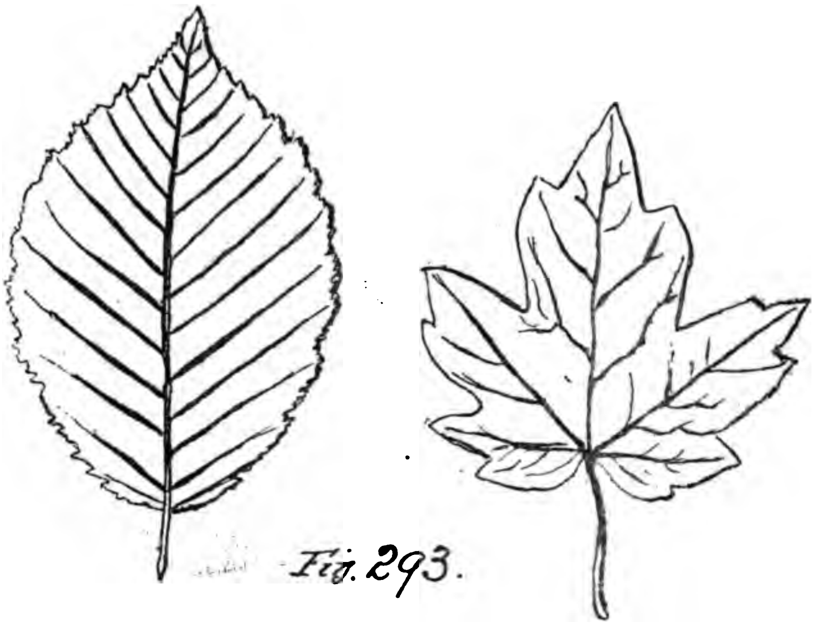


Fig. 293.

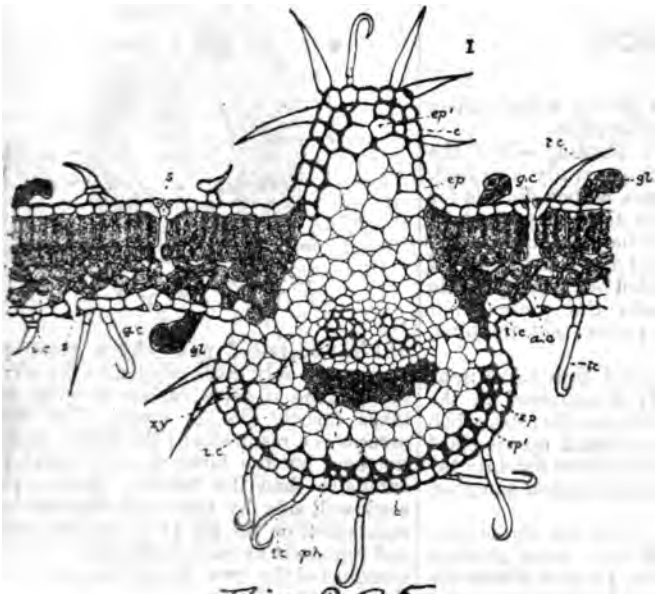


Fig. 295.

Fig. 296.

Margin. Entire, Fig. 322, *a* (syringa); crenate *b* (ground-ivy); dentate *c* (cork-oak); serrate *d* (berberry); doubly-serrate *e* (birch), and 293 (elm).

Pinnatifid *a*, Fig. 290 (oak); pinnatisect and ruminate *b* (dandelion); pinnatipartite *c* (potato); three-lobed *d* (anemone); five-lobed *e* (sycamore); palmately-lobed *f* (buttercup).

Apex. Rounded *b*; obtuse *c*; acuminate *d*; acute *a*; emarginate *h*—all Fig. 288.

Tendrils and spines have been explained. The only other special modification of the leaf calling for comment here is the phyllode. This is a leaf-like petiole resembling a lamina (Fig. 294), but (1) parallel-veined, although occurring in a Dicotyledonous plant, such as the Acacia [Leguminosæ]; (2) presenting its edges, not its face, to earth and sky; (3) uniform in structure histologically, and not presenting the differentiation of structure that the lamina does; (4) often carrying the lamina on the summit.

*Histology.*—Leaves arise laterally and within the apex by cell-division of a group of cells. They arise acropetally, the younger nearer the apex of the stem or branch. The group of cells presents periblem and dermatogen only at first; later plerome. These meristem regions undergo the same transformations into tissues as in the stem.

Fig. 294.

The petiole in transverse section shows epidermis outside, a mass of parenchyma within, traversed by parallel fibro-vascular bundles arranged semicircularly.

The lamina histology will be understood by reference to Fig. 295. This, copied from Howes' "Atlas of Biology," represents a transverse vertical section across a mature bean-leaf. *ep* is epidermis, with trichomes *t c*, and glands *g*, and stomata *s*; *ep'* is the hypoderma or sub-epidermis of cartilaginous cells, thickened at the points of contact of their walls. This is collenchyma. κολλα (kolla), glue. Between the upper and lower epidermis is parenchyma (mesophyll), traversed by fibro-vascular bundles, the veins. The upper parenchyma, *pl*, is of closely-packed oblong cells, and is called palisade parenchyma. To the close packing of its cells, containing chlorophyll, is due the deeper green colour of the upper face of the leaf. The lower parenchyma is of stellate cells, or spongy, with many intercellular spaces related to the many stomata of the lower epidermis. Between the palisade and spongy parenchyma is a layer of rounded cells. In the veins are seen xylem, *xy*, above, and phloem, *ph*, below. These relative positions are in consequence of the relative positions of xylem (within) and phloem (without) in the stem.

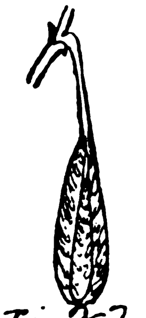


Fig. 297.

The histology of the vagina is the same as that of the lamina.

*Physiology.*—The functions of the leaves are (i.) absorption of liquids; (ii.) transpiration; (iii.) respiration; (iv.) assimilation; (v.) metastasis; (vi.) movement.

(i.) Absorption.—The root, as we have seen, absorbs liquids from the soil. The leaves, and indeed all green parts, absorb water, to some extent, from the air, but not to any great extent. Their chief functions in the way of taking in from the air concern the gases they take in during the two processes of assimilation and respiration.

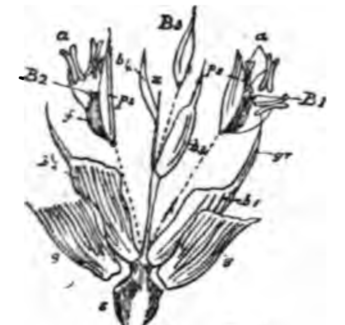


Fig. 298.

(ii.) Transpiration, or the giving out of water-vapour. The surface of the plant exposed to the air is the great agent in this process, and the surface of the leaves does most of the work. The stomata may take some part. The amount of transpiration will depend upon the amount of liquid taken in by the roots, the quantity of water in the plant-tissues, the condition of the surrounding air as to dryness or moisture, the amount of surface exposed, the texture of the leaves, the nature of the epidermis, the temperature, the light.

Only the last of these need detain us. The bearing of all the rest is obvious. The rays of the blue end of the spectrum are the active agents in exciting transpiration, not those of the yellow and red region.

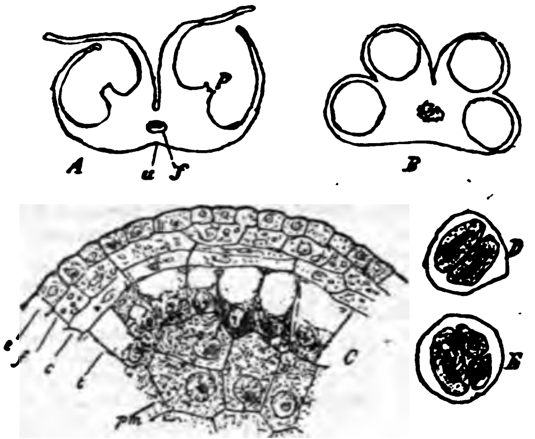


Fig. 299.

(iii.) Respiration.—The breathing of plants is effected by the surface of the stem and the leaves, and especially by the surface of the latter. Just as in animals, the work of the living plant involves decay or combustion or burning of its tissues. And burning is union with oxygen. Oxygen must, therefore, be taken into the plant. The two chief elements in plant tissues are carbon and hydrogen. The products of their combustion—carbon dioxide ($CO_2$) and steam ($H_2O$)—must be got rid of. This taking in of oxygen and giving out of the gaseous products of oxidation is respiration.

The gases going to and from the various parts of the various active tissues go partly by diffusion in the water saturating the cell-walls, partly through the vessels and intercellular spaces; but the actual taking in of oxygen and the actual giving out of carbon dioxide are by the plant surface.

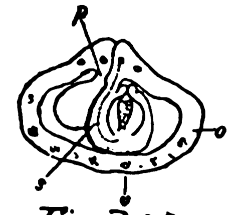


Fig. 300.

(iv.) Assimilation or Feeding.—But the leaves and green parts generally also feed. And they feed on the gas carbon dioxide for the most part; although they may also take in as food-stuffs a little ammonia ($H_3N$). This very important and distinctive function of the leaves is effected by the palisade parenchyma, and needs the presence of chlorophyll and of the yellow, not the blue, rays of the spectrum.

The carbon dioxide ($CO_2$) thus taken in as a food stuff is actually decomposed in the chlorophyll-bearing palisade cells; its carbon is retained, and helps to build up the plant tissues, and its oxygen is given out into the air. This is the process of fixation of carbon or of deoxidation.

Thus the effect of plants on air is two-fold, and as a point of very great moment comes under notice here, I repeat briefly the essential facts to be remembered in connection with respiration in plants and animals. A living being is at work. Work means waste. Waste means decay. Decay is combustion. Combustion is oxidation. Therefore a plant, as it works, wastes, decays, is burning, and forming, as results of its oxidation, carbon dioxide and steam. These are to be got rid of, and this getting rid of the gaseous products of decay is effected by the general surface. Thus much for the respiration of plants. But the effect of plants upon the air is two-fold. They take food in the shape of carbon dioxide from the air; they breathe the air. The two processes m considered together. (1) In brea plants take in oxygen, and give out dioxide. This process goes on cons day and night, in sunlight and in dar (2) In feeding, plants take in carbon d fix the carbon, and give out oxygen. process goes on intermittently, by d by night; in sunlight, not in dar Hence plants are both taking in oxyg giving it out; are both taking in dioxide and giving it out. The great tion is—which of these two processes more extensive? The answer to this i the feeding process is much the m tensive. Truly, it only goes on in th light; but plants feed far more tha breathe; therefore the feeding process the breathing process; so that much carbon dioxide is taken in, and much oxygen is given out; and the total e green plants is to remove carbon d from, and to supply oxygen to, the a

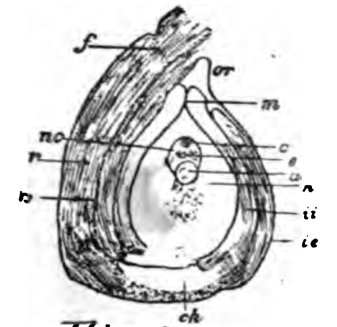


Fig. 301

will be understood now why a green apparently only gives oxygen to the a the daytime it gives carbon dioxide, takes carbon dioxide away. The process is a respiratory; the latter, a tive one; but the latter is very muc extensive than the former. Hence, work well side by side with animals main effect on the air is to receive o and replace it by carbon dioxide. A blending of the two forms is essen the good life of both.

(v.) Metastasis, or metabolism. μετ (metastasis), or μεταβολε (metabole), a After food has been taken in by the of feeding, and oxygen by the pro respiration, the changes wrought upo substances in the building them up i constituents of the plant and all the after changes these plant-constituents go, are called metastasis.

The substances, such as cellulose, proteids, that are to build up plant str are plastic substances. Those, such a that are not used in growth, but generally got rid of, are degradation products.

Summing up and comparing the two processes of feeding and changing, the organs that take in the food are the roots and the green parts. From the soil the roots absorb water with salts in solution. Many of these salts are nitrates, and many are ammonium salts. Ammonium has for symbol, $H_4N$. Hence the roots may be regarded as the organs that take in the nitrogenous parts of the food, for experiments, notably those of Lawes, Gilbert, and Pugh, have shown that nitrogen, as nitrogen, is not taken in from the air as a food-stuff by plants. On the other hand, the green parts take in food from the air, and the chief material thus ingested is carbon dioxide. Of this the carbon is fixed and the oxygen given out. Hence the roots take in the nitrogen-containing food-stuffs, and the leaves especially take in the carbon-containing food-stuff. From the roots the former must move up until they meet the latter coming down from the green parts. When the two sets of food-stuffs meet, the manufacture of those important plant-structures that contain carbon, hydrogen, oxygen, nitrogen, must occur, and from the place where this manufacture occurs, diffusion of these substances to other parts of the plant must follow. There are no openings for the intaking of food in either roots, or leaves, or stems. All is done by the general surface. This taking in of food is Assimilation (*ad*, to; *similis*, like). And to the various processes whereby the first materials thus formed are changed into the many things that are manufactured out of them, the general name of Metastasis, or change, is given. Contrasting the two processes, we find that—

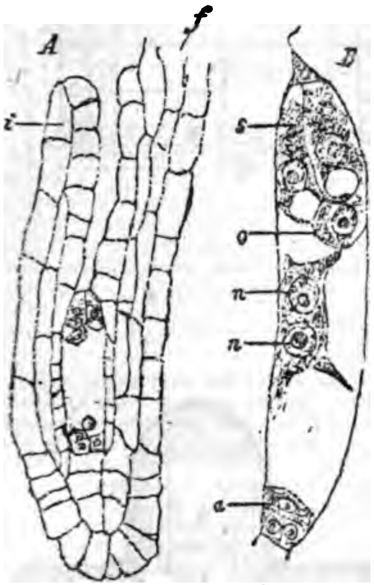


*Fig. 302.*

Assimilation takes place in parts containing chlorophyll.
Metastasis takes place in all parts.
Assimilation needs light.
Metastasis does not.
Assimilation liberates oxygen.
Metastasis uses up oxygen.
Assimilation increases the plant's weight.

Metastasis diminishes the plant's weight, for in the transformation changes work is being done and waste must ensue.

(vi.) Movements. Leaves are generally negatively geotropic, and positively heliotropic. Some of them also when modified into tendrils perform the movements already described and explained in connection with stem tendrils.

But, further, the leaves of certain plants exhibit periodic movements, also non-periodic movements, when they are stimulated by contact or strong light.

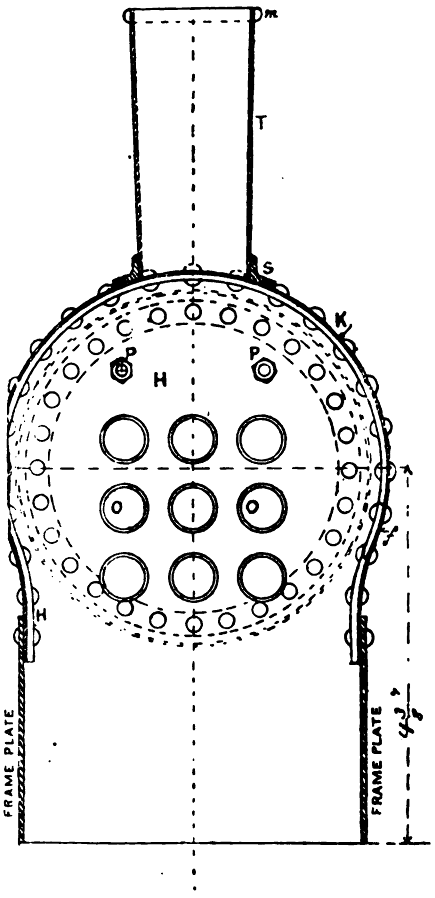
A familiar case of periodic movement is seen in the leaves of the Telegraph plant [Leguminosæ], Fig. 296. The left-hand figure is of the leaves in the day; the right-hand of them in the night.

The sensitive plant [Leguminosæ], Fig. 297, is the stock example of a plant whose leaflets fall after contact with some other body, or under increased light. All these movements appear to be due to either (*a*) increased cell-turgescence and more growth on one side of a petiole or petiolule, or (*b*) increased cell-turgescence, more growth on one side of a special, colourless mass of cells, the pulvinus (a cushion) at the base of petiole or petiolule.

(*To be continued.*)

## MODEL LOCOMOTIVE-MAKING.—IX.

I WISH it were possible to simplify the boiler work to the same extent that we are able to simplify the mechanism of the engine. But in a fuel-burning loco. we must have fire-box, tubes, and smoke-box, and therefore cannot contrive with less than a certain number of plates which have to be bent, flanged, and riveted. But there are some details and fittings inserted in the last loco. which are simplified here.

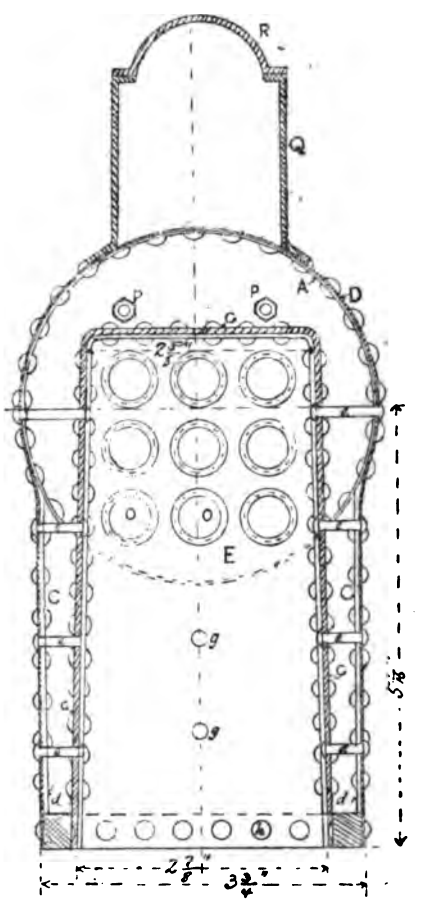


SECTION THRO' SMOKE BOX

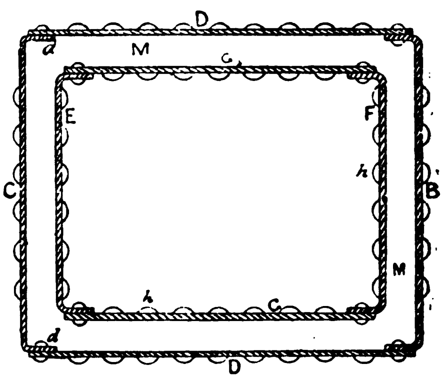
FIG 38

Fig. 38 shows the boiler in various sections, Fig. 39 gives an outside longitudinal elevation, to assist in the understanding of the relations of the various plates, and Figs. 40-48 give details of the separate plates of which it is composed. There are nine fire tubes, and coal or charcoal will be burnt in the fire-box, which is made deeper than required by exact scale, in order that there shall be sufficient *depth* for the fuel to burn freely—the *area* of the grate being inconveniently small. There is no brick arch, and no roof stays.

Beginning with the barrel A (Figs. 38 and 39), this measures 4in. in diameter inside, and should be of 18 or 19 gauge. It may be prepared from sheet-metal rolled or hammered round, and riveted, or a piece of brazed tube will do just as well, provided the brazed joint is perfect. As a boiler of this kind should be tested under water-pressure before getting up steam, there is no objection to using brazed tube, because if faulty, the water-pressure will find it out. Its employment will save the trouble of making a row of rivets and caulking.



SECTION THRO' FIRE BOX



SECTION ON FOUNDN RING

If riveted, the sheet for the barrel will measure 13in. by 10in., and a single lap joint with a single row of rivets spaced at about $\frac{3}{8}$in. centres will be good enough in so small a barrel.

The sheets for the outer and inner fire-boxes are as follows:—In Figs. 38 and 39, B is the back plate. It is cut from sheet of No. 19 gauge to the sizes given in Fig. 40. An oval hole, A, is cut for the fire-door; a $\frac{1}{2}$in. hole, B, drilled for the stuffing-box of the regulator handle, and two $\frac{1}{8}$in. holes, C, C, for stay-bolts. All the edges, excepting the bottom one, are hammered round to form a $\frac{3}{8}$in. flange for riveting.

C, in Figs. 38 and 39, is the throat plate, of

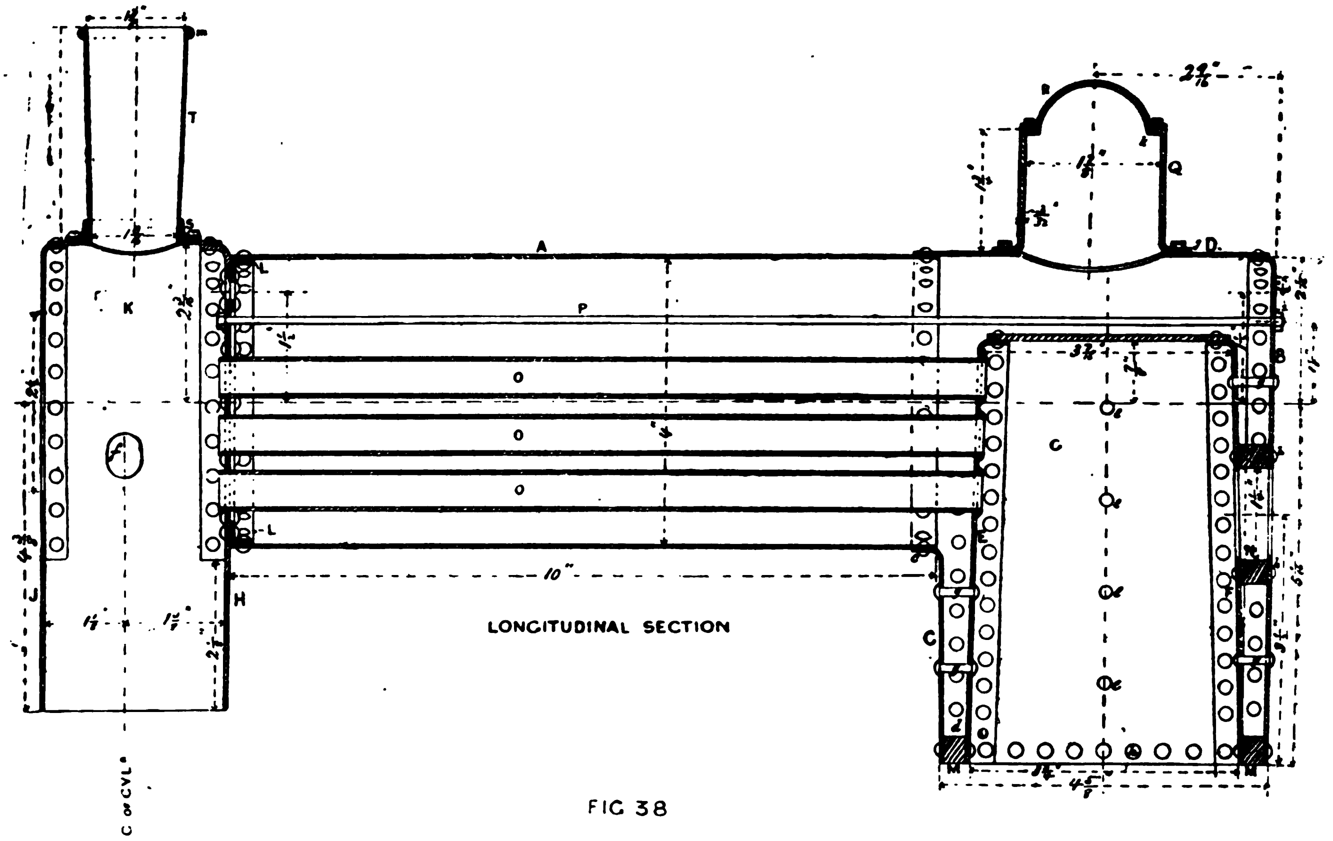


FIG 38

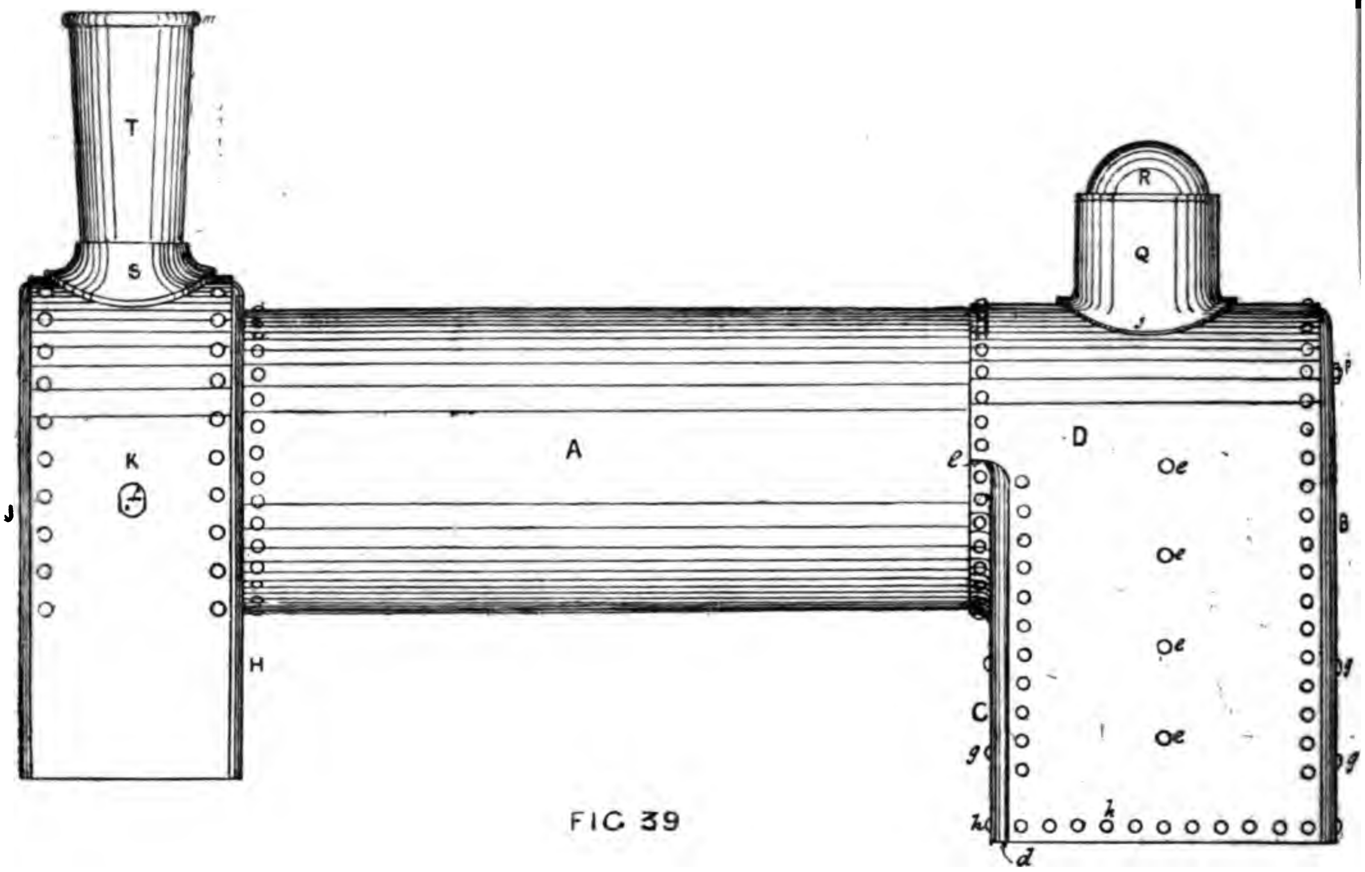


FIG 39

19 gauge, cut to the outline in Fig. 41, and flanged at *c* in one direction, and at *d* in the opposite direction (Figs. 38, 39, 41.)

D (Figs. 38, 39) is the saddle sheet of 20 gauge, cut to the outline of Fig. 42, with $1\frac{7}{8}$in. hole for dome, and bent and riveted to B and C.

The inner fire-box consists of the tube-plate, E (shown in Fig. 38 and in Fig. 43), of 13 gauge, with $\frac{9}{16}$in. holes drilled in positions given, and flanged over $\frac{3}{8}$in. for the rivets. The fire-plate F (Figs. 38 and 44) is of similar size shape, but of 19 gauge, and has an oval hole correspond with the hole in the plate, Fig. 40, and is also flanged. The saddle plate, G (Figs. 38 and 45), of 13 gauge, is riveted to E and F. Note that this plate is made exceptionally thick, to save the necessity of stiffening its crown with girder stays, which are troublesome in a small model, and to lessen the number of rivet stays, *e*, *e*, in the sides.

At the smoke-box end there are the front tube plate H (Figs. 38, 39, and Fig. 46), of 13 gauge, and flanged down as far as the top of the frame plates of the engine, and having $\frac{9}{16}$in. holes drilled for the tubes in the positions shown. A $\frac{3}{8}$in. hole is drilled at A for the regulator-pipe, two $\frac{1}{8}$in. holes at B for the stay rods, and tw $\frac{3}{4}$in. holes at C, through which the glands of th steam-chests will pass into their stuffing-boxe the ends of the stuffing-boxes abutting agai the inside of the plate H.

The front smoke-box sheet, I, of 19 or 2 gauge (Figs. 38, 39, and 47), is flanged as fi as the frame plates, and has a $2\frac{1}{2}$in. hole cut f the smoke-box door. The recesses cut at A A a to clear the front covers of the cylinders, whic as will be seen on reference to Fig. 25, p. 39 pass within the frame-plates.

The smoke-box sheet K, of 20 gauge (Figs. 3

FIG 46

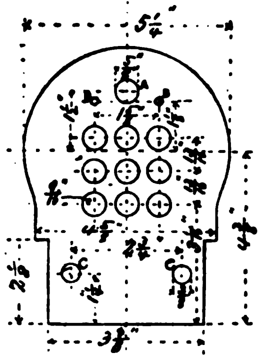


FIG 47

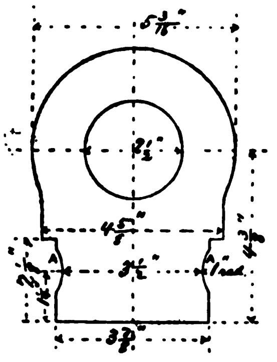


FIG 40

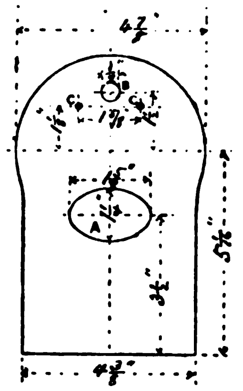


FIG 44

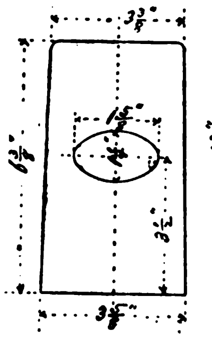


FIG 43

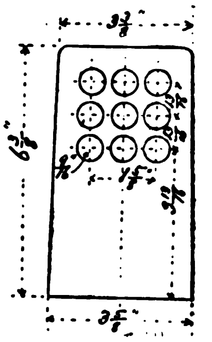
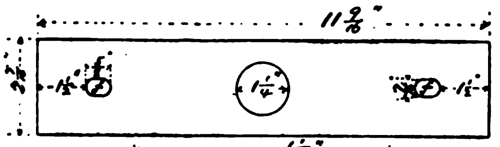


FIG 48



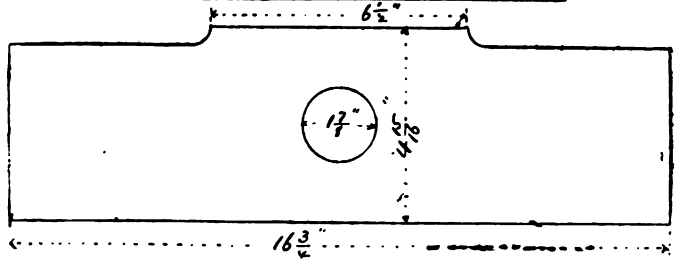
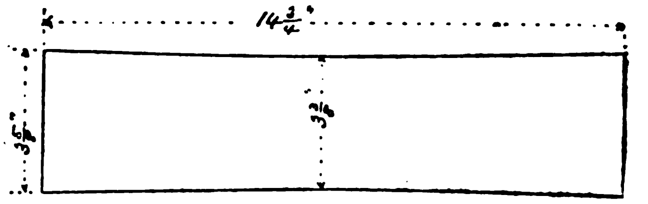


FIG 42

FIG 45



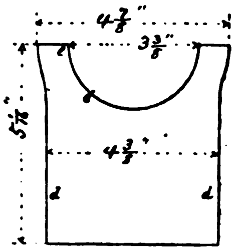


FIG 41

39, and 48), has a 1¼in. hole cut for the chimney, and two elliptical holes, *f*, through which the exhaust pipes will pass from the cylinders into the blast nozzle. This sheet is bent round and riveted to H and K.

Some full details of boiler-making are given in Vol. L. pp. 292, 356, and 398, and my remarks thereon will now therefore be very brief.

Copper is the best material to use in this case, because it is more easily flanged and less liable to become cracked than iron. I should use copper throughout. The bending and flanging will be best done over blocks of hard wood, or over special castings made for the purpose.

The sequence of the work should be as follows:—

Take the barrel A first. If made of a piece of copper or brass tube, chuck it upon a block of wood turned cylindrical to the diameter of the bore, and cut the barrel ends square to a length of 10in., and strike two lines round 3⁄16in. from the ends for the rivet centres. If made of sheet copper or brass, roll if possible, and if not, hammer the sheet into a cylindrical form, and rivet it, pitching the rivets at about ⅝in. centres, and placing the seam uppermost when fixing in position.

In actual boilers, and in the previous model, the barrel is attached to the front tube plate H with an external angle iron ring. In this case, a neater and simpler method is to cast an internal ring, L, of phosphor bronze. The ring should properly be turned and faced. If the barrel is riveted, the inner corner of the plate at the seam must be thinned down where the ring comes in contact with it.

The ring will first be riveted to the barrel A—an easy task, the end being open, and next the flat face of the ring to the front tube plate H, the rivets being turned over on the front of the plate, and a dolly pinched in the vice to support the rivet heads within the barrel.

Next, against the flange of the tube plate H will be riveted the fire-box sheet K, and then to this the fire-box plate I, the rivets being hammered over upon the outside, and a straight dolly, and a bent dolly, or else a holding-up hammer, according to the position of the rivets, being held against the heads.

At the fire-box end take the throat-plate C first. Flange the part *e*, to embrace the barrel, and the part *d* in the opposite direction to fall within the arched sheet D. Thin the corners down at *e* by hammering. Rivet the curved flange *c* at once to the barrel, taking care that the bottom end of the sheet is parallel with the smoke-box plates. Then the arched sheet D will be fitted and riveted both to the barrel and to the throat-plate. Afterwards the fire-door plate B will be slid within the arched sheet D and riveted.

The three plates, E, F, G, that form the inner fire-box are now riveted together free from winding, and are ready for insertion within the outer fire-box. There are four means of attachment employed—the foundation ring M, the fire-hole ring N, the tubes O, and the rivet stays *e* and *g*. The foundation ring M is made in wrought iron. But it can be made in malleable cast iron, or in gun-metal if welding presents any difficulty. The same remark applies to the elliptical fire-hole ring N. The rivets *h* that unite the inner and outer fire-boxes pass through these rings. If the rings are prepared to correct dimensions, and if the sheets in the fire-boxes are cut and put together truly, with the bottom edges flush, then the water spaces on opposite sides will be equal, as they should be. Afterwards the rivet-stays *e*, *g*, will be inserted, and turned over on the outside.

Observe that I show no countersunk rivets anywhere. It is safer in such thin sheets to use snap heads.

The tubes O, of brass, will be inserted through the smoke-box door, and expanded and beaded over in the fire-box, according to instructions given in Vol. L. p. 357.

A couple of bolt-stays, P, will complete the boiler proper.

No model locomotive boiler should be without a dome, because without it the steam will enter the regulator pipe so nearly on a level with the water that it will become very highly charged with moisture. Yet a properly constructed dome is a troublesome thing to make. One made of sheet copper is shown in Vol. L. p. 398, and a similar method may be adopted in this case. But as giving slightly less trouble to those who are able to construct patterns and core-boxes, I suggest the dome Q in Figs. 38, 39, made of tough gun-metal. The body is provided with two flanges, an external one, *j*, to screw to the boiler, and an internal one, *k*, to receive the crown R, the crown being necessarily made to unscrew for the purpose of getting at the regulator.

The body of the dome will be cored out, the thickness, 3⁄32, being too slight to permit of making the pattern like the casting. The cover R will be made just like its casting.

The saddle flange *j* will be filed and fitted with red lead to the boiler, and screwed to it with cheese-headed or button-headed screws, a film of red lead being interposed. Unless the fit is very good a ring of wire gauze, or of American cloth smeared with red lead, will make a steam-tight joint. Or a length of fine copper wire coiled around two or three times in the joint will suffice. The joint of the cover R will be rendered steam-tight by similar means.

The chimney base S can be cast more readily than by hammering sheet copper, and I show, therefore, such a casting, whose pattern will be exactly like it. Screws also will fasten this to the smoke-box. Within it, the chimney T, of copper, brass, or tin, will be soldered. A bit of half-round wire soldered round the top will form the beading. The sheet for the chimney will be cut to form the frustum of a cone, 3in. long, and tapering in that length from 4⅛in. to 4½in. This will allow about ⅛in. for a soldered lap joint. A piece of common brass tube will answer if the tapered form is discarded. Or a casting might be used with the bead cast on it. Or base and chimney body may be cast in one piece.

The consideration of the various fittings and mountings will be reserved for another article.

J. H.

The Antigua *Standard* advises the local Government to pass some measure for the protection of turtle against the wanton destruction that has been going on for some years, or else there will soon be a turtle famine.

In the forests of Galicia an electrical tree-feller has been introduced with success. The saw is actuated by an electric motor, to which the current is conveyed by conducting wires from the nearest generating station. The whole apparatus is mounted on a chariot or cart, which is brought to the foot of the tree and placed in position. When a trunk is cut through far enough on one side, the cut is kept open by wedges, and the saw removed to the other side.

# ASTRONOMICAL NOTES FOR OCTOBER, 1890.

### The Sun.

| Day of Month. | Souths. | At Greenwich Mean Noon. Right Ascension. | Declination South. | Sidereal Time. |
|---|---|---|---|---|
| | h. m. s. | h. m. s. | ° ′ ″ | h. m. s. |
| 1 | 11 49 37·18 A.M. | 12 30 18 | 3 16 24 | 12 40 40·82 |
| 6 | 11 48 5·63 ,, | 12 48 29 | 5 12 19 | 13 0 23·59 |
| 11 | 11 46 44·26 ,, | 13 6 50 | 7 6 39 | 13 20 6·35 |
| 16 | 11 45 35·30 ,, | 13 25 24 | 8 58 35 | 13 39 49·12 |
| 21 | 11 44 40·67 ,, | 13 44 12 | 10 47 18 | 13 59 31·89 |
| 26 | 11 44 2·11 ,, | 14 3 17 | 12 31 56 | 14 19 14·66 |
| 31 | 11 43 41·76 ,, | 14 22 39 | 14 11 43 | 14 38 57·44 |

The Method of finding the Sidereal Time at Mean Noon at any other station is explained on p. 353 of Vol. L.

The appearance of a fine group of spots in a low north latitude during the last four weeks indicates that solar activity is again setting in. Hence watch should be kept by the student on every fine day for spots and faculæ.

The Zodiacal Light may be seen over the eastern horizon before sunrise.

### The Moon

enters her Last Quarter at 8h. 23·3m. p.m. on the 5th, and is New at 11h. 5·0m. on the night of the 13th. She will enter her First Quarter at 5h. 36·5m. in the early morning of the 21st, and be Full on the 27th at 11h. 41·9m. p.m.

| Day of Month. | Moon's Age at Noon. | Souths. |
|---|---|---|
| | Days. | h. m |
| 1 | 17·2 | 2 1·6 a.m. |
| 6 | 22·2 | 6 17·8 ,, |
| 11 | 27·2 | 10 7·8 ,, |
| 16 | 2·5 | 1 49·8 p.m. |
| 21 | 7·5 | 6 34·7 ,, |
| 26 | 12·5 | 10 59·2 ,, |
| 31 | 17·5 | 2 22·9 a.m. |

The Moon will be in conjunction with Saturn (3° 40′ N. of him) at 6h. p.m. on the 10th; with Mercury at 7h. a.m. on the 12th (Mercury 3° 57′ S.); with Venus at 1h. p.m. on the 17th (Venus 5° 44′ S.); with Mars at the same hour on the 20th (Mars 0° 33′ N.); and with Jupiter at 2 p.m. on the 21st (Jupiter 3° 3′ N.)

At Noon on October 1st, the Moon is in a perfectly blank region in Aries; but she moves out of this into Taurus at 7 o'clock in the evening. She remains in Taurus until 6h. p.m. on the 4th, when she quits it for Gemini. She is travelling through Gemini until 9h. 30m. p.m. on the 6th, and she then enters Cancer. By 2h. p.m. on the 8th she has traversed Cancer and passed into Leo. Her journey through Leo occupies exactly three days, or 72 hours, and at 2 p.m. on the 11th she leaves Leo for Virgo. She is in Virgo until 3h. a.m. on the 15th, at which hour she enters Libra. Having crossed Libra, she arrives, at 11h. 30m. p.m. on the 16th at the Western edge of the Northern spike of Scorpio, out of which she passes into Ophiuchus at 11 o'clock the next morning. She is in Ophiuchus until 9h. 30m. p.m on the 18th, and then she quits it for Sagittarius. She leaves Sagittarius for Capricornus at 8h. a.m. on the 21st, and Capricornus, in turn, for Aquarius at 1h. a.m. on the 23rd. Having completed her journey through Aquarius, she, at 1h. a.m. on the 25th, goes out of it into Pisces. As she traverses Pisces, she, at 3 p.m. on the 25th, arrives at a portion of Cetus, which she enters; emerging in Pisces again at 6h. p.m. on the 26th. This is, however, only to plunge into another part of Cetus at 2h. p.m. on the 27th, and when she finally leaves Cetus at 10 o'clock on the same night, it is to come out in Aries. Her passage over Aries terminates at 5h. am. on the 29th, at which hour she enters Taurus. She is on the confines of Taurus and Gemini at midnight on the 31st.

### Occultations of Fixed Stars, and an Occultation of Neptune, by the Moon.

| Day of Month. | Star's Name. | Magnitude. | Disappearance. | Moon's Limb. | Angle from N. Point. | Angle from Vertex. | Reappearance. | Moon's Limb. | Angle from N. Point. | Angle from Vertex. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | h. m. | | ° | ° | h. m. | | ° | ° |
| 1 | 38 Arietis | 5 | 1 4 a.m. | Bright | 355 | 8 | 1 35 a.m. | Dark | 304 | 310 |
| 2 | NEPTUNE | | 9 46 p.m. | Bright | 58 | 98 | 10 42 p.m. | Dark | 261 | 302 |
| 5 | 48 Geminorum | 6 | 11 28 ,, | Bright | 93 | 132 | 12 26 a.m. | Dark | 257 | 299 |
| 21 | B.A.C. 7197 | 6 | 9 35 ,, | Dark | 63 | 37 | ‡10 39 p.m. | Bright | 257 | 225 |
| 22 | B.A.C. 7550 | 6 | 7 3 ,, | Dark | 80 | 85 | 8 14 ,, | Bright | 233 | 227 |
| 23 | $\tau^1$ Aquarii | 6 | 11 28 ,, | Dark | 115 | 88 | 12 5 a.m. | Bright | 188 | 157 |
| 24 | $\tau^2$ Aquarii | 4 | 12 28 a.m. | Dark | 68 | 36 | ‡1 26 ,, | Bright | 237 | 200 |
| 27 | 64 Ceti | 6 | 6 28 p.m. | *Dark | 55 | 94 | 7 26 p.m. | Bright | 250 | 288 |
| 27 | $\xi^1$ Ceti | 4½ | 7 22 ,, | *Dark | 42 | 80 | 8 21 ,, | Bright | 259 | 293 |
| 28 | $\xi$ Arietis | 5½ | 2 42 a.m | Bright | 28 | 356 | 3 56 a.m. | *Dark | 281 | 244 |
| 28 | B.A.C. 755 | 6 | 3 29 ,, | Bright | 83 | 48 | 4 30 ,, | *Dark | 229 | 191 |
| 29 | B.A.C. 1240 | 6 | 7 59 p.m. | Bright | 135 | 174 | 8 21 ,, | Dark | 179 | 221 |
| 30 | $\omega^1$ Tauri | 6 | 1 8 a.m. | Bright | 345 | 351 | 1 18 ,, | Dark | 329 | 332 |

‡Moon has set. *But apparently bright.

### Jupiter's Satellites.

| Day of Month. | Satellite. | Phenomenon. | H. | M. | S. | Day of Month. | Satellite. | Phenomenon. | H. | M. | S. | Day of Month. | Satellite. | Phenomenon. | H. | M. | S. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | *III* | *Tr E* | 5 | 56 | P.M. | 9 | II | Sh E | 8 | 44 | P.M. | 19 | III | Ec R | 8 | 57 | 32 P.M. |
| 1 | III | Sh I | 7 | 12 | ,, | 10 | *I* | *Tr I* | 10 | 34 | ,, | 19 | I | Tr E | 9 | 16 | ,, |
| 1 | *III* | *Sh E* | 10 | 54 | ,, | 11 | I | Oc D | 7 | 54 | ,, | 19 | *I* | *Sh E* | 10 | 36 | ,, |
| 2 | *II* | *Sh E* | 6 | 7 | ,, | 11 | IV | Ec D | 9 | 47 | 49 ,, | 20 | I | Ec R | 7 | 54 | 2 ,, |
| 2 | *I* | *Oc D* | 11 | 34 | ,, | 12 | I | Sh I | 6 | 20 | ,, | 21 | *I* | *Sh E* | 5 | 5 | ,, |
| 3 | IV | Sh E | 6 | 30 | ,, | 12 | I | Tr E | 7 | 22 | ,, | 23 | II | Tr I | 8 | 19 | ,, |
| 3 | I | Tr I | 8 | 41 | ,, | 12 | I | Sh E | 8 | 41 | ,, | 25 | II | Ec R | 8 | 7 | 36 ,, |
| 3 | I | Sh I | 9 | 56 | ,, | 13 | *I* | *Ec R* | 5 | 58 | 40 ,, | 26 | III | Oc R | 7 | 38 | ,, |
| 3 | *I* | *Tr E* | 11 | 1 | ,, | 14 | *II* | *Oc D* | 10 | 38 | ,, | 26 | I | Tr I | 8 | 50 | ,, |
| 4 | *I* | *Oc D* | 6 | 1 | ,, | 15 | *III* | *Tr I* | 9 | 57 | ,, | 26 | *III* | *Ec D* | 9 | 25 | 43 ,, |
| 4 | I | Ec R | 9 | 34 | 26 ,, | 16 | *II* | *Tr I* | 5 | 45 | ,, | 26 | *I* | *Sh I* | 10 | 11 | ,, |
| 5 | *I* | *Tr E* | 5 | 29 | ,, | 16 | II | Sh I | 8 | 2 | ,, | 27 | I | Oc D | 6 | 11 | ,, |
| 5 | I | Sh E | 6 | 45 | ,, | 16 | II | Tr E | 8 | 39 | ,, | 27 | *I* | *Ec R* | 9 | 49 | 23 ,, |
| 7 | II | Oc D | 8 | 6 | ,, | 18 | *II* | *Ec R* | 5 | 29 | 42 ,, | 28 | *I* | *Sh I* | 4 | 40 | ,, |
| 8 | *III* | *Tr I* | 6 | 4 | ,, | 18 | *I* | *Oc D* | 9 | 48 | ,, | 28 | I | Tr E | 5 | 41 | ,, |
| 8 | III | Tr E | 9 | 44 | ,, | 19 | *III* | *Ec D* | 5 | 24 | 36 ,, | 28 | I | Sh E | 7 | 1 | ,, |
| 8 | *III* | *Sh I* | 11 | 13 | ,, | 19 | I | Tr I | 6 | 56 | ,, | 28 | IV | Ec R | 8 | 41 | 40 ,, |
| 9 | *II* | *Sh I* | 5 | 48 | ,, | 19 | IV | Tr I | 7 | 35 | ,, | | | | | | |
| 9 | *II* | *Tr E* | 6 | 7 | ,, | 19 | I | Sh I | 8 | 16 | ,, | | | | | | |

Ec, Eclipse; Oc, Occultation; Tr, Transit of Satellite; Sh, Transit of Shadow; D, Disappearance; R, Reappearance; I, Ingress; E, Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight, or by Jupiter's proximity to the horizon.

### Mercury

Is a morning Star throughout the month, and may be caught during the earlier part of it above the horizon to the South of East before sunrise. He attains his greatest elongation West of the Sun (18° 5′) at 5 a.m. on the 15th. Between the 1st and the 31st his angular diameter shrinks from 9·9″ to 5″, so that, towards the end of October, he becomes a very insignificant object indeed, if not practically undiscernible.

| Day of Month. | Right Ascension. | Declination South. | Souths. |
|---|---|---|---|
| | h. m. | ° ′ | h. m. |
| 1 | 12 14·3 | 3 35·2 | 11 33·7 a.m. |
| 6 | 12 2·7 | 0 30·1 | 11 2·4 ,, |
| 11 | 12 5·2 | 0 40·3N. | 10 45·4 ,, |
| 16 | 12 21·4 | 0 17·1S. | 10 41·8 ,, |
| 21 | 12 46·1 | 2 42·8 | 10 46·7 ,, |
| 26 | 13 14·7 | 5 52·2 | 10 55·6 ,, |
| 31 | 13 44·9 | 9 14·8 | 11 6·1 ,, |

The curiously looped path indicated by the above Ephemeris is described in Virgo. On the morning of the 19th, Mercury will be a little to the South of the well-known binary star γ Virginis, and he will be in conjunction with Uranus (Mercury 1° 4′ N.) at 7h. a.m. on the 31st.

### Venus

is an Evening Star throughout October, and attains her greatest brilliancy at 3h. a.m. on the 30th. Unfortunately, at this time she will have such tremendous South Declination as greatly to impair the chance of her observation. Were it otherwise, she would now be by far the most brilliant and conspicuous object in the sky. As it is, we need only caution everyone who may read these lines, that should he soon after sunset detect a glittering object close over the S.W. by S. part of the horizon, that such object is *not* "The Star of Bethlehem." The diameter of the planet steadily increases from 26·4″ on the 1st, to 43·1″ on the last day of the month, and, if visible in the telescope she exhibits a beautifully crescentic form.

| Day of month. | Right Ascension. | Declination South. | Souths. |
|---|---|---|---|
| | h. m. | ° ′ | h. m. |
| 1 | 15 25·0 | 22 40·5 | 2 43·9 p.m. |
| 6 | 15 43·7 | 24 6·0 | 2 42·8 ,, |
| 11 | 16 1·7 | 25 18·9 | 2 41·1 ,, |
| 16 | 16 18·6 | 26 19·0 | 2 38·4 ,, |
| 21 | 16 34·2 | 27 5·6 | 2 34·2 ,, |
| 26 | 16 48·0 | 27 38·5 | 2 28·3 ,, |
| 31 | 16 59·3 | 27 57·4 | 2 20·0 ,, |

Whence it will be seen that Venus will start in a perfectly blank region in Libra, and traverse nearly all the central part of Scorpio. On the evening of the 17th she will be less than ½° south of Antares.

### Mars

Is, for all practical purposes, invisible; and

### Jupiter

must be looked at as close as possible to his Meridian passage to be seen at all, as he is rapidly approaching the West. His angular ıl diameter diminishes from 40·3″ on the 7·7″ on the 31st. He is in quadrature Sun at 2h. a.m. on the 27th.

| Right ıscension. | Declination South. | Souths. |
|---|---|---|
| h. m. | ° ′ | h. m. |
| 20 19·2 | 20 25·6 | 7 37·3 p.m. |
| 20 19·6 | 20 24·1 | 7 18·0 ,, |
| 20 20·4 | 20 21·5 | 6 59·1 ,, |
| 20 21·4 | 20 17·7 | 6 40·5 ,, |
| 20 22·8 | 20 12·8 | 6 22·2 ,, |
| 20 24·5 | 20 6·9 | 6 4·3 ,, |
| 20 26·5 | 19 59·8 | 5 46·6 ,, |

ort arc is described to the south of a f little stars in the western part of aus.

n, **Uranus** (who comes into conjunction sun at noon on the 20th), and—for the of the ordinary amateur observer— , are all invisible.

### ima of the Variable Star-Algol

pen on October 6th at 3h. 57m. a.m., th at 12h. 46m. a.m., on the 12th at p.m., on the 14th at 6h. 23m. p.m., 6th at 5h. 39m. a.m., on the 29th at a.m., and on the 31st at 11h. 16m. well as on the other occasions when the non will be invisible.

### Shooting Stars

ibly be seen between the 1st and 6th; the 18th to the 21st is the most likely r their appearance; and notably on the ight may a shower be expected.

### ich Mean Time of Southing of f the Principal Fixed Stars on ght of October 1st, 1890.

| Star. | Souths. h. m. s. |
|---|---|
| ) | 6 38 12·30 p.m. |
| . | 7 3 36·12 ,, |
| orni | 7 30 4·18 ,, |
| . | 7 55 43·49 ,, |
|  | 8 33 53·98 ,, |
| . | 8 56 40·13 ,, |
| ii | 9 17 57·71 ,, |
| ut | 10 9 16·09 ,, |
|  | 10 16 57·05 ,, |
| ı | 10 51 52·10 ,, |
| medæ | 11 20 12·09 ,, |
| peiæ | 11 51 41·59 ,, |
| . | *12 36 41·90 ,, |

* Early morning of 2nd.

ethod of ascertaining the Greenwich Mean Southing of either of the stars in the t on any other night in October, as also determining the Local instant of its at any other station, will be found on f Vol. L. It must, however, be noted first of the rules there given is not rue when applied to Polaris, or, in point o any close circumpolar star; though it bably be found quite sufficiently so in actice.

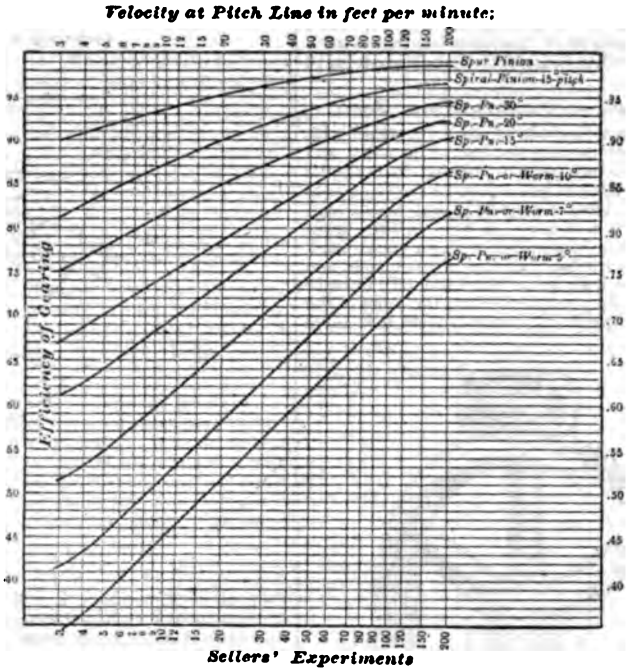
## ICS, OR THE THEORY AND CTICE OF THE TEETH OF RS.—XI.*

### ncy of Spiral and Worm Gearing.

SS the shafts are parallel the teeth of a ir of spiral gears are moving in different s, and therefore they cannot pass each hout sliding on each other an amount that rapidly with the angle of divergence of the s of motion, that is, the shaft angle.

iding action creates friction, and tends to teeth, and to a very much greater extent enerally supposed. The friction is so great, hat such gears, particularly worm gears, e used only for conveying light powers. extensively used, or rather misused, for elevators, and are even found in milling , gear gutters, planers, and similar places, t ignorance that they waste from a quarter hirds of the power received.

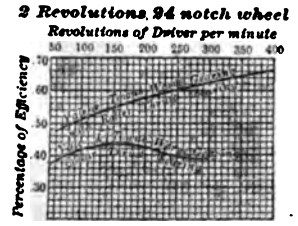
ost extensive experiments on the efficiency of d worm gears ever made were made by Wm. nd Co., and they may be found described in great detail in a paper by Wilfred Lewis in the "Transactions of the American Society of Mechanical Engineers," vol. vii. Space will not permit extensive quotations from this valuable paper, but the general result of the experiments is shown by the diagram, Fig. 93. The diagram shows that a common cast-iron spur gear and pinion on parallel shafts have an efficiency of from 90 to 99 per cent., according to the speed at which they are working; that a spiral pinion of 45°, angle working in a spur gear, with shafts at 45°, has an efficiency of from 81 to 97 per cent.; that the efficiency decreases as the angle of the shaft increases, until, for a worm of a spiral angle of 5°, at a shaft angle of 85°, it goes as low as 34, and does not rise higher than 77 per cent. This includes the waste of power at the shaft bearings as well as that at the teeth of the gears. The efficiency is lowest for slow speeds, and rises with the speed. The diagram may be relied upon to give its true value, under ordinary conditions, within 5 per cent.



*Sellers' Experiments*

*Fig. 93*

The same experiments developed the fact that the velocity of the sliding motion of the cast-iron teeth on each other should not be over 200ft. per minute in continuous service, to avoid cutting of the surfaces. It may be assumed that the efficiency will be higher when the worm is of steel, particularly when the gear is of bronze.



*Yale & Towne Experiments*

*Fig. 94.*

Diagram, Fig. 94, shows the result of similar experiments by Prof. Thurston, with a worm of 6in. diameter and 1in. circular pitch running in a gear of 16in. diameter, both cast iron.

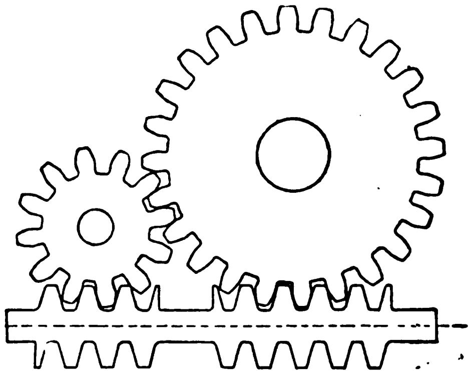
It is to be observed that it is the shaft angle, and not the angle of the spiral, that determines the efficiency. A pair of spiral gears on parallel shafts are practically as efficient as gears with straight teeth.

The great friction of worm gearing is of advantage for one purpose, and for one only, to secure safety and prevent undesired motion of the gears. The worm of Fig. 97 will easily move the gear, but the gear must be moved with great force to start the worm. When the angle of the worm is as small as the "angle of repose" for the metals in contact, it is impossible for the gear to drive the worm. This may be an excuse for the use of the worm gear in elevators, but it would seem that the safety of the cage should depend on devices attached to the cage itself, rather than to the hoisting machinery or other distant part.

Unless the friction of the gears must be depended upon for safety, the worm gear should be used only for purposes of adjustment, or when speed must be greatly reduced or power increased within a small compass, and not for conveying power.

### Thrust of Spiral Teeth.

The oblique action of the teeth of spiral gears on each other tends to throw the gears bodily in the direction of their axes, and this tendency creates a thrust that must be opposed by thrust bearings.



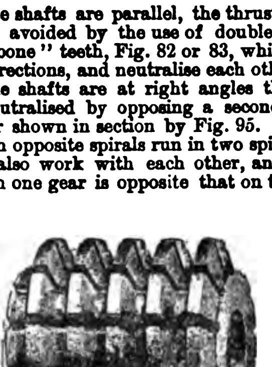
*Arrangement to avoid thrust*

*Fig. 95.*

The end pressure on the shaft of a worm is greater than that exerted on the teeth of the worm gear it is driving.

When the shafts are parallel, the thrust may be completely avoided by the use of double spiral or "herring-bone" teeth, Fig. 82 or 83, which act in opposite directions, and neutralise each other.

When the shafts are at right angles the thrust may be neutralised by opposing a second gear in the manner shown in section by Fig. 95. The two worms with opposite spirals run in two spiral worm gears that also work with each other, and, as the pressure on one gear is opposite that on the other, there is no thrust on the shaft. When this combination is made with worm gears having concave teeth, the teeth can bear only at their ends.



*A Hob. Fig. 96.*

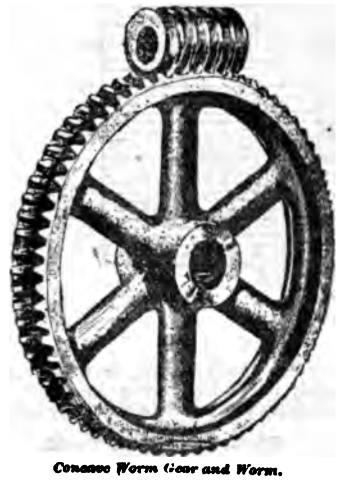
When the thrust cannot be avoided it should be takan by a roller bearing, rather than by the common collar bearing. The diagram, Fig. 94, shows the superior efficiency of the roller bearing as compared with the collar bearing, the gain being from 10 to 20 per cent.

---

* y Geo. B. Grant, in *American Machinist.*

### The Hobbed or Concave Worm Gear.

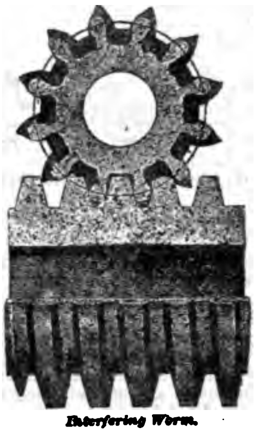
If a spiral gear is made of steel, provided with cutting edges by making slots across its teeth, and hardened, it will be a practical cutting tool called a spiral milling cutter or hob. Fig. 96 shows a spiral milling cutter, having a great spiral angle, and, therefore, called a worm. If this cutting spiral gear is mounted in connection with an uncut blank so that both are rotated with the proper speeds, and the shafts of the two gears are gradually brought together while they are revolving, the edge of the blank will be formed with concave teeth that curve upwards about the sides of the cutting gear. If the hob is then replaced with a spiral gear that is a duplicate of it, except that it has no cutting teeth, we shall have the familiar worm and worm gear of Fig. 97.



*Concave Worm Gear and Worm.*
*Fig. 97.*

The principle of the concave gear applies to any pair of spiral gears, on shafts at any angle, but in practice it is confined to the worm and gear on shafts at right angles.

The nature of the contact between the worm and the concaved worm gear has not yet been definitely determined, but there is no reason to suppose that it is different from that between plain spiral teeth, a point contact on the normal spiral, but it is probably continuous. It is certain, however, that the contact is consideraly closer, more nearly resembling surface contact, and being surface contact when the diameter of the gear is infinite.



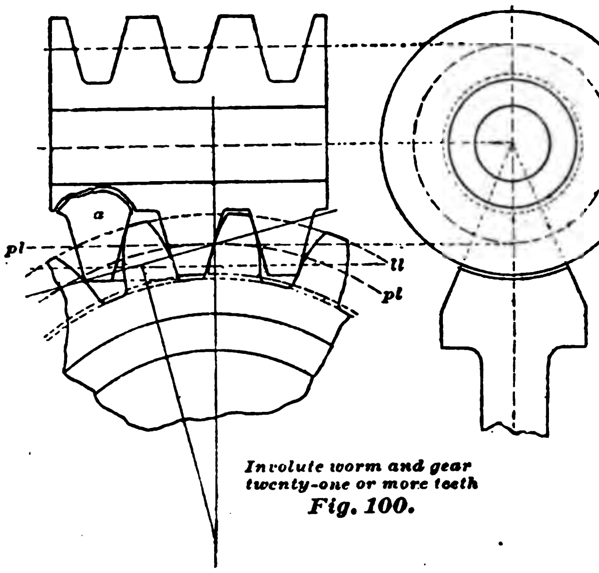
*Interfering Worm.*
*Fig. 98.*

The worm is adjustable in the concaved teeth of the gear in the direction of its axis, and will change its position as required by the wear of the thrust bearing. It is not adjustable laterally.

### Hobbing the Worm Gear.

When the hob is provided it is a simple matter to cut the gear. The gear is generally provided with the desired number of notches it its edge, that are deep enough to receive the points of the teeth of the hob, and the hob will then pull it around as it revolves.

It is a too common practice to make the hob do its own nicking, for, if it is forced into the face of the gear as it revolves, it will pull it around by catching its last teeth in the nicks made by the first.



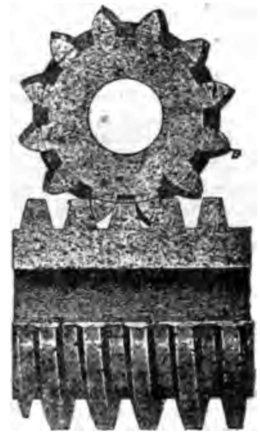
*Involute worm and gear*
*twenty-one or more teeth*
*Fig. 100.*

If luck is good, these nicks will run into each other, and the gear will be cut with teeth that appear to be correct; but, as the outside diameter is greater that the pitch diameter, there will be one, two, or three teeth too many. The teeth of the finished gear are therefore smaller than those of the worm by an amount that is ruinous if the gear is small, although it is not noticeable when the diameter is large. If there are 12 teeth where there should be but 10, each tooth will be too small by two-twelfths of itself; but if there are 102 teeth where there should be but 100, each tooth is too small by but two-hundredths of itself. This handy makeshift process will do very well on large gears; but not on small ones, unless the worm to run in the gear is made to fit the tooth, with a tooth that is smaller, and lead that is shorter than that of the hob.

### Involute Worm Teeth.

Worms are generally cut in the lathe, and as a straight-sided tooth is most easily formed, the involute tooth is generally adopted.

Strictly, the form of the tool should be that of the normal section of the thread, and it should always be set in the latho with its cutting face at right angles to the thread. But custom and convenience allow the tooth to have straight sides, and to be set with its face parallel with the axis of the worm, and the real difference is not generally noticeable.



*Interference Avoided.*
*Fig. 99.*

The standard tool has its sides inclined at an angle of 30°, and has a length and a width dependent upon the pitch.

### Interference of Involute Worm Teeth.

There is one difficulty that is seldom recognised, but which must be carefully guarded against if properly running gears are expected, and that is interference. The teeth of worm gears will interfere with each other when the conditions are right for interference, just as spur involute teeth will interfere, as shown by Fig. 36. Fig. 98 shows the gear that would be formed by the usual process. The difficulty can be remedied by rounding over the tops of the teeth of the hob and worm.

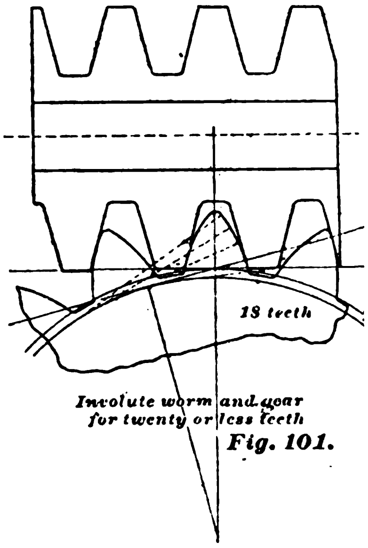
It is also a simple matter to avoid the inter by enlarging the outside diameter of the gear. If, as shown by Fig. 99, the tooth ha short flank, or none at all, and the addendun gear is about twice that by the usual rule, the will be confined to the face of the gear a flank of the worm, and there can be no ference. By adopting an obliquity greate 15°, interference can be avoided without ch the addendum.

This method has the advantage that th straight-sided worm and hob can be used fo gears as for large ones, and the disadvanta the action is confined to the approach and to greater friction.

When the standard 30° tool is used, all g 26 teeth, or smaller, should be made in th but the correction is not strictly necessary fo of more than 20 teeth, unless particularly nic is required.

Fig. 100 shows the proper construction of of 21 or more teeth, and Fig. 101 shows th gear of less than 21 teeth. In the former ca teeth of the worm should be limited by the li *e e*, but the interference for 21 to 25 teeth noticeable.

*Draw worm teeth straight*
*Draw gear teeth by points (57)*



*Involute worm and gear*
*for twenty or less teeth*
*Fig. 101.*

### Clearance of Worm Teeth.

There is another practical point that is recognised, and that is that worm teeth shou clearance, for there is no reason for cleari teeth that will not apply quite as well to an kind.

The clearance is easily obtained by mak tooth of the hob a little longer than that worm, as shown by the tooth *a* of Fig. 10 the same reason the hob should have no cl at the bottom of its thread, so that the top gear teeth will be formed of the proper The custom of making the hob and worm of the same diameters will apply only when th "bottoms" in the gear and the gear bot the worm.

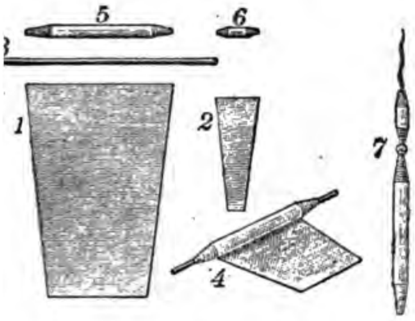
## APANESE PORTIERE OR CURTAIN.

HERE is a certain delicacy in a curtain made of long lashes formed of straw or bamboo and ads which is not found in a fabric of any kind. rtains of this sort have been largely introduced o this country of late, some of them being simple, ain, and cheap, while others are really very borate, and, of course, correspondingly expen- e. It is a very simple matter to make a curtain this class, provided the materials are at hand; t where neither bamboo nor straw nor beads are ailable, it becomes more difficult. But a very esentable curtain may be made from paper, which obtainable everywhere. Simple patterns may be de of straws of different length, and glass beads different colours, strung on strong thread or fine, ong twine.

The first thing to be done towards making the rtain is to draw a design roughly on a sheet of per, then tie a thread in a bead which is to form e finish of the lower end of the lash. Then the ad is fastened in its place on the pattern by iving an ordinary pin through it into the board table beneath. The stringing of the straws and ads is thus proceeded with according to the uirements of the pattern.

When one lash is finished, its upper end is tened on the design by an ordinary pin driven ough a knot tied in the thread. The next lash order is proceeded with in the same manner, and on until the entire series of lashes is done. A ut string is stretched along the series of pins by ich the upper ends of the lashes are secured. ch thread is then tied around the transverse ing. If desired, the threads may be spaced by ds arranged on the string between the lashes. all the knots are necessarily trimmed close, it is ll to touch each knot with mucilage. When this dry, the curtain is finished. A very handsome rtain may be made from beads alone, or from ads and plain uncoloured straws, or the straws y be dyed different colours by means of aniline es, or by dipping them into thin coloured lac- ers. A curtain or portiere of bamboo and beads made in the same way, but on a larger scale.

It is easy to make a good imitation of these rtains with paper tubes and beads, or the tubes ne. The manner of making these tubes is shown the sketch. The paper from which the tubes are de should not be thicker than common writing per. It may be either coloured or white. The t results will be secured by using common white iting paper and colouring the tubes after they formed, and dry by means of thin brown or ite shellac varnish, coloured with pigments or anilines.



he pieces of paper from which the tubes are de are preferably cut in trapezoidal shape, as wn at 1 and 2, so that when the tube is finished ill have conical ends, as shown at 5, 6, and 7. wire shown at 3 is used as a mandrel upon ich to roll the paper. The larger end of the e of paper is applied to the wire when the paper lled up in the manner illustrated at 4. The rower end of the paper is gummed and pressed n closely, when the wire is removed and the ration is repeated. It is not advantageous to the entire surface of the paper. Fastening at end is sufficient. The wire used as a mandrel ld not be more than $\frac{1}{18}$in. in diameter, as too e a hole through the rolls allows them to arrange nselves irregularly. At 7 is shown a part of a formed of a long tube, a bead, and a short . In stringing both the straws and the paper s a long, slim needle will be required. If this ot obtainable, a very good substitute for it may nade by forming an eye or loop on the end of a wire of suitable length. There is scarcely any t to the amount of labour that may be expended n an article of this kind; but very pleasing lts will be secured by the adoption of simple gns, which may be easily carried out.—*Scientific erican.*

HE National Library in Paris contains 2,500,000 umes. It is said to be the largest library in the rld.

## SCIENTIFIC NEWS.

THE second of the asteroids discovered by M. Charlois recently, and known as 298, may prove to be Aschera (No. 214).

The biography of Tycho Brahe, on which Dr. Dreyer, of the Royal Observatory, Armagh, has been engaged for several years, will probably be issued next month. It will contain some interesting notes obtained from rare old publications and unpublished papers, some of which have been recently found in parts of Denmark.

Mr. Comstock has issued the sixth volume of the "Publications of the Washburn Observatory," which includes the measures of double stars by himself made with the 15½in. Clark equatoreal.

Mr. K. J. Tarrant, F.R.A.S., publishes in *Astronomische Nachrichten* a continuation of his measures of double stars made at Pinner during 1888. Observations of double stars made at the Cincinnati Observatory in 1882-86, and some of those made at the Leander McCormick Observatory of the University of Virginia have also been issued.

The Urania is an institution at Berlin which may be described as a public observatory, containing some well-appointed telescopes and other instruments, including microscopes, as the work done is not limited to astronomy. The institution has not been open much more than a year, and has already been visited by about 100,000 persons, who have had the opportunity of listening to about 1,000 lectures. The publications of the Astronomical Society of the Pacific contain particulars supplied to Prof. Holden by Dr. M. W. Meyer, director of Urania. In some of the observatories located in the United States certain nights of the week are set apart for the admission of the public.

The Swiney Lectures on Geology will be delivered at the Natural History Museum, Cromwell-road, S.W., in connection with the British Museum, by Prof. H. Alleyne Nicholson, M.D., D.Sc., F.G.S. The course will consist of twelve lectures on "The Microscope in Geology" (with special reference to the structure and origin of the stratified rocks), on Mondays, Wednesdays, and Fridays, at 3 p.m., beginning October 6th and ending October 31st. Admission to the course is free.

The Committee of Council on Education have sanctioned grants by the Council of the city of Worcester to certain institutions in that town, under the Technical Instruction Act, 1889, for subjects of general information not included in the branches of science and art ordinarily subsidised by South Kensington.

A useful "Guide to Evening Classes" in London is being prepared under the direction of the National Association for the Promotion of Technical and Secondary Education. It will show students the details of the classes held in each district—the subjects, fees, and hours of attendance, &c. It will be published by Cassell and Co.

In a lecture delivered to the students of engineering at the Manchester Technical School, Mr. W. H. Bayley said:—Most of the British mechanical inventors who laid the foundation of our prosperity, and whose work had given us our present commercial supremacy, were men of very little education, but of strong individuality. But the time was now past when illiterate men, however able, could influence our commercial destinies. Their future course as engineers would be guided and controlled by the followers of Dr. Joule, the great discoverer of the mechanical equivalent of heat. The coming man will be the thermist.

The beautiful Primula which has the specific name of obconica has often been accused of setting up a painful irritation of the skin, and it appears now that there is no doubt of the fact, especially in the cases of subjects liable to eczema.

Prof. Elihu Thomson has, it is said, recently devised a method of case-hardening iron or steel by means of the heat produced by the passage of an electric current. His process consists essentially in heating the object electrically, and then applying to the metal so heated a surrounding envelope—either gaseous, fluid or solid—for the purpose of changing or preventing change in the quality of the material, according to the special end to be attained.

The completion of the under-river portion of the St. Clair tunnel by means of the Beach hydraulic shield is announced. This portion is 2,300ft. in length, but including the cuttings on both sides of the river the total length is 6,050ft. The object of the tunnel is to connect Port Huron, Mich., with Sarnia, Canada, and thus join the railways in the respective neighbourhoods, especially those leading from Montreal to Chicago.

M. Richet, a French physician, says he has found quinine a preventive of sea-sickness.

Six lectures on "Electricity Meters" are to be delivered in October and November on Monday evenings at the Finsbury Technical College, by Prof. Silvanus Thompson. Considering the number of persons at present hard at work trying to invent a reliable electric meter—the greatest *desideratum* at the moment in the electrical industry—the announcement of Prof. Thompson's lectures seems singularly opportune.

A very remarkable paper has appeared in a recent number of Wiedemann's *Annalen* on the snbject of "Liquid Crystals." An industrious German chemist has, it appears, discovered some most curious organic liquids, drops of which when examined in the microscope, by polarised light, show definite axes of elasticity, just like crystals. That a liquid should possess an internal structure of this kind is one of the most remarkable of recent discoveries in the domain of molecular physics.

## USEFUL AND SCIENTIFIC NOTES.

**The Mascart Dynamometer.**—In a recent number of the *Comptes Rendus*, M. Mascart describes a direct-reading transmission dynamometer with the photographic recording-apparatus devised by him. The following abstract of his description is taken from the Foreign Abstracts of the Institution of Civil Engineers. On the shaft of the prime mover are mounted two pulleys, one fast, the other loose. The latter is connected to the former by springs, the deformation of which is indicated by a pointer playing over a scale on one of the pulleys. The scale is empirically graduated. When the movement is slow, the position of the pointer can be determined by inspection; but for quick-running shafts, M. Mascart increases the time during which the pointer is visible, by adding to it a lens so placed that the pointer is in its focus. The pointer and corresponding mark on the scale remain then visible during the time that the shaft requires to revolve through an angle equal to the focal angle of the lens. The image of the pointer can be photographed on a slip of sensitised paper set in movement by the shaft. M. Mascart states that the dynamometer described has been fitted to a 10-H.P. steam-engine at the Central Meteorological Bureau.

**Prof. Virchow on the Cat in Antiquity.**—Was the cat, as a fireside pet, known to the ancients? If it was, was it as the domestic animal familiar to ourselves, or was it simply as a domesticated savage, like the monkey or the gazelle? Prof. Virchow inclines to the latter opinion. Having examined the mummies of Egyptian cats, he found they had nothing in common with our feline friend. The cats of antiquity, according to other archæologists, were slenderer than ours, and approached the weasel in appearance. But Signor Saglio, the distinguished Italian scholar, who is engaged on the magnificent "Dictionary of Greek and Roman Antiquities" now in course of publication at Paris, under the editorship of Daremberg, read the other day before the Academy of Incriptions a memoir on the subject, in which he holds a contrary opinion to that of Virchow. The cat in ancient times was, he maintains, the identical domestic animal known to modern Europe. On Etruscan tombs he has found paintings which represent the cat as a regular inmate of the house of the deceased, one of these pictures showing us a company at dinner, and the cat toying under the table with bones of chicken or partridge. Signor Saglio further refers Prof. Virchow to the British Museum, where on two water jars belonging to the fifth century B.C. domestic cats are depicted in a "Scuola di Musica." Of these cats one is held by a string and another stands upright on a footstool while a boy offers it a dainty. There are other pictorial representations, according to the accomplished Italian archæologist, which prove that the cat was cherished in antiquity as one of the most useful, as well as graceful, domestic animals, inspiring the affection bestowed on it by eminent persons of all times—from Mahomet to Petrarch, from Montaigne to Hoffmann and Dumas.—*Lancet.*

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# LETTERS TO THE EDITOR.

*[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]*

*All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 832, *Strand, W.C.*

*All Cheques and Post-Office Orders to be made payable to* J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

◆

## "LOCAL" (?) LUNAR ATMOSPHERE.

[31623.]—IN answer to "F.R.A.S.'s" (letter 31597, p. 80) request that I will "kindly explain how an atmosphere of aqueous vapour on the moon can, by any conceivable possibility, be of 'a local character,' how is it to be limited, bounded, or circumscribed *in vacuo?*" I beg permission to say that, perhaps my use of the word atmosphere was not a happy term to use in describing the possible existence of a localised portion of tenuous water vapour; and I shall perhaps best explain the condition that seems to me as possibly holding in the moon, by quoting from the writings of the late Mr. R. A. Proctor (see note on page 588 of the "Old and New Astronomy"), wherein, speaking of Jupiter's atmosphere, he says:—"I use the expression 'atmospheric region,' rather than atmosphere, advisedly. The evidence appears to render it doubtful in Jupiter's case, as in the sun's, whether the gaseous and vaporous regions surrounding the larger masses of the Solar system to great depths can be regarded as forming a continuous atmospheric envelope." And, again (on page 420 of the same work), speaking of the sun's surroundings, at 300,000 miles from his surface "exist large quantities of exceedingly tenuous and diffuse gases (not in atmospheric continuity) at a higher or lower temperature."

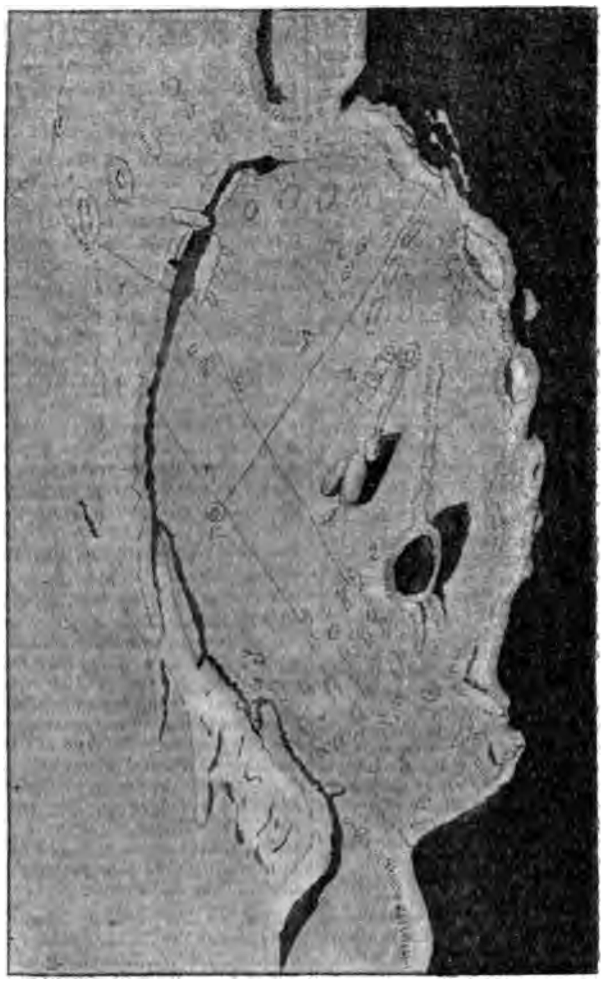
In the above cases Mr. Proctor seems to think that the conception of discontinuous masses of gas is not absurd, and it is in such a sense that I spoke of the existence of aqueous vapour in the moon.

Doubtless several of us have noticed how, on a very cold day, the steam from a railway engine is deposited as snow at a short distance around the point of escape, and so I suggest it is on the moon, where the day is apparently very cold, and there is no wind to blow the vapour away; the aqueous vapour, escaping from vents communicating with sources of heat below, is deposited as snow around the vent hole, forming the crater-like openings and ring plains, which form such a prominent feature of the moon's surface, for the unlimited expansion—referred to by "F.R.A.S."—offers an additional cause of rapid cooling. **H. G. D.**

## SELENOGRAPHICAL—HEVELIUS.

[31624.]—THOUGH this most interesting walled plain has often been observed, and several very delicate objects—such as the rills it contains—have been discovered, yet it requires further studies in order to find out still finer details which, no doubt, exist there in large number, and among which changes may still take place.

The above sketch was made on the 2nd of May of the present year, with a beautiful 8½in. mirror, by With. The sky was rather cloudy, the air damp and rather unsteady. The rills, as represented here, were easily seen. The central mountain and the region south of it were carefully observed, and this is what I found. Though the central mountain appears generally as formed of one single, solid block, yet on the present occasion it was distinctly seen as composed of three large masses, as represented in the sketch—one on the west, and another on the south-east of the central and largest mountain. This appearance I had never seen before, and I believe that, besides very good atmospherical conditions, a very superior telescope is necessary to see it so. On the south of the central mountain, the crater given by Schmidt there was an easy object, and appeared rather shallow. A ridge connects it with the central mountain. West of these is another short ridge, on the top of which there are two minute craters, *b* and *c*, *b* being the larger, and not quite at the northern extremity of the ridge. The five ridges south of these craters were seen as represented; but the whole region here is rough. At 6, on the west of rill δ, there is a comparatively large swelling, on which a few objects were seen, the nature of which I could not make out. This spot might be studied with care in order to clear out all doubts about the objects it contains. At *a*, on the west of the floor, I found a minute crater, which, I believe, has never been recorded before. It was very neatly seen, and there is no doubt about its existence at the place given. I had never seen before the north part of the floor of Hevelius so full of ridges and mounds, among which the clefts E and *y* are lost. The small crater seen among these hillocks is given by Schmidt, and was easily seen. **C. M. Gaudibert.**



## FINE GROUP OF SUNSPOTS.

[31625.]—A CORRESPONDENT, J. Webb, in speaking of the large group of sunspots recently visible, says that on September 1, "the two principal spots were upwards of 112,000 miles asunder." This must be a mistake, for I made a number of careful measurements, and found that the longitudinal arc over which the entire group extended was 106,000 miles on September 1. The distance separating the two chief spots of the group was considerably less, and there must be something wrong either with Mr. Webb's eyes or his micrometer, or he would not have given the exaggerated values alluded to.

Newport, Sept. 20. **J. S. Rogers.**

## "TENEBRIS" AND REFLECTORS.

[31626.]—WILL "Tenebris" be so good as to inform us the diameter of telescope, and whether achromatic or reflector (also the power of eyepiece) which enabled him to nicely separate β 648? It has hitherto defeated my attempts with either a 12¼ With, or 12¼ Linscott mirror; of course a 9 or 10in. achromatic may perform better than my reflectors. Is it possible he has been examining B.A.C. 6468? not far from B.A.C. 6480, which is β 648 in "Gledhill," p. 415?

B.A.C. 6468 is much easier, being 1½" apart.

β 648 is difficult from the closeness, 0·6", and difference of magnitudes combined.

My mirrors separate β 63 in the Dolphin at 0·7" on good nights, and β 396, 6 : 11 mags. at 1", called extremely difficult by Burnham. But β 648 is too hard in these "bad" times. **Bramley.**

## THE REFLECTING TELESCOPE.

[31627.]—IF I misquoted "H. E.'s" meaning, letter 31607, let me hasten to express much regret; but I have read and re-read his remarks *re* the 4in., and still think they suggest a continuation of what he says in same paragraph about 4in. o.g.

The statement "H. E." makes about "80 and more to the inch" being usable with "fine results" on 4in. reflector, on "95 per cent. of the nights stars are visible at all" will be news to many, and will lead to a good demand for that hitherto unsaleabl the 4in. reflector. But perhaps "H. E.'s' pieces are, like most others, over-estin "H. E." can rest satisfied concerning my s ments. I have ground, polished, and m mirrors for amusement, and am not likely to the ABC of observation. None of my con on reflectors refer to my own work, though, the best makes can be suitable for compariso

A poor film does affect definition, and as i permits internal reflection, it must do so. compared several other sizes of reflecto refractors besides the ones referred to, and s them were not so unequal in size, but the were always the same — certainly in the tube, and the reverse in the other; and it wi be so. I used a fine 3¼in. Wray, alternately first rate 6in. reflector, and the one genera well, and the other sometimes did.

I am proud to find my opinion so fully coi with that of Nasmyth, as recorded i Webb's chatty letter—31558. Here is a ma all bias, who spent hundreds of pounds, an of his valuable time, trying to render the r reliable, and yet he "never made any appoi with any friend to meet him for observati his reflectors." Does not this speak volume

**Tene**

## THE SECTIONAL WORK OF THE

[31628.]—PERMIT me to assign a few why the sections of the B.A.S. should be cally patronised by its members.

(1) Because it is a recognised fact that to excellence in the arts or sciences, division of is a *sine quâ non.*

(2) Because astronomy, of all other s demands and admits of specialité in its purs

(3) Because there are but few amateurs v command the time, or have the mental ca previous training, that would qualify the comprehensive grasp of all the departm observational astronomy.

(4) Because professionalists are almost specialists. The controllers of labour in ou observatories, know well the value of the of labour principle in securing reliable resu they are a safe guide, as to principles of a amateur operations.

(5) Because excellence in any departme more satisfactory to the individual than smattering in all can ever become, and astronomers are seeking pleasure in their as well as contributions to science.

Because the diffusive spirit engendered by ing from topic to topic is destructive to that of patient and persevering application so tial to successful discovery or deduction.

Because the interchange of thought and ig arising from *common* pursuit is most pleasant udful to each member of section, inducing a ig of brotherhood that becomes a mighty incen- o activity.

Because it is a great boon to have a qualified tive mind to which to refer in the many diffi- s that arise in observational astronomy.

Because sectional arrangements imply and e *methodic* action which, other things being l, can alone secure success in astronomy.

) Because an *aggregate* of results by several vers affords data for the deduction of means rerages that is far more likely to be correct any set of observations by even the best fied observer, admitting, as it does, of an st perfect elimination of errors arising from nal equation, and reducing even instrumental s to their minimum.

) Because co-operation is an acknowledged r in securing good results of any kind, and in nomy a partial corrective to the solitariness ent to personal observing and its attendant

think, therefore, that every member of the S., with but few exceptions, should join one her of its sections. For those well qualified selves to direct can materially aid the director heir contributions to the common stock of ledge, and help in many ways those in the l stages. Even those who have attained the of scientific position will gather honour and ure in aiding their less advanced co-workers. lignity of true science consists in assisting the glers in the lower strata.

ere are many who will join the B.A.S. ous of more thorough acquaintance with the ellations and their glittering orbs; let me say ch, that if they will join the "Coloured Star on," under the able direction of Mr. Franks, work for even one twelvemonth with per- t diligence, they will be astonished at the ligent and comprehensive knowledge they almost unconsciously acquired of the stellar ems—a knowledge which memory will always n, and which will lay a sure foundation for e operations, even if they have not been very ssful in colour records.

is hoped that the number of sections already uted will be at least doubled before long, and Mars and Saturn will have sections to them- s as well as Jupiter. All the other planets t with advantage be grouped. Other con- ations to promote sectional work will suggest selves to thoughtful readers. The importance e subject must be my excuse for occupying so a space.

W. B. Waugh.

## JOSHUA AND THE SUN.

629.]—"E. L. G." seems to suggest, as an nation of the Joshua difficulty, that "the nt was not written till a long time after a."

e interesting question arises: When were these rs relating the historic records of the Jews en, and by whom? I should be glad, from an ic view alone, to get information on these s. It is well known that the early history of tions is wrapped in mystery and uncertainty, f fabulous events drawn from tradition.

had better take the much that is so noble, and beautiful in their writings, which no r people will fail to admire, and cease to ourselves about that which we find difficulties r to that of Joshua.

Jews—like all ancient and prehistoric people e singularly fond of the marvellous, and very to exaggerations in their statements, clothing with supernaturalism. They were a peculiar e, too, as their writings show by such a strange xture of the sublime and frivolous. Those dren of Israel" were certainly "children" in- tually, and it is a waste of time to try to make of what they record to harmonise with modern ht and our knowledge of nature; neither do ed it. All the sacred books of the world are r, and all nations have, in the evolution of n, grown superior to their original religions, shown by the rejection of that which has d erroneous or mischievous. The age of strife errorism has passed away—the mental air is and we may be outspoken and honest.

haps those portions that need a different read- suit our present state would best fall into proper place by disuse and neglect rather than to bring them up to date by a strained read- translation. This is what many modern and ost men, I believe, do, believing that the ns of mankind are a necessary part of our l development, and every attempt to make square with science proves it cannot be done. thinking man will admit that science with creasing knowledge of nature have been the of rationalising our opinions, and both science and our religions are the better for it; and in my humble opinion it is worse than useless to try to bring back vitality to such worn-out and fossilised opinions, such as the Joshua difficulty, and many others of its kind.

There is a point to which I should like to return, and ask "E. L. G." (as I know he can) to help us, and also others of our readers who can—carefully avoiding a mere theological debate. I would return to his remarks, that "the account was written long after Joshua's time." I take it that he is of opinion (as I myself am) that much, if not all, the difficulty about these supernatural and incredible accounts recorded in the Jewish history is due to the fact that they were recorded a long time after the events are said to have happened. It must be allowed that the Jews were given to exaggerate the importance of their nation and its doings, and that they have done this to such an extent that their accounts cannot be accepted literally.

Now, the distance of time elapsing between the events and their record is an important element as lending itself to the fancies of the writer. *When* were these accounts written, and by whom?—in what language? They take us back into prehistoric times, and before writing, as we understand it to mean, was known. Were they not written fully 900 years after they are said to happen? If so, they could not be the records of either eye witnesses or contemporaries. As far as I can gather, the five books ascribed to Moses could not have been written by him, or by any of his contemporaries, but were for the first time seen in the form we now have them, as compiled by Ezra, 900 years after Moses, from tradition and fragments unknown.

There seem many reasons for believing Moses did not write these accounts; but are there not strong reasons for believing he could not have written them, there being then no alphabet known to him, if indeed the alphabet was known at all in his time? He, as well as all his fellow-countrymen, no doubt spoke the Egyptian tongue, and if he wrote he must have written in the Egyptian hieroglyphic characters. Is there any mention anywhere of books written by Moses except the "Book of the Law"? which were the subjects of the "two tables of stone," and nothing more?

Was there not, then, plenty of time and opportunities for romance and error to accumulate around the real facts of those ancient people, semi-barbarous as they were, and existing at the very dawn of historic times, and the beginning of letters? Are we not warranted, too, at this distance of time, in refusing a literal reading to their many miraculous accounts, seeing that the most enlightened and learned of their own men tell us these wonders were "allegorical" and "dramatic," to convey moral and religious lessons?

"E. L. G." rightly says Josephus only lightly touched on the Joshua miracle. It is, I am sure, well known to "E. L. G." that Joseph ignored and, as it were, hid from view much of the miraculous portions of the history of the Jews. He wrote with an eye to Roman and Greek readers, and he wished to remove some of the contempt held out to his country. The celebrated Jew, Philo, especially explains that much of the sacred books of his country must be taken as figurative, and not real. Yet here are we at this distance of time, with all our progress, insisting (and with "E. L. G." helping) on reading these things as though they really happened! If the Jews could distinguish and show us the real, the beautiful, and good, from the figurative of their books, their manners, and customs, why should we not accept them, and thus throw away the conflict and agree?

Moses was, by the well-informed Jews, justly regarded as a grand, noble, and wise lawgiver—one of the few great and leading moralists and teachers of mankind, yet none the less so to them because they knew the romance that surrounded his noble efforts for the good of his race.

The conditions of their wandering life in the Wilderness made it next to impossible for him to have written these accounts. I see no reason why we should not use the same criticism and methods as we apply to other histories; but, if we force on these Jewish records a real and literary meaning, we do them violence, and what we do not force on other ancient records, and we place difficulties and obstacles in their way.

There are the same difficulties forced on the early records of Christianity with regard to the supernatural element. These accounts were almost certainly not written as we now have them for pretty well two centuries after the events are said to have happened, and we know by what did obtain for a long time after, how easy it was to clothe real facts and history with fiction and fable.

Is it wise to encourage doubt in so much that is beyond comparison for simple purity and beauty, by persisting in making it father the incredible and impossible?

These difficulties are of the same nature as the early Jewish records; they were not written down till tradition had long had full play to alter and add. We find no mention (as far as I can at present learn) of the Gospels as we have them, till the end of the second century A.D., when they are first named by Iranæus (180). Then there is the difficulty as to who could write them, for they are first seen in Greek—a tongue almost certainly quite unknown to the illiterate Apostles who were supposed to have written them. Internal evidence also leads to this conclusion.

If we cannot be sure who were the writers of these accounts, what matter? We can distinguish the grains of gold from the quartz; and if we can make no use of the quartz, why let it hinder us? If we cannot believe that the affair of the devils and swine ever happened, we can believe that the beautiful Sermon on the Mount did. We might just as well quarrel about the rude morality and customs of those early times as to quarrel about and try to make their superstitions square with our day.

G. Calver

## DEMAGNETISATION.

[31630.]—I SEND the following extract from a paper by Mr. Abrahams, published in the "Transactions of the Society for the Encouragement of Arts," &c., for the year 1826, pp. 22-3.

"For some time I found a little difficulty in performing the experiment satisfactorily, owing to the invisibility of the fluid, but I was relieved from this difficulty by dipping the apparatus to be experimented upon into fine steel filings, which rendered the situation of the active magnetism visible.

"Upon presenting a fine magnet to the part clotted with filings, at the distance of from 1in. to ¼in., according to the power to be neutralised, it will immediately be perceived whether the polarity of the magnet be of the same kind as that in the apparatus; if so, the filings will gradually fall from the part as the power becomes neutralised. When all the filings have fallen from the part submitted to experiment, dip it again into the filings, to prove whether it has acquired opposite polarity by remaining too long in the vicinity of the magnet; if that be the case, present the contrary end of the magnet at a distance in proportion to the power to be diffused. Very little practice will enable any person to deprive any part of the steel apparatus belonging to the timepiece of active magnetism in two or three minutes. I can generally perform the experiment in one minute, however magnetical the balance or other part may be that is to be deprived of the concentrated power."

Mr. Abrahams gives no description of his fine magnets, but I have no doubt that very long darning needles, more or less magnetised, would answer all purposes.

H. E. G.

## DIPLEIDOSCOPE—TO "A. S. L."

[31631.]—WRITE to "J. K. P.," at Pitcairn's Library, King's College-road, N.W., and you will get all that he knows thereanent. If your instrument has ever been taken to pieces, it is just about a guinea to a gooseberry that it never got put together again, that is to say, correctly. I have one, and used it for several summers; but my house is so situated, with other houses in front, that I could find one spot only on all the premises—viz., at a first-floor window, whence I can see the sun at noon all the year round. Then again, I could only fix the instrument on a bracket to the woodwork inside the window, and that seemed to alter in position from time to time, so that I could not depend upon it from year to year. I have now discarded it altogether for the upright-slit-meridian-mark, which, if well placed at first, may be reckoned on within about three or four seconds of time always.

The base of the dipleidoscope, which must be level, has two sides parallel, and these must point north and south. The internal prism must be prismatic, and not a portion of a pyramid. Also, the axis of the said prism must be in the meridional plane. I do not remember now the origin of the third sun of the three that you see, but want of coincidence of the images is owing to the pyramidal state of the reflectors, and I found this error extremely difficult to correct in my instrument, since, as far as I could make out, the screw-holes were not properly placed, and although the instrument bore all the marks of having been ground down on to its seating, it had been so inefficiently done originally, or had got bent since, that on tightening the screws it went completely out of adjustment. I do not mean to say that it had not once been right in this respect, particularly as it was not new when I obtained it; but it remains to me a difficult problem to say when that "once" may have been. The dipleidoscope has the advantage of showing the sun through cloud or fog, when his light is insufficient to make a clean-edged shadow, but beware of clouds passing east or west whilst you are observing with the slit instrument.

It might surprise some folks to see an enumeration of the times when, at southing of the sun, an observation has been possible in the course of a year. This year I saw the sun at noon on Easter-day and Whitsunday, and not again for some three months. Twice out of three times during the last fortnight a cloud has appeared either one half minute just before or not gone away till just after the southing. In one season, a few years back, I do not think I observed half a dozen times.

**J. K. P.**

## VICTOR MUSTEL.

[31632.]—The notice of the death of this truly great man in your last issue will be read with regret by all who have had the pleasure of using the instruments made by him, and the regret will be increased by the knowledge that his life was troubled by poverty. If your correspondent had made this fact known years ago, there can be no doubt that some assistance would have been forthcoming. I have one of his organs made 26 years ago, which is to-day simply perfect, and as an instrument for rendering orchestral music, it is as near perfection as one can hope to obtain.

It is painful to know, when too late, that so great a man should have been harassed with want of means, and the only satisfaction is in the hope that his labours have been a pleasure to him, which would, to some extent, be a compensation. We have lost a genius; let us hope that his sons will follow in his steps, and be more satisfactorily compensated in money matters than he has been.

**Thos. Fletcher.**

## FULLER'S CELL.

[31633.]—Some time ago a correspondent stated that the connection between the zinc and its terminal in this battery was *never* insulated. Feeling sure this was incorrect, I have been at some trouble to ascertain how the original was made, because when at Fort Monckton, Gosport, with the Submarine Miners in 1879, one of the officers showed me in the appendix of Fleeming Jenkin's "Electricity" an illustration of the new cell, where the zinc rod above the cone at bottom is covered with an indiarubber tube or insulating varnish. The same illustration and description is to be found on page 321 Vol. XXIII. of the "E. M.," or specification of patent No. 3340, 1875. For some reason, though, the connection with the zinc was very soon altered, because in Mr. Preece's Cantor lecture, "Some Recent Advances in Telegraphy," he describes the zinc (on page 170 Vol. XXX. "E. M.") thus: "The zinc is a small block, of pyramid shape, fixed at the end of a stout copper wire, *both* being well amalgamated, to which the binding screw is attached," and adds: "It would naturally be thought that the copper, being directly connected to the zinc rod, would cause local action to be set up; but this is prevented by capillary attraction. The mercury gradually rises up from the bottom of the cell, and coats the copper wire with a thin film of mercury and dissolved zinc wherever local action could take place."

The question now comes, Why was this change made? Of course, the insulated zinc rod was useless to produce current, so to speak, likewise the amalgamated copper wire; therefore, would it not be better to leave the cone at the bottom of zinc rod and zinc rod exposed to the action of the acid, and thus get all the surface of the zinc into action? I can quite understand that for intermittent signalling and that class of work, it would not be wise to keep exposed so large a surface; but for continuous use, such as driving small motors, I think the Fuller cell unequalled, so perhaps electrical friends and Mr. Maycock, who seems to have had considerable experience with these batteries, will say why a change in the connection and exposure of the zinc was made.

**John J. Gilbert, A.I.E.E.**

Birmingham, Sept. 20.

## LITHANODE.

[31634.]—I am sorry to be obliged to contradict your esteemed correspondent S. Bottone as to the nature of lithanode. This is not "peroxide of lead compressed into the form of plates." At the cost of much time, labour, and money, the notion embodied in these words has been proved utterly impracticable. Compress peroxide of lead as much as you like, the mass will disintegrate when immersed in an electrolyte. To make lithanode, a pasty mass of protoxide of lead (litharge) and water must first be caused to "set" by means of a slow chemical reaction involving the production of an insoluble compound; and the latter, in the form of a plate having no tendency to disintegrate when immersed in a fluid, must then be electrolytically converted into hydrated peroxide of lead, containing a certain percentage of lead sulphate. It is difficult, but quite possible, to carry the conversion too far, with detriment to the hardness and cohesion of the plate. Properly-formed lithanode, such as is now supplied by Messrs. Cathcart and Peto, is the negative element *par excellence* for a voltaic couple, either primary or secondary. It is the negative of which we dreamed in the old days when W. Tonkes held the honourable position subsequently filled by "Sigma," and now occupied by S. Bottone, as an authority on voltaic batteries at the service of the electrical readers of the "E. M." The next best negative is platinum, immersed in a mixture of nitric and chromic acids; but, in efficiency as well as in convenience, this is a long way below lithanode.

The suggestion that lithanode can be replaced, or has been superseded by, compressed peroxide of lead, is due to one or more of the parasitical and piratical fraternity who fatten at the expense of inventors, and add insult to injury by contemptuously running down the inventions they infringe.

I may add, in conclusion, that the spongy lead element which is now used in conjunction with lithanode in the most improved form of secondary battery, adapted for miner's lamps, &c., is something very different from the "partially decomposed lithanode" referred to by your correspondent.

**Desmond G. FitzGerald, M.I.E.E.**

46, Loughborough-road, Brixton, S.W.

## NASMYTH HAMMER.

[31635.]—The attempt of French writers (see letter 31621) to claim for their countryman Bourdon the credit of the invention of the steam-hammer, is one of those pieces of Gallic effrontery which arise periodically to stagger one's belief in the saying that ridicule kills in France. The article in the Paris *Figaro* is no doubt based upon a paper read some years ago before the French Société des Ingénieurs-Civils, in which were put forward claims that Bourdon never made himself. The real facts about the invention will be found set forth at p. 240 *et seq.* of Nasmyth's "Autobiography," edited by Samuel Smiles, and published in 1883. In this work will be found a reproduction of the original sketch of the steam-hammer, dated 24th November, 1839. Bourdon's connection with the invention is briefly this: He visited Nasmyth's works at Patricroft in company with Mr. Schneider, the head of the Creusot Works, of which Bourdon was the engineer, in order to see some machine tools. While there he was shown Nasmyth's "scheme-book" containing, among other sketches of mechanical appliances, the original drawing referred to above.

Nasmyth had not yet constructed his hammer, as times were bad, and he was told there was at that period no use for such a tool in England. Two or three years later, being at Creusot, he saw the first steam-hammer, which had been constructed by Bourdon, from drawings he had been permitted to make from the Patricroft sketch-book. While delighted to find that his idea had been practically realised, Nasmyth appears to have become alarmed lest the fruits of his invention should be lost to him. On his return to England, therefore, he patented the hammer, the specification bearing date 1842. In those days a patent cost £500, which is the reason given why the invention was not protected when it was first made.

If we are to believe James Nasmyth, who was a man of singular simplicity of character, Bourdon fully acknowledged the source of the invention, and thankfully accepted some improvements of detail, which Nasmyth then and there suggested. The whole story as told in the autobiography is a most curious one; but it bears the impress of truth, and had, up to the time of the appearance of the paper before the French Society of Civil Engineers, been universally accepted as correct.

The French have a way of making these claims years after the parties are dead, and when it is difficult, if not impossible, to disprove them. In this way they assert their countrymen to have invented steam navigation (Marquis de Jouffroy), the locomotive (Seguin), and gas-lighting (Lebon), the diving-bell, photography (Nièpce and Daguerre), the screw-propeller (Sauvage), the telephone, the sewing-machine, and a host of other things that were certainly not first brought out in France. In fact, it is not too much to say that they claim every discovery in science and every invention in mechanics, and will at some time or other accentuate their claims by erecting statues to their heroes. The worst of it is that when one of these statues is inaugurated, the correspondents of English and American newspapers seriously reproduce the bombastic orations delivered, in which the most extravagant assertions are made, and on the principle that *gutta cavat lapidem, non vi, sed sæpe cadendo*, such claims, at first laughed at, in time get to be taken seriously, and find their way into textbooks. One of the most recent of these *reclamations* is that the basic-steel process is a French invention. Fortunately, Mr. Gilchrist is still alive to vindicate the truth in this matter; but English inventions are not always so fortunate.

Speaking generally, I may say that I cannot recall a single invention of importance, with the exception, perhaps, of the reaping-machine, which has not at some time or other been claimed by the French.

**F. G. D.**

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[31636.]—In reply to letter 31621, I refer your readers to the "Life of Jas. Nasymth" by himself, published some years ago, his interesting account of this matter, especially of the way in which Schneider of the Creusot Works obtained (in perfect good faith, I believe) the invention from the notebook of Mr. Nasmyth.

The latter was surprised to find his own invention put into operation by another before he had worked it himself.

**Jos. Edmondson.**

## LATHE MATTERS.

[31637.]—I am sorry to say I cannot help "Frank" with his mysterious lathes. With regard to the "drill spindle," I hope we shall soon have some more articles from the same writer. I have a drill spindle with two cones pointing same way, and the smaller one near pulley end is loose, and cannot be set up, which makes one think Mr. Evans's way of fitting on a loose cone (in one with the pulley) and pointing the other way, is better. How are Holtzapffel's drillers fitted?

In the *American Machinist* for July 24th, there is described a most interesting headstock, of a hollow mandrel turret lathe, by Jones and Lamson, fitted with a chuck for holding the work which can be opened and closed *without stopping*; a self-acting motion for feeding forward the stock when chuck is opened, and a handle for throwing in and out the back-gear. I think if the Editor would kindly extract that description it would please many.

I am busy with a straight-line chuck I have made to use with my Rose engine attachment, and find it very interesting to square up and ornament oblong caskets of hard wood.

**F. A. M.**

## IMITATION IVORY.

[31638.]—During the last few months I have experimented with xylonite for ornamental purposes, and find it a failure. It will not take fine cutting, and it dulls the tools like a piece of sandstone. "Fluting" is the only style of work with which I have succeeded, and, singularly, one traverse with a ½-round drill produces a clean cut, whilst in ivory a second traverse is required. But the worse feature in it is the *contraction*: this would not matter so much if the whole piece of work were built up of xylonite; but some months ago I inserted a bottom of xylonite into a large piece of ivory work, and when I took it up yesterday it fell to pieces—the contraction being more than ⅛in., so that the screws had no hold whatever. Of course, the remedy, if one cares to work in it at all, is simple—viz., turn the work nearly to size and dry it thoroughly before finishing.

**C. C. Ellison.**

## SAP IN TREES.

[31639.]—"W. H. S." (letter 31613) says as trees "contain numerous extremely fine tubes," that is evidence that water will rise in them. I fail to see the force of such argument. Blotting-paper or calico may be said to contain extremely fine tubes, and therefore it might be said water will rise 50 or 100ft. in them; but the facts go to prove it will not rise 1ft. in either. Possibly glass tubes may be made sufficiently small for water to rise in them 2ft., as stated. In the smallest vaccine tubes the maximum height is 2in.

With regard to osmosis, "W. H. S." has evidently never tested the effect of using more than one membrane, but is simply stating his opinion. At the roots of trees there is no water in a liquid state, although moisture may be held in the soil by absorption, and that being the case, there is no water to pass through any membrane. In many parts of the Tropics, where the most succulent trees flourish, the soil is absolutely dry as dust. How, then, are the fine tubes under such conditions to obtain the bountiful supply of mosture needed?

**J. A. Reeves.**

## CURIOUS EXPLOSION.

[31640.]—On Sunday evening last a most curious explosion occurred here in the surgery of one of our local medical men. A large glass mortar, that had been used for making a simple chalk mixture in the morning, had been left standing on a table, when, without any apparent cause, or anyone being near it, it exploded with a loud report, blowing itself into hundreds of little pieces, the largest of which was about the size of a hazel nut. These pieces had the appearance of glass that had been heated and suddenly chilled in water, and could be easily crumbled into tiny crystal-like bits.

Have any of "ours" had a similar experience with glass mortars? I should be glad if anyone could explain this peculiar phenomenon.

Hinckley, Sept. 18. **Jno. H. Robottom.**

## HOMŒOPATHY.

[31641.]—I am very glad to have the opportunity of replying to Mr. Gerard Smith's courteous letter (31564), which I think might have been very justifiably couched in an aggressive tone.

He touches upon what I have wished to impress on the readers of the English Mechanic in my scarcely scientific or even effectual criticisms of the "Lydney Dispenser": that disease can only be understood with a lengthy training satisfying the iirements of the State. I am sure that he is as l aware as I am that a very great deal of un- ssary harm is done by ignorant quacks, and ıœopathic literature, professing as it does to e as popular books of reference for diagnosis, gnosis, and treatment. Can Mr. Gerard Smith rm me who is responsible for this extensive and ious literature, by means of which such indi- ıals as the "Lydney Dispenser" are allowed to le on the credulity of the public, in the name of ıt I am glad to believe are a conscientious body cientific men?

have always considered that the really con- ntious homœopaths make a very great mistake not energetically disclaiming and discountening the numerous publications, so often con- ing utter rubbish, written by members of the ıœopathic heresy. That, and I think that only, unts for the uncompromising attitude of the ıodox portion of the profession. Why should y secede from their ranks and depart from the ges of professional etiquette to establish what y hold to be scientific principles? So long as n qualified homœopaths pursue such reprehen- e methods, I shall feel myself justified in ing a great many of them "knaves, fools, quacks." The tribunal before whom they uld not cease to plead their cause is that their medical press, not the ignorant laity ose infinite gullibility in matters medical is a rord. I must confess that, in my opinion and t of many provincial members of the profession, re is no branch of medicine in which, with exception of a dozen drugs or so, the profession more hopelessly at sea, without any scientific ndation, and, as he justly says, at the mercy of dists.

here is the element of error, the so-called "faith e," which is always confronting us, and which n accounts for many vaunted cures ascribed to gs. The number of times I have relieved pain l produced sleep by the mere injection of dis- ed water, or the administration of peppermint- ter, is really extraordinary. I have heard ients ascribe the most curious virtues to drugs t are certainly innocent of any but their flavour- properties. I am quite convinced that the cess of the practice of therapeutics depends very gely on personal influence.

had an opportunity, a few days ago, of seeing a y striking instance of the influence of mind over ly. A young lady who had been under medical ervation some days (for some complaint entirely connected with the one I am mentioning) was jected to the influence of a violent mental shock, ich was followed by abdominal pain like colic, stipation, and vomiting. Such instances, with ny curious cases of idiosyncrasy, are constantly urring in the course of medical practice, and tribute to the uncertainty of therapeutics.

n short, as far as I can gauge the temper of the fession—and I have exceptional opportunities in ing with a large number of its members—I sure I am right in saying that they would lly welcome any elucidation of the tangled maze herapeutics.

can assure Mr. Gerard Smith that if the prin- es of homœopathy are true, all the "odium licum" and the studied opposition of orthodox sicians will be utterly powerless to arrest its plete triumph. Innominate.

## E HARDENING AND TEMPERING OF STEEL.

1642.]—To a sweeping assertion that nothing be said in its favour the writer of letter 31320 , in more reasonable averrance, that my theory t new. Be it so, then! I bow myself before possibly wider information and withdraw any t of its novelty I may have unwittingly made; as long before publication I had instituted a r rigorous search, he must not be offended if I him to state chapter and verse of the alleged ier statement of the hypothesis; and, if I may r presume upon his kindness, its substance as . Of course I should not admit that a crude estion that the carbon of the steel undergoes in hardening process a transmutation into the nond form, could be said to run on the same as mine: I could only allow that it led to the terminus, which is a very different proposition. however this may be, this gentleman of Sheffield rely not very happy in his choice of words in phrase "guilty of re-enunciation." To me it s that to re-enunciate is an achievement only proud than to enunciate in a primary sense; n truth the one act is the least worthy merely in g the least fortunate.

proceeding, "T. M." must excuse my saying he is all at sea in his reflections upon my use of Eggertz' colour test, for so, indeed, he seems; if he actually intends to question the existence mportance of the facts adduced, he has taken a se which really doesn't concern me at all. For oughout much the greater part of my treatment this aspect I was simply and often closely follow- some most highly esteemed authorities, and the lts quoted were arrived at by researches specially organised and undertaken to determine the chemical distinction between annealed and hardened steel, and every care was taken properly to indicate, verify, and establish them so that they can hardly be questioned. Knowing them to be fully corroborated I neither had, nor have, any reasons to doubt their accuracy; hence I consider them important points in the problem and by no means to be ignored. Indubitably, therefore, these two facts, that hardened steel in this test exhibits a marked decrease in coloration and a more coherent residue, are not to be dismissed as obscure and ill-defined distinctions; even without the expressed opinion of the eminent author of the researches in question, who esteemed them as important characteristics, and himself derived therefrom the conclusion that the carbon becomes "fixed." This I quoted and accorded a qualified acceptance; and in all reference to the chemical aspect of the subject I kept most closely to the path thus previously laid down; departing from it only to extend it by suggesting that the carbon of the steel, instead of being "fixed" as graphite, as was tacitly assumed, suffered a further mutation into a denser or adamantine form. And as I venture nothing more in this direction, the doubts "T. M." expresses reflect rather upon the authorities I have followed than upon myself—surely an inadvertence upon his part, for of course one with his deep reverence of authorities would never intend anything of the sort.

His next paragraph is not very clear; but I may say at once that I do not admit the need of any inordinate boldness of speculation to sustain this theory. And though I can recall neither instance nor reason for disbelief as to the possibility of even a ten thousandth part of a foreign admixture to a substance producing appreciable effects upon its nature, I make use of no such assumption. For my theory proceeds deliberately from the thesis that the major part of the carbon is converted. As to the colour test, I should be very loth to use it as a quantitative test for the purpose denoted. It is admittedly a most excellent, and I might add a most elegant, resource, in its proper function; but it were absurd to expect it to determine the actual degree to which a physical change in the colouring constituent may have attained. I referred to it chiefly to show that the hardening process inaugurates a different phase of solubility. In other respects the fact that the difference is not more marked, and that the solution is easily completed by heat, inclined me to the belief that there is no dissociation, the carbide of iron being directly converted into an adamantine form. My critic fails entirely to explain away the increased coherence shown in the residue of hardened steel—a fact which Prof. Abel considered especially remarkable; and I need only refer back to the attempt to show how. Indeed, his arguments on these two preceding points bear sufficient refutation on the face of them, for, in the first place, might I not with as much reason argue that diamonds are sometimes black—*ergo*, Why should not my iron-born diamond be black also? And, again, can it be expected that a structure would remain in evidence if deprived of its struts, leaving only the ties?

But criticism from the indifferent graduates well-nigh into the ridiculous stage when it takes the form of paragraph six. I can answer it only by asking "T. M.," point blank, whether he fancies steel to be simply a subcarbide of iron? If he does, it were perhaps best to leave him alone, as lone he must be, in that belief; but if he holds instead to the more usual and rational conclusion, that it is an alloy of iron with carbide of iron, then I should much like to know how he imagines the laws of chemical combination can define its composition? For the question then becomes, Why should a mixture of iron and iron carbide in a certain limited range of proportions produce a substance of such marked and peculiar characterististics as steel? And to this I submit no answer offers except mine, which indicates this same limited range of composition as a strongly-defined consequence of the theory.

My critic finally proceeds to draw comparisons between my theory and that of Prof. Roberts-Austen; and, of course, he decides for the authority. Now, in the logical issue, there is not so great a divergence between our respective theories as may seem. There is a strong distinction, of course; but there is also an affinity; and as a just insight into the manner in which they diverge and converge will greatly facilitate arbitration upon their respective merits, I will state it as briefly as possible. My own theory may be described as an almost wholly mechanical one, inasmuch as it ascribes the wonderful hardening effects to a purely mechanical strengthening produced by the formation within the iron of interlacing fibres of a substance of very high rigidity and tenacity. Molecular effects — i.e., the action of carbon molecules upon adjacent molecules of iron, I have ignored as indefinite and probably insignificant in comparison with the effects which may reasonably be expected in the first case. Prof. Austen, on the contrary, swears entirely by the molecular effects, and practically holds that the hardening is the result of a molecular strengthening, i.e., an increase of the molecule's individual powers of attraction, or, rather, of its powers to resist displacement in relation to its comrades. As, in view of the detailed data of the problem, it is manifestly too general and insufficient a statement merely to say that the presence of a certain proportion of carbon can cause the necessary large increase, he supplements it by surmising, from certain peculiar facts in the behaviour of iron, that there is a hard condition of that metal, existent in the purer forms only at a comparatively high temperature. Thence he reasons that carbon in the proportion and state in which it is present in steel may have a retentive power (mysterious power!) upon that condition, such that it can maintain it permanently after the metal has been suddenly cooled from the high temperature at which the condition exists. Here, then, is a full-grown hypothesis; but to fit it in with the chemical evidence he is under the exigency of encumbering it further with an additional thesis. This is the well-worn conclusion that the carbide suffers decomposition, leaving its carbon in a state of solution or alloy in the iron, in which condition it is better prepared to exercise its said retentive power—why is not indicated, as are not the why's and wherefore's of several other items in the theory. From the foregoing, it will be seen that the possibility of there being any mechanical strengthening, such as I have described, has quite escaped the professor's observation, though it is very patent that such strengthening can and does exist in nature, while there is absolutely no instance of the molecular strengthening he assumes. For it must be remembered that it is concomitant with a slight increase of bulk, instead of a more natural decrease—wherein lies its peculiarity.

Now I fancy it can be shown generally, if not mathematically, by reasoning from the elementary postulates of the theory of matter, that this assumption of molecular strengthening, on which the professor's theory is chiefly based, is absurd and untenable. Thus, premising that matter is composed of ultimate atoms, each endowed with two simple forces of attraction and repulsion, and kept in equilibrium with regard to each other by the balancing of these forces at certain prescribed distance of their centres of force, we have to judge whether it is possible to increase the strength (which term I use as a short expression for the resistance to displacement as mentioned above) of these atoms —i.e., a molecule; and in such a way that a further aggregate of molecules thus constituted will not exhibit decrease in bulk. As the atom is unchangeable, and excluding the utterly fantastic idea that atomic arrangement can effect aught in the said direction, there is plainly no other means than an increase in the number of atoms constituting the molecule. But, as it is impossible to discuss with any certainty the accumulative actions of the primitive forces of the atom, not knowing what these are, neither side can claim to predict what the result of such change upon the physical properties of the molecular aggregate would be: whether alteration in bulk or molecular rigidity. This can only be surmised from observation of actual instances where there is a probability of such molecular growth in substance. Here I claim a balance of evidence which strongly points to the conclusion that augmented hardness is always accompanied by diminution of bulk. But I can hardly think that the author of the theory would choose to avail himself of the apparent breach here disclosed in ramparts of reason, otherwise strong to exclude it, for the entry of this assumption of his, that hardness is independent of density: even though it is the only point open to assault. For the molecular-arrangement notion is easily shown to be a fallacy by a simple Euclidian argument to its absurdity. Thus, recalling our former premise that molecular rigidity is proportional both to the strength and distance of the molecules, *inter se*, we find above that the first case necessitates disturbance of the existing atomic relations, and is therefore not a probable event in the phenomenon in question. But alteration in molecular distance means alteration in the volume of the aggregate. Therefore there can be no arrangement of molecules maintaining them unchanged and at unaltered distance which can produce change in the molecular rigidity.

As to "T. M.'s" last shot, I have no knowledge of designating Prof. Roberts-Austen's theory a "speculative effusion." I rather think it was to my own that I was referring in that connection. But if he chooses to include both in the same category he is quite at liberty to do so as far as I am concerned; for I label them so myself, and without any intention of describing them as other than what they are. This, indeed, is their chiefest point of affinity.

In conclusion, may I direct the attention of those interested to Sir F. A. Abel's recent remarks bearing on this subject, and especially to his caution against the drawing of broad conclusions from the results of these same researches upon which Roberts-Austen bases his theory, which is very much the same as what I said previously in my letter of June last.

Sept. 10. J. Q.

## MOTOR FOR CYCLE.

[31643.]—IN reply to "G. G." (p. 83) I would ask whether he does not see that the crucial point is exactly what I have already explained? I cannot waste space by talking about steam, compressed air, or petroleum. Get a smooth, level road or surface and you may then use, perhaps with pleasure, a motor on your cycles; but until you do get that, or an elastic connecting-rod (in fact, an elastic engine all over), your engine will be knocked to pieces "in a week" (more or less). That's where the "rub" comes in. One Replier did see so far, when, in answer to my question, he said he would drive by a chain from a counter-shaft; but, gentlemen, there is nothing like trying. You will learn more from one experiment than from columns of print.

**Nun. Dor.**

[31644.]—SOME of our correspondents, I think, have taken "Jack of all Trades'" letter rather too seriously. They evidently cannot appreciate a piece of irony. Personally, I enjoyed its perusal immensely. Apparently that "surgical operation" is needed by some. However, to return to the matter in hand, motors for cycles don't seem to get much further. All arrangements for utilising power downhill, and storing it for use on the level or uphill, are, in my opinion, quite useless. Where would you be on a road with no hills, or such slight gradients where the machine would not run without foot power? Suppose for a moment that it were possible to store up all the power wasted downhill, and convert it into driving power, also that the apparatus had an efficiency of 50 per cent, it would only take you up half the hills you had come down, and leave you to drive all the rest on the level.

"W. G. J." (31260) seems to think that a two-speed gear is something quite new. I think, for the last six years, there have been half a dozen varieties on the market, all quite practicable, and more or less used; but for some reason the cycling public would not be "caught on."

It is, no doubt, quite possible to drive at eight miles per hour on the level by means of an electro-motor; but what about the hills? An ordinary tandem tri. would not be in it for weight. Only those who have pushed a heavy tandem single-handed up Muswell-hill would be able to sympathise with the poor rider of the electric trike, and that only in a very small degree.

I really believe it possible to drive a bicycle at eight or ten miles on the level, and about six on very slight gradients, and pedal or push the rest, if a small high-pressure steam-engine, as described in my former letter, be applied to it. Anything heavier than that could not be pushed up hills with any comfort, and even this would take *all* the driver's attention, make his hands and clothes dirty and greasy, keep him in a perspiration, and suffocate him (more or less) with the fumes of burning oil. It would require an enthusiast in the matter (like I was at one time) to ride it at all. If made too heavy to push up hills, you would at once require an engine powerful enough to drive itself, machine, and rider up grades of 1 in 10 at least. This would be little short of a road locomotive. There would be no mean. An auxiliary power for the levels and to aid slightly up hills is a possibility with high-pressure steam, if the rider is prepared to put up with the inconveniences mentioned above. And, as far as I can see, until some much lighter source of power is found, nothing more than an auxiliary power is possible.

**F. J. Garrard.**

## AUXILIARY POWERS FOR TRICYCLES.

[31645.]—SHALL it be gas, steam, compressed air, or petroleum? For these we shall want some data to work from, and I think that I can put some of "ours" in the way to come at something. There are some things that will act in a small way, the which, if we want to enlarge upon, we get in a fog; and some in a large way, that act very well, are difficult to apply in a small way to any advantage. Now we will take petroleum first. It has its advantages for the purpose in several ways, and we can get it at almost any density, that it will evaporate by passing air through it at 32°, and generate an explosive compound: but can we get a rapid action and a reliable pressure for small motive power, for instance, as needed for a tricycle? The cylinder must be small, say 2in. diameter and 4in. stroke; this off a chain wheel 3in. diameter and a driver 6in. should do all we require. However, I propose to construct an experimental machine without much outlay, to assist those who have an eye to small power and its application, the material brass, as it is easily manipulated, and if a failure the material is available for other purposes, and it can be found in the market in so many forms that it is possible to find it for any purpose almost. The sketch, Fig. 1., is a conglomeration of sectional view, &c., the which will carry with it enough to explain itself with what I shall give, but as space is an object, I am somewhat cramped for room in one sense. I wish it was not so, for I am not up to much in small work now. A is a piece of triblet brass tube 8in. long; A 1 another 5in. long, 2in. diameter; B B two pieces of triblet 3in. long, 1¼in. diameter. This is inside diameters given, and the inside of those two pieces that will fit nicely. At Smith's, St. John's-square, Clerkenwell, this may be selected to suit any requirement without any fitting. B 1 sheet brass 18 B.W.G. 6in. wide 12in. long will probably cut all that is required, and D two pieces of tube that fit one another, the same size 8in. long, a piece of brass rod ⅛in. thick, ½in. wide, and 18in. long, and a piece ⅛in. thick and 8in. long, 1¼in. wide, 12in. of ¼ rod, and a foot of ¼ brass or copper tube light, and about 6in. of $\frac{1}{16}$ brass or copper. Now A is the main body of the cylinder, B B are the valves or shell cocks—the top one the igniting valve, the bottom one the exploding charge, and can be made larger than top if required; E is the lamp trimmed with wick and ordinary paraffin oil, or mixed with olive, camphor, &c.; F feed for jet, and G feed for charge; these are taken from top of vapour generator, A1, in which is inserted a pump, D, a non-return valve being in the bottom of barrel, and another in the hollow ram, the pump taking its feed from the inside around the barrel; at the bottom is perforated with small holes, and above that a washer, then a series of washers of old flannel; above that a larger collar to keep them in their place; the action of the pump: take air through plunger, press it through the holes, and through the flannel, and out at pipes C: the flannel being saturated with gasoline or benzoline, imparts its explosive properties to the air for use for the engine;

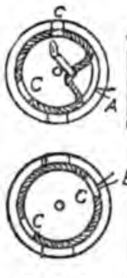

FIG. 2

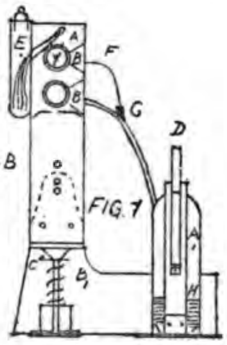

FIG. 1

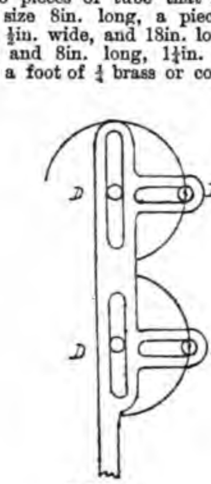

FIG. 3

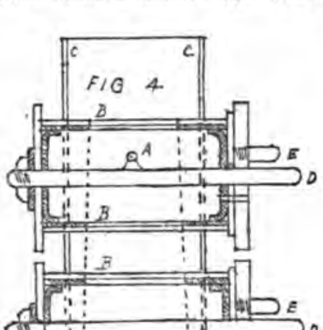

FIG 4.

C is a brass disc, with a cone and rod, and
at the bottom, which should be made a
against the pedestal at the bottom.

This spring may be made of 18 B.W.G. s
wound upon a ⅜ mandrel and ⅛in. space
coils, and will bear, when compressed, abo
12lb. Fig. 2 is an enlarged view of valves
show where the feed-pipes from pump en
ports and their true position and the p
igniting jet (Fig. 3), the rod for working t
on pins E and D (Fig. 4).

This rod is worked from the same lever
pump is, a fulcrum put between upon the
B I; in Fig. 4 ports are shown, B B B
through; but, upon referring to Fig. 2,
see that is only right as regards the outer
of valves, and Fig. 4 shows how to constr
valves. Referring to Fig. 1 at B B, two
brass are fitted in and soldered; a ¼ pin
right through into the outer shell of va
projecting outside for connection. These
to be perforated, the lower one an eighth
and the top one $\frac{1}{16}$. A diaphragm of shee
fitted tight below the lower valve with a p
a piece of wood fitted into the ports, and t
mediate space lightly packed with pipe-
asbestos wool mixed. When dry, the w
can be removed from ports.

**Jack of All T**

## PHOTO-MICROGRAPHY (72275,
## FRESH-WATER MEDUSA.

[31646.]—"G. T. B." will find it adv
familiarise himself with the ordinary run
micrography before attempting such o
milk and other fluids, though, were he a li
explicit in his statements, one would be abl
more particular advice. If he wants to ph
fat globules, &c., in milk, a good ¼in. obj
say a Zeiss D, which is about ⅙in., and
spherical condenser, such as Baker supplie
complete, would probably fulfil his requi
If he wants to photograph germs in wate
Reichert oil-immersion $\frac{1}{12}$in., and an Abbe c
of N.A. 1·2 would be about the least expensi
nation which would yield anything like sat
results. Both the lenses above mentioned are
for photography, and may therefore be use
without an ordinary (Huyghenian) eyepiec

Liquids, if in a thin layer under a co
will not, as a rule, present any special di
it would, however, be well to run a ring o
solution round the cover, to prevent eva
A vertical photo-micrographic apparat
expensive, and at best, an inconvenient aff

As to my position on the question of
objective, frankly, I prefer to pin my fai
statements of known experts rather than
*parte* statement of an interested individual.
full results are published, as they will be
"Coarse Adjustment" will find it is h
grievously mistaken, not I. This is all
say now, as I am not at liberty to give det

I am not at all anxious as to the relation
"F. R. M. S." and "Coarse Adjustment,
now acting as his substitute in your colun
the contrary, my mind is quite at rest on t
since "Coarse Adjustment's" last lett
question of the extended fine adjustment
ever, so important in practice, that I thi
to refer to it at some length, quite apart
fact that it is used in a particular form b
individual.

With an easily working (i.e., a somewh
fine adjustment, so light a weight as 3oz
sufficient to furnish the necessary friction;
not think that for the highest class of w
adjustment, capable of being so moved, w
the focus sufficiently firmly—for Bacter
especially. Such a weight as 3oz. would
effect whatever upon my own fine adjustm
during the last few days I have been photo
Spirillum, to show the flagella, and have
focus without difficulty for two hours at a
view of the fact that the diameter of the
certainly not more than $\frac{1}{30000}$in., and
focussing was effected by the tight gut ba
I have previously recommended, the result
tive, which showed the flagella of every
on the plate, may fairly be taken to esta
thoroughly sound character of the arrange
"F.R.M.S." and "Coarse Adjustment"
data of better results, I shall be happy to
method. If they cannot, what have I to

As to the eyepiece, the question is, Are
disadvantages attending its use such as to
the convenience of the short camera, and
graphing the image exactly as it was
visually. I have never yet seen the perfor
a lens injured by the use of an eyepiece,
negative was at the same magnification a
it, and the more perfect a lens is photogr
the more safely may it be used with the Hu
eyepiece. My Zeiss *aa* is quite up to the
tion given by "Coarse Adjustment" of
lens, and I am unable to see any differe
performance with or without an eyepiece
magnifications.

sing screen most suitable for photo-
is a sheet of patent plate-glass, ruled
uld otherwise be the ground surface,
l and transverse lines. These lines
ld in the focus of as low a convex lens
and the image brought to the same
very slightest obscuration of the glass
e where delicate details are concerned.
water Medusa, Limnocodium Sowerbii,
lly-fish, allied to the marine Trachy-
s origin is unknown; but it is supposed
introduced with one of the water lilies
al climates. It is allied to Hydra, being,
of the Cœlenterata. It is, possibly,
ith a curious polyp discovered by Mr.
s in the same tank.

**Edward C. Bousfield.**

## TILATING GAS-ENGINES.

-A SHORT time ago I erected a Crossley's
in a shed outside my workshop. The
passing through the wall carried some
led air with it; so I carried up from the
ed a 4in. iron pipe, with an Archimedean
ator at the summit by inserting one end
pe into the exhaust pipe, and directing
to the ventilator. The engine now vent-
o perfection.

**C. C. Ellison.**

## IERE—ETHER, OR EITHER?

-In reply to "F.R.A.S.," page 32,
, the source of my information was
School Electricity," Sampson Low and
ages 179 to 200 inclusive, which I have
l or seriously misapprehended. I quote
graph:—"But at a very high exhaustion
ena noticed in ordinary vacuum tubes,
duction spark passes through them—an
of cloudy luminosity and of stratifica-
pear entirely. No cloud or fog what-
in the body of the tube, and with such
is used in these experiments *the only*
*d* is that from the phosphorescent sur-
glass." But this does not matter, for
experiments appear to have been tried
ed room, and consequently the only
observation was that which resulted
jection of the radiant matter from the
e.

**Henry Stooke.**

## CTRICITY AND ETHER.

-I WILL now point out the reasons which
ply the term "nonsense" to some of
now becoming rather fashionable, and
he statements made as to the relation of
tricity.

manifests itself in phenomena of two
as so-called "static" electricity, the
of which were the earliest discovered,
he invention of "fluids"; (2) current
to which are related all the practical
, and in the study of which it soon
at the fluids failed to supply an ex-
As knowledge progressed, it was found
two actions were most conveniently
"induction" and "conduction." *In-*
ifests itself in the form of stresses
motion; *conduction* is attended with
ects, mechanical and chemical. Ex-
ows us that these two orders of
depend, not upon any difference in the
o-called electricity or electric force, but
absolutely upon the nature of the
n which the force acts—upon its relation
s which are able to set up either an
circuit" or a "conductive circuit";
y, we find that different forms of matter
different properties in relation to the
e (just as they do to the magnetic force,
lated to electricity) that they may be
their inductive capacities and their
capacities.

it remembered, are indisputable known
e careful examination of these facts, as
al properties of tangible matter, and
in connection with the other relations of
light, heat, chemical constitution, and
stresses, offers a wide and most profitable
ting field of scientific work — true
rk; for *science* is merely the Latin name
*ge*—it is knowledge disciplined and
*Speculation is not science.* But some
ind are not content with climbing the
owledge step by step; they must make
s wings (at all events, in fancy) and
unknown, untrammelled by the limita-
ity and fact. By this class of thinkers,
m some of the apparent resemblances
actions of light and electricity, it has
ed that the medium which was supposed
order to explain the facts of light, was
ncerned in those of electricity, and they
his probability by mathematical pro-
w the mathematical mill is like a me-
: the product will depend on what you
e mill. There is a good deal of resemblance between the machinery for making bread and that for making bricks (in fact, we have brick loaves), but the product depends upon whether we feed in clay or good flour. It is just the same with mathematics: if we feed in facts, the result is practical; but if we feed in *fancies*, no matter how elaborate the mechanism, the product will be of no value whatever.

I have in previous letters shown that all these notions about the ether depend primarily on mere assumptions; we *know* that the ether has none of the properties of what we know as matter; but these theorists apply to it calculations and laws derived from these properties, and demand our assent because they are worked out by the exact and trustworthy mathematical mill. Bricks, my friends, bricks!—not sound bread. Your mill cannot work up the clay you feed it with into digestible and nutritious mental food.

Let us see. There are certain resemblances between light and electricity; but what are they?—purely effects upon ordinary matter. For let us note this fundamental fact: that we know that light traverses space, and therefore we may admit that a medium is essential, and for this purpose the ether (which is merely a word to name this apparently necessary medium) is justified as a working hypothesis. But we have not the smallest trace of evidence that electric or magnetic action traverses space. The ether idea is here superfluous. Let us have the fact first before we invent an explanation of it.

But still more, light differs in essentials from electricity and magnetism. It is radiant, moves in straight lines only, and above all, it is *single in its essence*. That is, it originates at one source and moves direct from that source, as it does from any point at which its direction is changed. Its direction is in no way influenced by the object which it is ultimately to reach. In every one of these *essentials*, that is, necessities of existence, electricity and magnetism are opposed to light: they are *dual* in nature; they have two directions; they never travel in straight lines except when compelled to, or that is the easiest path. Their normal direction is in curves, uniting the two points of originating direction. They are entirely controlled by the state or the nature of the substance to which they are directed, which can divert the direction of their lines. In view of such fundamental distinctions, what justification is there for applying to them the idea of the ether, which is, in a sense, necessary in the case of light.

However, there are some obscure facts in the inductive class of phenomena, which, it is alleged, become more intelligible when they and some assumed possible properties of the ether are ground up together and put into the mill. That is to say, we have facts which we do not know the cause of. We invent an agent having properties which would produce the facts; so we do a little bit of arithmetical hocus-pocus, and, like the conjurer who brings a bird out of a pocket-handkerchief, we have the cause of the facts; having, like the conjurer, merely worked a delusion with materials provided by ourselves, not really derived from nature.

I take up any electrical book, and I find a record of discovered facts in the form of a table of "Specific Induction Capacities." I will take my own, as it is by my side, and I take a few figures of Faraday's experiments.

| | |
|---|---|
| Dry air | 1·00 |
| Resin | 1·77 |
| Sulphur | 1·93 |
| Caoutchouc | 2·80 |
| Guttapercha | 4·20 |
| Mica | 5·00 |

All these are known forms of *matter*. It is also found that a change of density in air alters its capacity somewhat (as also pressure, heat, &c., alters all of them); and from this little bit of fact, the speculators assert that the "ether" is the real agent, and go so far as to call it 1·0, and say, with Mr. Searle, p. 464, that the action "may be modified more or less by the presence of air, water, or glass molecules." *May be! More or less!* Oh, dear!

On page 9 of this Vol. "W. C. E." says, "Some of your correspondents have very strange ideas as to the function of the higher mathematics, which in physical inquiries is simply to demonstrate that a particular hypothesis will cover a certain group of facts." I am afraid I am one of those holding strange ideas; I have this very strange one, that the higher mathematics applied to some of the hypotheses evolved in Bedlam would be ridiculous waste of time. I feel that the same term is fairly applicable to the application instanced by "W. C. E."—viz., the examination of the phenomena which would occur in four-dimensioned space. By the bye, I am not at all sure that this problem did not originate in the endeavour to explain some of the (alleged) spiritualistic phenomena of Mr. Home and others *sui generis*. I know the *mathematical demonstrations* were used to support the truth of these phenomena (of clever conjuring). But, as "W. C. E." says, these exercitations are not to be used as showing that four-dimensioned space is existing, or ever will exist. But the similar and equally valid operations of the higher mathematics are actually used as demonstrating that electric induction is an action of the ether, when not one single experiment ever has, or ever can be, made on the ether, and the figures I have given above show that the capacity varies with the properties of mere matter.

More, the mathematics have shown that inductive capacity should be related to transparency, and opaque bodies should not possess it. Look at this picture and on that; mathematic theory *versus* observed fact. I think "ether nonsense" is a very good working hypothetical name. But this is only introductory.

**Sigma.**

## THE ORIGIN OF GOLD.

[31650.]—In this week's issue of the "E. M." there is a short abstract of a paper on the "Origin of Gold" contributed to the British Association by Mr. J. Logan Lobley, F.G.S. Having lived the whole of my life on the greatest goldfield the world has seen (Ballarat, Victoria), I feel a little interested in the matter.

The author is in error if the following paragraph really occurs in his paper:—

"Gold, although a most widely distributed metal, is almost, if not quite, unknown as a product of volcanic *regions*." The italics are mine.

Why, Ballarat is a distinctly volcanic *region* (of a past age, thank goodness), there being miles of volcanic soil and acres of ash on all sides. Mts. Warrenheip and Buninyong are both extinct volcanoes, and all the deep alluvial gutters are covered in some instances with three and four hundred feet of basaltic rock.

I am quite agreed with the author that gold is of aqueous deposition, and of opinion that alluvial gold has been deposited in the gravels and old river beds in same manner. This opinion is strongly held by the best practical geologists of this mining district. It is found that alluvial gold is different in quality to quartz gold (the former being purer) even when the alluvial gold is found in the vicinity of quartz reefs, and should, according to older theory, have come by the disintegration of these reefs. It is found that large boulders of quartz in the alluvium, as a rule, do not contain gold.

There is a remarkable feature in one part of the Ballarat district. For about seven miles in length, north and south, a vein of pyrites cuts through the slates. Sometimes this vein is several inches thick, and will thin down to thickness of a sheet of paper, but quite continuous, except when faults or slides shift it bodily to east or west; there is no gold in this vein, which is composed of arsenical iron pyrites. The remarkable feature is, that where it cuts through a body of quartz, the latter is rich in gold, the quartz being more or less horizontal; such of these flat makes of quartz as are not cut by the vein do not carry gold. So decided is this feature, that the pyrites vein is called the "Indicator." It possesses the same character for the whole of its north and south course, and also to such depths as it has been worked. The miners follow the course of the "Indicator," knowing that when it cuts any of these flat makes of quartz, gold will be present.

The existence of gold in the Ballarat district presents all the features of deposition, and, except in the Haddon district, could not be due to organic precipitation, but probably due to chemical substitution or electro-deposition. I incline strongly to the latter, and have been of opinion for the last twenty years that the deposition is due to thermo-electric action.

What I have considered the strong point in favour of aqueous deposition is shown in the fact that quartz reefs act the part of great underground waterways, it being through these reefs that undergronnd waters travel. Now these waters are mineralised, and it is from these waters I consider the gold is deposited. The point I see is this: The total quantity of mineralised water passing through the quartz is the same for all variation of thickness in the lode, therefore the thicker portions of lode should be poorer in gold. It is found, as a rule, that as the lode narrows down it becomes proportionately richer. A point in favour of electro-deposition is this: It is found lodes are richer on one side. That is what we might expect if electrolysis be the cause.

In conclusion, I may draw attention to the great Mt. Morgan Gold Mine (Queensland), which seems to be a great mass of volcanic matter permeated with gold in an invisible state of division. This rich deposit of the precious metal is isolated, as, so far, I have heard of nothing in the vicinity being gold-bearing. The gold-bearing water has evidently deposited its valuable burden *in the crater of an extinct volcano*. This is the prevailing opinion in Australia.

Sept. 20. **Henry Sutton.**

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In 1889 five steam pipes were burst. Three of these were of cast iron, and their failure was attributed to the "water hammer" action—i.e., through the water therein, produced by condensation, not being properly drained off before steam was admitted.

# REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[71929.]—**Oil and Gas-Engines.**—An oil-engine will be shown at the Dairy Show at the Agricultural Hall the second week in October driving a cream separator. The engine, made under Knight's patents, is of 1H.P., and uses ·17 gallon per B.H.P. per hour. If "Glatton" hails from near London, he should take the opportunity of seeing it.

N. Y. T.

[71929.]—**Oil and Gas-Engines.**—I here send a table of the relative consumption and power of four types of gas-engines:—

| | Acme. | Cycle. | Otto. | Griffin. |
|---|---|---|---|---|
| Brake H.P. ...... | 8·04 | 9·48 | 14·7 | 12·5 |
| Gas per hour per B.H.P. ........ | 17·06 | 19·93 | 21·49 | 25·2c.ft. |

The above is from a paper by Prof. W. T. Rowden, Anderson's College, Glasgow.

U. R. E.

[71929.]—**Oil and Gas-Engines.**—Errata &c.—On checking over the figures given on p. 64, I see I have not mentioned that gas for ignition is not included in the fourth and fifth tables. In fourth table, for 238·8 revs. read 223·8. In eighth table 98·88 should be 97·88. The second figures in value for gas in this and preceding table are the value of the first when reduced to 32° Fahr. and 30in. barometric pressure. Besides the trials I have given, Prof. Unwin quotes some others on p. 434, Vol. XLIII., *Engineering*, which may be referred to. Hutton gives 1lb. of petroleum as consumption for Spiel's smallest petroleum engine per horse-power per hour, and says it is considerably less for larger sizes. The one quart of benzoline mentioned on p. 64 would weigh 1·75 to 1·8lb.

Glatton.

[72026.]—**Prurigo — Arsenic.**—The "Lydney Dispenser" states a fact and makes his hypotheses fit, whether correct or not. In the first place, I do not suppose for one moment that Sir Erasmus Wilson ever meant his prescription to be so misused as to be taken for ten years; secondly, arsenic is a cumulative poison, according to some authorities, whereas it is a well-known fact that the dose of arsenic, like almost every other poison, may be gradually increased till five or six grains may be eaten with impunity; thirdly, it is also a well-known fact that a slight or chronic ailment of the skin may act as a sort of safety valve, and its sudden disappearance be attended by alarming and even fatal consequences. Had I been in attendance on the "Lydney Dispenser's" relative, the disappearance of the psoriasis would have been a very disquieting sign, and I should have expected something else to follow; but for anyone to say that the death of a lying-in patient on the 21st day is the result of a treatment pursued for ten years off and on, is utter rubbish, and not worth serious consideration for one moment. I also will relate a tale. I had a near relative who suffered off and on for 35 years from palmar psoriasis, which was treated by me under Sir Erasmus Wilson's orders for over twelve years. When the psoriasis disappeared, gout appeared; when the eruption disappeared four years ago, an attack of gout came on which proved fatal; but no one thought of blaming the treatment for alleviation of the psoriasis as cause of the death. The "Lydney Dispenser," no doubt, knows all about homœopathy; so do I, perhaps more than he does. I was a homœopath for over fourteen years, and during the whole of that time, nearly fifteen years in all, I read, reasoned, and tested for myself, not as a blind adherent of certain tenets, but as a reasoning being possessed of special chemical and medical training, and I am compelled to state that in my opinion there is no science (?) so full of humbug and humbugs as homœopathy. No reasonable being will believe that $\frac{1}{1,000,000,000}$ of a grain of a certain drug which contains an average percentage of less than 8 per cent. of an active alkaloid, amounting to $\frac{1}{8,000,000,000}$ of the alkaloid, an amount which cannot be detected by any known chemical, microchemical, or spectroscopical analysis, is going to do any good even if that quantity be taken three or four times a day. Strip homœopathy of its system of living, dietary, and hygiene, and it is the biggest humbug going. That is my conclusion after knowing and practising homœopathy for over fourteen years. In conclusion, let me state that I am not an allopath now, and that whilst there is an awful amount of humbug and trickery in homœopathy, there is also much good, but not in the medicines. I do not intend to enter into any controversy with the "Lydney Dispenser"; but the treatment I suggested for prurigo was reasonable, and proved by personal experience. "A. W. S." in 72134, has given the "Lydney Dispenser" rather more than he has time or ability to answer. I do not consider any good results will accrue from an *exposé* of homœopathy or the "Lydney Dispenser" in the columns of the "E. M.," as it might exclude matter more interesting to others beside

Foto File.

[72070.]—**Black Varnish for Iron.**—Brunswick black and turps with just enough gold size to bind it. Several recipes in back volumes. Perhaps lampblack treated in the same way would suit querist, but it is cheaper to buy if you are near a varnish shop.—Nun. Dor.

[72074.]—**Scratched Window Plate-Glass.**—Get a piece of wood of such a shape that it can be held firmly, glue to a flat face a piece of emery cloth, and then with just a little oil rub over the glass until the scratches are worn out. Then take a little jewellers' rouge and a bit of old felt hat, or chamois leather, and bring up the polish. If the scratches are very deep, use two rubbers—one of rather coarse emery, the other finer. The simple answer is: You must grind the scratches out.

Nun. Dor.

[72076.]—**Hydraulic Jack.**—Without the "jack" how can anyone say which way to take it to pieces. Clean with paraffin oil, and if there are any leather valves soak them in castor-oil or cod-oil.

Nun. Dor.

[72084.]—**Music for the Deaf.**—Allow me to express my thanks to you, and to those readers who have so kindly responded to the above, and especially to "A. E. B. M." for the kind and disinterested opportunity of being able to test the audiphone, but unfortunately not a sound even could be heard with its help, and which perhaps was to be expected from the fact that years ago the stick between the teeth plan was tried, but of no avail, and I was hoping that you or your readers could kindly have given some hints on the plan suggested, viz., either as to a better instrument likely to be an improvement on the mouth-organ, or, what would be better, as to the best probable arrangement for a kind of sounding-board, or helmet for the head. I must apologise for this delay in acknowledging the Editor's courtesy and the kind replies, pleading a pressure of other matters, as well as a hope for other hints of a more modern kind. I may also add that I have just lately had a conversation tube made by Sheath Bros., 89, City-road, E.C., which has a much larger opening in the mouthpiece, and consequently is a very great improvement on the old one, but still there is plenty of room for further improvement. I would like very much to know what are the best sound conductors, and the best sound reflectors.

Afflicted One.

[72089.]—**Indiarubber Moulding.**—The rubber is masticated and moulded into shape by means of heat and pressure. It is ridiculous to ask whether a "useful solution of indiarubber" can be made when it has been used for years on macintoshes, &c. The rubber is dissolved in mineral naphtha or bisulphide of carbon (you can employ chloroform if you like), but rubber must not be "melted," in the ordinary sense of the term, or it is destroyed. The tubing, rings, slabs, &c., are usually vulcanised —that is the rubber is mixed with sulphur and moulded up under pressure at a temperature of say 300° Fahr.

Nun. Dor.

[72093.]—**Snow in Theatres.**—Wet the edges of the leaves of a book with sulphuric acid, and you will readily obtain a supply of theatrical snow.

J. K. P.

[72107.]—**Gold and Silver Casting.**—Cast in ordinary plaster moulds; or if the querist wishes to work at the trade, let him procure Gee's handbooks from Crosby Lockwood & Son, Stationers' Hall-court, E.C.

S. R.

[72109.]—**Bessemer Steel.**—This can be magnetised easily enough. Fault must lie with the operator. The harder the steel, the better (as a rule) it takes and holds the magnetism.

M. D. C.

[72110.]—**Stereo Metal.**—Add some antimony to the stereo metal that is too soft, or if wanted extra hard, use a little bismuth. As no information is given as to what it is to be used for, how can anyone say when it will be hard enough? The only way is to "try." As a rule stereo metal (old) is generally hard, and the tea-lead (being pure as a rule) is used to soften it, while the tallow or resin is used to protect the surface from the action of the air when the metal is molten.

D.

[72115.]—**Midland Railway.**—The sketch asked for by this querist, Aug. 15, was actually given on July 4, p. 406 of last volume.

S.

[72117.]—**Brickwork Question.**—Is it not merely an examination question, Mr. Querist?

C.

[72125.]—**Asphalte.**—The best asphalte (barring the natural) is made by boiling pitch until all the water is out of it; then mixing with clean gravel (about the size of peas or haricots), and rolling down with a heavy roller, using plenty of sand or crushed spar on the top. If gravel cannot be had, spar does excellently.

S. R.

[72128.]—**Cleaning Russet Leathe**
—Use a weak solution of oxalic acid, or
soap and water and dress with castor-oil.

[72131.]—**Gas for Engine.**—Presuma
refers to the petroleum engines; but he
misinformed; the mixture of the gas wi
can be done safely only in the cylinder,
explosion is required.

[72138.]—**Gunpowder.**—The firing
powder is a very complex reaction. The
affecting the largest quantities are—

$$4KNO_3 + C_4 + S = K_2CO_3 + K_2S$$
$$+ 2$$
$$2KNO_3 + C_3 + S = K_2S + N_2 +$$
$$4KNO_3 + C_5 = 2K_2CO_3 + N_4 + 3$$

At the same time there are an enormous
equations producing the less important
The second equation given by "Sm.
paratively unimportant. The size of t
rapidity of firing, and space allowed g
fluence the products. According to Noble
it gives—

| | Pebble Powder. | Rifle L |
|---|---|---|
| Potassium carbonate, $K_2CO_3$ | ·3258 | ·34 |
| ,, sulphate, $K_2SO_4$ .... | ·0710 | ·08 |
| ,, sulphide, $K_2S$ ...... | ·1042 | ·08 |
| ,, sulphocyanide, KCNS | ·0014 | ·00 |
| ,, nitrate, $KNO_3$ ...... | ·0013 | ·00 |
| Ammo. carbonate $(NH_4)_2CO_3$ | ·0005 | ·00 |
| Sulphur, S .................. | ·0445 | ·04 |
| Carbon, C .................. | ·0008 | ·00 |
| Total solid products .... | ·5495 | ·55 |
| Carbon dioxide, $CO_2$ ........ | ·2685 | ·26 |
| Carbon monoxide, CO ...... | ·0477 | ·04 |
| Nitrogen, N ................ | ·1123 | ·11 |
| Hydrogen sulphide, $H_2S$ .... | ·0111 | ·01 |
| Marsh gas, $CH_4$ ............ | ·0006 | ·00 |
| Hydrogen, H .............. | ·0006 | ·00 |
| Oxygen, O ................ | | ·00 |
| Total gaseous products .. | ·4408 | ·42 |

W

[72168.]—**Electric Bell and Batter**
Allsop, in his criticism of "A. B. T.'s"
this query, lays down the law so dogmat
so erroneously, that I feel bound to ris
confusion of counsel by reiterating wh
tried to impress upon all sorts and con
electricians for the past seventeen year
since the same erroneous advice was give
columns by the oracle of that day, viz., t
not matter "which pole of the battery go
and which to bell." When Mr. Allsop says
convenience sake" "the carbon pole is
taken to push," he ought, one would thin
assured himself that there was no strong
the practice becoming uniform, and
established rule. But when Mr. Allsopp
say that in some cases it is "advisable to
to push," without a hint that there ma
cases where the opposite is advisable, it s
time for some other practician to put
governing reason for the prevailing pract
simply this. The wire attached to the
(carbon or other negative pole) is
exposed to electrolytic corrosion through
ness with which it is partially or w
rounded, and hence the wear and te
whole wiring of the installation, and th
use of the battery will be least when
attached to the "copper" pole is shorter
attached to the "zinc" pole. In nine
out of twenty there is a shorter aggregat
wire attached to the pushes or other cont
than is attached to bells and indicators, &
very little consideration is needed to con
one that as the wire most exposed to wea
requires better insulation, the shorter len
should be the one to expend most tr
expense upon. This leading idea is pro
quite sufficient—once impressed upon
guide any intelligent fitter when any r
parent exception to the general rule crops

Walker M

[72327.]—**L. C. and D. Locos.**—T
six-coupled good has bee
fitted with the and
struck off. I su
correspondent

[72222.] —
"Grosveno
6ft. 9in.
h
V
s

lens, or a 5in. lens if for small room work, and you will get what you want. 2. If your lamp shows best when pushed *close up* to condenser, get a condenser of *longer* focus, and then push lamp about till best effect is obtainable; although it is possible your lamp is not powerful enough. If that be so, exchange or sell and get a *triple-wick* one. There was one in the "Exchange" columns of this week. I have given beautiful lantern shows with oil lamp, but other things must be in correspondence. Try again. F. G. Willatt.

[72326.]—**Small Glass Furnace.**—It certainly is "possible to operate a small glass furnace occasionally"; but not without a ruinous expenditure for pots and furnace repairs, to say nothing of the waste of fuel involved in the cooling and reheating of the furnace to melting heat every few days. The competition in this business is now so keen that Mr. Proctor could not possibly hold his own, on the lines he has sketched out, against a manufacturer who keeps his furnace going continuously. It is not too much to say—and I speak from practical experience—that the pots, especially if of any considerable size, would break every time the furnace was put out, whilst the continued cooling and reheating of the furnace bricks would soon bring the furnace down. I am not, I am thankful to say, in the line of "penny inks"; but I can tell Mr. Proctor that they are blown in moulds, and "burst off," as it is termed; and also that, judging from the price they are sold at wholesale, a man *must* make not less than 10 gross per day in order to make anything like a decent living. The bottles can be made from broken glass ("cullett"); but Mr. Proctor will find it beneficial (if he goes into the trade, which, for his own sake, I hope he won't do until he knows considerably more about it than he evidently does at present) to add a little raw "batch," as it is technically called, consisting of sand, soda, and lime, in the proportions (roughly) 9, 3, 2 respectively. Shall be glad to give our correspondent further information and advice if required. Mons.

[72332.]—**Cement for House Cisterns.**—I have found that a mixture of two parts resin to one part of suet will answer very well for cold-water tanks, and will not affect the water for drinking purposes. To apply, melt together in an old iron saucepan over a fire. Then you want something to warm the zinc at the bottom of the tank—I used flat irons made hot, and stood over the part where the leaks were; then apply the mixture with a stiff brush. W. H.

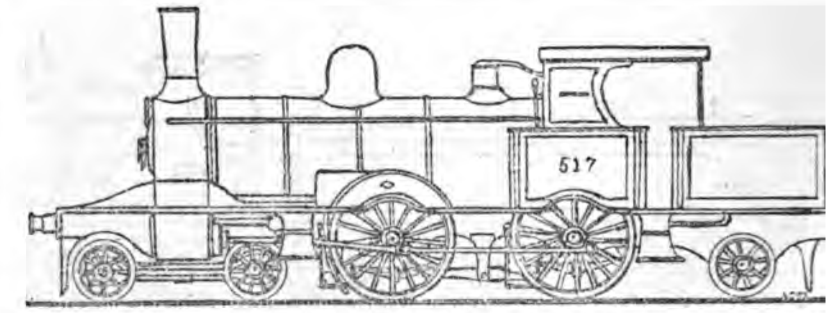
[72348.]—**Chemical Analysis.**—The amount of bromine in a sample of potassium bromide could be estimated in the way you say—i.e., by liberating the halogen and passing it into a solution of potassium iodide, and then ascertaining the amount of iodine liberated by means of a standard $\frac{N}{10}$ solution of sodium throughout, using the starch indicator. I do not see any difficulty in testing for a chromate in presence of an oxalate. If you add to your mixture a solution of barium chloride $BaCl_2$, you will get a yellow precipitate of barium chromate, and you can confirm the presence of a chromate by adding a salt of lead to your original solution, when, if a chromate be present, you obtain chrome yellow. The presence of a chromate does not interfere with the oxalic acid in the least. St. Clair.

[72378.]—**Guessing a Person's Age.**—First ask a person to place on paper the day of the month on which he was born and the number of the month, as it stands in the Calendar, as one whole number—i.e., if he were born on the 24th December, he must write thus: 2412. The process will then be (2412 × 2) + 5 × 50 + the age (which we will say is 70) + 365, and then ask the result, which here is 241885. From this sum privately subtract 615, and you will have 241,270. Here strike off the two right-hand figures for the age 70, the next two, 12, represents the month, December, and the two left-hand figures will be the day of the month. Lastly, subtract the age, 70, from the present year, and you have 1820. Thus, you find, the person was born December 24, 1820, and is 70 years of age.

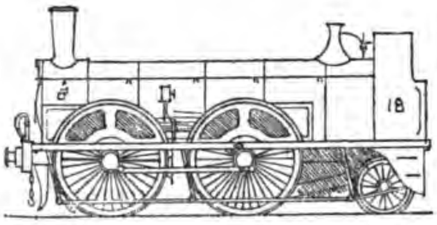
Keynsham. S. P. C.

[72381.] — **Hardening.** — Try heating them as usual, only, instead of dropping them into the water horizontally, drop them in perpendicularly. Incognito.

[72358.]—**L. and S.W. Tank Locos.**—I send a sketch of No. 517 class herewith. No. 123 class are very similar, except they have large side tanks, and only eight wheels. I am sorry I cannot send a drawing of any of the front-coupled engines. The dimensions of the engines mentioned are as follows:—517. Cylinders, 17½in. by 24in.; heating surface, 1,056sq.ft.; weight, 58 tons; driving-wheels, 5ft. 7in. diameter; other wheels, 3ft.; bogie at leading end, radial axle-boxes at trailing end; total length over buffers, 38ft. 8¼in. 123. Cylinders, 18in. by 24in.; weight, 50 tons 15cwt. 2qr.; driving-wheels, 5ft. 7in.; bogie rollers, 2ft. 6in.; bogie at leading end; total length over buffers, 32ft. 6in. 61. Cylinders, 18in. by 26in.; driving wheels, 5ft. 6in.; bogie at trailing end. 177. Cylinders, 17in. by 24in.; driving-wheels, 4ft. 9in.; bogie at trailing end. C. F. Dendy Marshall.



[72373.]—**G.N. Railway No. 18.**—I beg to send sketch of G.N. engine No. 18. The dimensions will be 5ft. 6in., coupled wheels, cylinders 17½ by 26 (about). L.N.W.R. Pacific is one of the compound express engines—the large type, I fancy. C. H. P.



[72386.]—**Level Power from Windmill.**—The windmill could be employed to drive a dynamo and charge accumulators, from which the electricity for lighting the lamps could be obtained. An electro-motor could be employed to drive the cream separator, &c., the electricity being obtained from the accumulators also. F. C. Allsop.

165, Queen Victoria-street, E.C.

[72386.]—**Level Power from Windmill.**—If "Argentina" wants power for dairy purposes he will find nothing equal to steam, as I know from experience: nearly as much fuel was required to heat water for washing and scalding vessels, heating milk, &c., when I drove my separator by horse-power as is now needed to drive the machinery with a steam-engine and do all the heating, scalding, &c., with steam. Doctor Med.

[72386.]—**Level Power from Windmill.**—I think your idea is perfectly feasible. I would advise you to consult some engineer who has made a speciality of cold-air machinery as to the best means of carrying it out. A reducing valve would be required between the reservoir and the engine, to steady the pressure; and the reservoir, or the air passing to it, should be cooled by flowing water. Of course, if you use its power for compressing air, you must not expect to do much other work too. Glatton.

[72388.]—**Self-acting Cylinder Drain Cocks.**—These are simply spring valves, and when the cylinder contains water, give way on advance of the piston, allowing the water to flow out, and thus prevent accidents. Sm.

[72388.]—**Self-acting Cylinder Drain Cocks.**—I know of no drain cocks self-acting. But there is a double-valve or spindle, with a cone facing each other at either end, and this is kicked backwards and forwards by the steam, and drains the cylinder. Jack of All Trades.

[72389.]—**L. C. and D. Railway.**—There are about 100 engines of this company which formerly had names; but as they have been rebuilt the name plates have been struck off. Only the boat expresses and a few Scotchmen now have names. As the list is rather a long one, perhaps the Editor would not care to insert it; but if "Locomotive" cares to advertise his address, I shall be glad to let him have the particulars he desires. W. J. Payne.

[72389.]—**L. C. and D. Ry.**—In 1878 I collected the following L. C. & D. engine names:—Passenger four-coupled: Alert 33, Asia 54, Africa 55, America 56, Brigand 1, Bluebell, Champion, Coquette 28, Cerberus 15, Dotterel 8, Dawn 32, Don, Daffodil, Elk 45, Esk 46, Europa 53, Enigma 50, Falcon 3, Frolic, Gorilla 14, Harpy 20, Herald 34, Hyacinth, Heron 5, Iris, Jackal 19, Kite 73, Lothair 52, Lynx 13, Leopard 18, Lupin, Mermaid 51, Ostrich, Pelican 12, Pegasus 22, Petrel 11, Pioneer 35, Reindeer 44, Stork 6, Swift 7, Swallow 9, Snowdrop, Sylph, Talisman 48, Tiger 16, Templar 47, Vulture 4,
Vulcan 73, Vigilant 37, Verbena 41, V
Xanthus 26, Zenith, Zephyr 49. Tanks:
Albion 95, Arran 84, Annan 91, Bute 82,
Calypso, Corsair 2, Clyde 88, Cambria 98,
Erin 97, Iona 81, Islay 85, Jura 83,
Myrtle 78, Nith 93, Panther 21, Rose, Sha
Spey 90, Scotia 100, Thanet 96, Tay 9
Goods six-coupled: Acis 113, Adrian 127
120, Constantine 132, Diomedes 115, Go
Gorgon 17, Pertinax 131, Pyramus 118, Ta
Thisbe 127.

[72390.]—**Cement for Glass and T**
Shellac dissolved in methylated spirit.
Inco

[72390.]—**Cement for Glass and T**
Shellac and naphtha, or the transpare
polish. Jack of All T

[72390.]—**Cement for Glass and T**
White hard varnish is a good cement f
and is also a non-conductor.
Siebert C.

[72390.]—**Cement for Glass and T**
Nothing is better for this purpose than go
varnish, made by dissolving shellac in m
spirits. If not put on too thick, it dries qu
adheres perfectly. S. Bo

[72390.]—**Cement for Glass and Tin**
this cement is for an induction machine,
paste—made from rye-flour preferable; b
varnish will do admirably if the operator
This is a non-conductor of electricity. It
applied to the previously cleaned glass, an
laid down smoothly.

[72390.]—**Glass and Tinfoil.**—Ordin
answers every purpose for electrical work.

[72391.]—**Making Smooth Round**
**Glass Plate.**—Work over it with a rag
fine emery with oil, and finish as bright a
with rouge on the palm of the hand.

[72391.]—**Making Smooth Round**
**Glass Plate.**—Use a piece of wrought or
with a channel cut in it, and some N
emery; then with flour emery, and then
pumice powder in a groove in a piece of w
Jack of All T

[72391.]—**Smoothing Edge of Glas**
—I always cut my circular plates with a
and fixed diamond. This gives me a
smooth edge, which, of course, is square.
round the edges myself, but if you want t
and round yours, all you need do is to m
glass plate on a trunnion and rotate it,
gently against the edge at the same time w
piece of red tile. Mind the lower edge of
must run in water, like a trough grindsto
wise you will chip the edge. When grou
bevel required, the edge can be polished w
used on a cork. S. B

[72392.]—**Dentistry.**—In order to prac
tistry it is now necessary to obtain a d
license in dental surgery from the Royal
Surgeons of England, Ireland, Edinb
Glasgow (Michigan and Harvard are
foreign diplomas acknowledged). A p
examination in general education, such
the College of Preceptors or Matriculat
University of London, must be passed, a
ticeship in mechanical dentistry of three
dentist, two years hospital practice at a d
general hospital, and various courses o
must be attended. The time required by
lations of the College being at least f
With regard to the expense, the appr
varies according to the position of the d
the amount of time the pupil can dev
workroom, and therefore a nominal figure
£200. Lectures, &c., come to £70 or £8
nation fees, £10 10s.; registration, £5.
Manual," edition 1890, is one of the
manuals, but I do not think that "I
have mastered that yet. Jones's "Dent
and Coleman's ditto are the most gener
M.R.C

[72395.]—**Heat from Electricity**
not care to know anything about tec
such as heat equivalents, calories, j

l not enter into the theoretic part of the at all, but simply tell you that in an ıtal way I have kept a quart of water pidly with the expenditure of about a half ver. Neither the dynamo nor the heating were specially constructed for the purpose, ere would be plenty of room for improveven with such a makeshift apparatus I 'e kept boiling three or four gallons of th an expenditure of 6H.P. To weld a iron about 5 H.P. is needed; to weld a bout 7 H.P. These results have actually ined. S. BOTTONE.

—**Dressing for Leather Belting.**—eswax and two of fresh lard.
JACK OF ALL TRADES.

]—**Teeth-Stopping.**—Tin, silver, or gold gam. More depends upon the manipuputting of it in than the material.
JACK OF ALL TRADES.

|—**Teeth-Stopping.**—The old-fashioned amalgam (copper) lasts the longest, but sadvantage of not only being a bad colour turning the whole tooth blue; thus it is ble for front teeth.
M.R.C.S. and L.D.S.

|—**Teeth-Stopping.**—I am not a dentist, had much experience in tooth-stopping—own. I prefer the copper amalgam to ause it is harder and expands well to fill . The only disadvantage it has is, that black, and is unsuitable for front teeth. phosphate is also an excellent stopping, ast for years if the saliva is alkaline.
SM.

|—**Hygrometer.**—I can only suggest vaporation of the water leaves as deposit matter previously in solution. Cleanse and use distilled water. SM.

—**Hygrometer.**—This cannot be preıd Mr. Marriott, in his unequalled paper t-bulb thermometer, read before the Royal gical Society in 1877, says; "The bulb of ometer should be immersed in dilute suld every time before fresh muslin is put on, y deposit which may have been formed on nay be removed." Give the thermometer sh by holding it and the conducting threads ınning water tap every week. I find it ıging muslin so often.
F.R.MET.SOC.

]—**American Organ.**—My organ had a ound similar to that complained of by I opened it at back, and oiled the fan ıis stopped the nuisance. F. B.

|—**American Organ.**—It is not easy to is query in any definite manner without the instrument. The "rattling sound" used by a loose spring—by any loose parts in ı by something in the case. "Gnosts" known in the "shop," and are often find in even new instruments. Ten years derable time for a modern-made instrul there may be some difficulty in finding of the rattle, but if "Rogo" will examine as he can, and give some more definite on, he shall have all the assistance I can
ORGANON.

|—**Proportional Galvanometer.**—I le many such. For small and delicate e a piece of stout card, and strike on its wo circles 1½in. diameter. Draw two nes across each circle, about ½in. each side . Now cut out the circles, and cut away e at the centre. Now bend two pieces of at $\frac{3}{16}$in. into the shape of a letter D, but . smaller than the four half-circles just Glue these pieces together to form two ıdrical flat bobbins. Now wind each th 100 turns of No. 36 silk-covered copper ue the bobbin down flat on the baseth a ¼in. parallel gap between the two, et the two coils together at the centre, so coils join like a letter ∽. The middle about 1¼in. long, and pivoted so as to coils (and graded cord) by about ¼in. lvanometer will be found extremely sensinotice that Ayrton, in his book, gives Valmsley and Mather the credit of making vanometers. Perhaps he was not aware ınometers of this form have been on sale ris electricians' shops for the last 25 years fore these gentlemen had ever dreamt of eters. S. BOTTONE.

]—**Electric Bell and Battery.**—You quire more than one cell for the battery. pushes can easily be connected to ring the See my book "Practical Electric-bell in which there are numerous diagrams of ns. Fig. 100 shows the diagram you s it shows how four pushes are connected ing the same bell. F. C. ALLSOP.

]—**Dynamo.**—Start your machine and uit the terminals with a piece of wire to increase magnetism in fields, now remove wire, and your difficulty will no doubt be overcome.
C. PETERS.

[72404.]—**Dynamo.**—Apparently the external resistance is so high that the machine fails to excite unless run considerably above its normal speed. Try putting on a larger number of lamps at the start, and turn off those you do not require when the lamps are properly alight.
F. C. ALLSOP.

[72404.]—**Dynamo.**—This behaviour of the dynamo points to the fact that the resistance of the outer circuit is too low to admit of the field-magnets properly magnetising themselves when the lamps are in circuit on starting. Probably affairs would be improved if lamps of higher voltage were used, or if the present lamps were run in sets of two in series. S. BOTTONE.

[72405.]—**Demagnetising Steel.**—Is it necessary to demagnetise the steel of a watch? I suppose the trouble is that the coils of the balance-spring stick together, which is often the case with watches. Try this—take plenty of chalk on your brush, and job it on both sides of the balance-spring until you see (through the glass) that the spring is covered with very fine particles of chalk; although not visible to the naked eye, it is quite enough to prevent the coils from adhering to each other, or to the balance above, or the regulator underneath. I have had watches of which the balance was magnetised strong enough to hold a jewel screw, but that does not prevent the watch taking a good action and going well. If the watch goes with a sluggish action, look for the fault in the escapement.
J. A.

[72405.]—**Demagnetising Steel.**—To demagnetise a watch, a pretty powerful dynamo must be used, and the watch must be spun between the poles, close to them at first, and then gradually increasing the distance from them, remaining always equidistant from each pole, until the watch is virtually out of the range of the magnetism of the dynamo. I may say that in practice I have never found this to fail. The dynamo I use for this purpose is Siemens', giving 55 volts, and 5 or 6 ampères. S. BOTTONE.

[72406.]—**Telephone Connections.**—Connect the telephones in series and use a relay if possible; but I expect you will have to alter the connections of the telephones, which I presume are the D type. Put the batteries down below; if the room in which the telephone is fixed is very warm, it will not matter, the batteries being some way off the telephone. A set of diagrams of connections will appear shortly in "Telephones: their Construction and Fitting," if in which there is nothing to suit, I shall be pleased afterwards to give sketch of special requirements in this column. F. C. ALLSOP.
165, Queen Victoria-street, E.C.

[72408.]—**Varnishing Drawings.**—Float them with skim-milk. JACK OF ALL TRADES.

[72408.]—**Varnishing Drawings.**—Mix some starch to a paste, and when cold go over drawing with a sponge, one coat, then varnish with following:—Three pennyworth of Canadian balsam, thin down with about half as much turpentine, one or more coats, as required. If the starch still makes the colour run, varnish without it, only will want more coats. Will dry hard and white in few minutes. MOUNT CUTTER.

[72408.]—**Varnishing Drawings.**—"Draughtsman" does not say whether his drawings are water-colour, oil, or crayon. I give him one for each. For water-colour or crayon: First size your picture with a solution of isinglass, taking care to cover every part, then varnish with the following:—Clear balsam of Canada, 2oz.; rectified oil of turpentine, 4oz.; warm gently and shake together until dissolved. Oil colours: Varnish with the following:—Chio turpentine, 1½oz.; mastic, 6oz.; camphor, 15gr.; powdered glass, 2oz.; rectified oil of turpentine, 30oz. FRANK.

[72409.]—**Ventilation.**—Take pipes from the bottom outside and run them up the angles of the room within 2ft. of the ceiling, and put a perforated cone of zinc on; the pipes can be zinc.
JACK OF ALL TRADES.

[72409.]—**Ventilation.**—Get a piece of wood about 4in. wide and same thickness, and ½in. shorter than lower sash of window, cover one of the long edges with green baize. Then open bottom half of window, insert piece of wood horizontally in groove with baize-coloured edge upwards, shut window down on to this, and air will come in between the sashes. W. H. S.

[72409.]—**Ventilation.**—Fit a piece of wood under the bottom sash of your window, taking care to have the wood of sufficient length that it will admit no air. This will raise the bottom sash, and so there will be a space between the two sashes, and the air can obtain admission. This method does not produce a draught, because the air rises vertically into the room and disperses, and becomes warm before it can produce that undesirable effect.
R. B. T. W. Z.

[72411.]—**Wasps.**—If a single individual, a touch with a feather dipped in benzoline. If a wasps' nest, a pint of benzoline poured into the nest, and entrance plugged. In the former case, directly the benzoline touches the breathing holes (spiracles) at the sides of the insect's body he falls dead, as though he were struck with lightning. In the second case, the vapour of the benzoline just renders them insensible (like chloroform on the human subject), and then kills them. S. BOTTONE.

[72412.]—**Dryers.**—Sugar of lead, litharge, black oxide of manganese, permanganate of potash.
S. BOTTONE.

[72414.]—**Transparent Clock.**—The works are concealed either in the counterpoise of the minute-hand or in the axis. I forget which. SM.

[72414.]—**Transparent Clock.**—There have been many varieties of mysterious clocks, but perhaps the one mentioned is similar to one I had to repair a few years ago. This it would be quite impossible for "F. W. B." to make unless he is a watchmaker. It was worked as follows:—In centre boss of minute hand was the mainspring, a train of watch wheels (very minute) extended down the hand to a boss placed as a counterpoise to hand itself. This boss was hollow, and contained the escapement. The centre pinion was fixed to the glass, and the mechanism revolved around it something like a Waterbury watch. It was very delicate. The least draught of air would serve to make it very irregular, if not to actually stop it.
F. J. GARRARD.

[72417.]—**Photography.**—Place microscope in front of lantern in horizontal position. Focus lantern until you get an image of flame upon the object, then focus microscope (with or without eyepiece) upon screen. W. H. S.

[72418.]—**Compound Oscillating Paddle Engines.**—I suppose you mean the class of engine where the steam-chest is separate from the cylinder and forms a pedestal for the trunnion of the cylinder to run in, two ports being in the trunnion and the valve face in the steam chest, the same as an ordinary slide-valve exhaust carried out at one of the angles. JACK OF ALL TRADES.

[72419.]—**Selenite.**—On the sea-shore at Sheerness, from Mile Town to Marine Town, Crimea Scraps Gate, along the cliffs to the Royal Oak, Minster, and Warden; along the sea-shore there I found a good sample of very nice specimens; that is all a selenite clay there. But, as it abounds in treacherous silts, places like quicksands, you have to be very careful, as when I was out on the hunt I have had to lie down and roll over the ground, as I could not walk; and once I got so deep that I left the bottom of my shoe in it, as it pulled it clean off the upper, and I was sadly afraid I should never get out: it made me break out in a perfect cold sweat. JACK OF ALL TRADES.

[72420.]—**Extracts from Herbs.**—Consult the "British Pharmacopœia." SM.

[72420.]—**Extracts from Herbs.**—To make the extracts of plants, such as used in the British Pharmacopœia, those parts of the plants which contain the extractive principle are placed in powerful presses and the juices extracted. The juice is then placed in a steam-jacketed vacuum pan (one has been described and figured at p. 341, Vol. LI. of the ENGLISH MECHANIC for June 30, 1890) and evaporation in vacuo carried on until the extract has reached the desired consistency.
S. BOTTONE.

[72420.]—**Extracts from Herbs.**—It just depends on what Mr. Thomas requires as to the method to be employed. If he requires simply the juice, then he must pound, in an earthen or stone mortar, the plant from which he wishes to get the juice. If he wants an infusion, he must boil (not in anything made of metal) the plant or part of plant. If he wants a decoction, he must let it stand in water (cold) for twelve hours, and then stew it. If he wants syrups, distilled waters of plants, or tinctures, he had better get a suitable book, or if he likes to publish his address, I will write and let him know. R. B. T. W. Z.

[72423.]—**Dynamo Armature.**—Armatures have been constructed in which the coils rotate and the iron core remains stationary; also in which the core rotated while the coils remained stationary; but apart from the great mechanical difficulty of constructing such armatures, it has been found that no advantage has been gained. This might have been foreseen, since the space required for clearance between the coils and the core is so much air space inserted, and consequently so much magnetism wasted. S. BOTTONE.

[72424.]—**Accumulator.**—If your accumulator consists of five cells, each containing a pair of plates 7in. by 4in., then the capacity would be about 2½ ampère-hours when fully charged. But if it consists of one cell containing the five pairs of plates, then the capacity would be about 12 ampère-hours. The reason your small dynamo will not charge the accumulator is simple enough:

it is because the resistance of the accumulator is so low that the dynamo cannot magnetise its fields when coupled to so low resistant an outer circuit. Gradually add resistance to the outer circuit, in the shape of a few feet of No. 30 iron wire, until you get current through the accumulator. But, the dynamo being small, will charge the accumulator, very, very slowly, as it gives but little current.

S. Bottone.

[72424.]—**Accumulators.**—In reply, no doubt the resistance of cells is too high for the current of your shunt dynamo to pass through. Have you connected it up to the right terminals? You might try this way so as to encourage the current to pass through an outside circuit; supposing your machine lights easily four lamps, connect a piece of wire equal in resistance to one lamp in parallel with the accumulator, then try. You cannot charge an accumulator with a dynamo having an ordinary Siemens H armature, for when in action, instead of brushes collecting the full throb of electricity produced, it is gradual and diminishes in the same way, and you will see that the machine first charges the cells, then as the current diminishes the charge in the cells runs down the same time; but in using an armature whose commutator is made up of a great many sections, say only $\frac{1}{4}$in. in thickness, the brushes would cover each section at once, and at the same time collect the whole strength of current produced, and instead of the brushes having to pass over a surface of the commutator where the current strength is practically nil, they meet with a full throb of electricity each $\frac{1}{4}$in. the commutator revolves, and so allow no time for the back-flow from the accumulators to pass: this is partly the reason why it is that certain dynamos can only be used for charging. Perhaps your machine changes its polarity each time it is used, which is no uncommon occurrence.

Mick.

[72427.]—**Electrical.**—To Mr. Bottone.—Six cells of a chromic-acid battery joined in series, having plates exposing about 16sq.in. of negative surface, should work it well. What kind of a governor do you mean—for regulating speed, or for regulating the current?

S. Bottone.

[72429.]—**Accumulator.**—Reckoning six ampère hours for each square foot of lead surface, at two volts per cell, and 746 watts per horse-power, and allowing 2lb. for each foot of very thin lead in each couple, we get 63lb. as the theoretical minimum of lead surface, that would give 1HP for one hour. Now, we must allow at least 30 per cent. waste of energy in conversion, and another 20 per cent. for weight of acid and cells. I think you may safely say that an accumulator to give 1HP for one hour would not weigh less than 1cwt.

S. Bottone.

[72430.]—**Barlow Lens.**—This is a concave lens, and is used to lengthen the focus, and thereby increase the size of the image; but I have never heard of its use in a microscope.

Sm.

[72432.]—**Photograph Lens.**—To Mr. Bottone.—By removing the stop farther from the lens the effect is twofold. 1. It diminishes the actual aperture of the lens, the same as if a smaller stop were used. 2. It diminishes the field.

S. Bottone.

[72435.]—**Sting of Wasp.**—This is purely a matter for actual experiment, and one that can be carried out by anyone gifted with the necessary powers of observation. Let "Simpleton" catch a wasp, and induce him to sting his arm. He will be able to answer his questions himself.

Sm.

[72435.]—**Sting of Wasp.**—If the wasp extracts the sting from the wound without breaking the sting she can sting again and again, as the bag containing the stinging fluid (formic acid) is replenished during life. But if the wasp stings deeply she sometimes cannot extract the sting, as it is furnished with barbs, and then it breaks off, and "Mrs. Wasp" can sting no more. The insect does not necessarily die, or, at all events, not quickly. Wasps have been known to live and feed several days on syrup when their abdomen has been snipped off at its junction with the thorax, the imbibed syrup appearing as a head at the snipped off portion.

S. Bottone.

[72435.]—**Sting of Wasp.**—I can say by experience that a wasp can sting a fairly reasonable number of times in quick succession ere it leaves off. It is a mistake, however, to suppose that a wasp's sting is barbed, for if it were (as in the case of the bee) it could not possibly sting twice over. I have a microscope magnifying objects about 2,000 times, in which the sting of a wasp strongly resembles a very slender and curved thorn, with an exceedingly fine point; whilst that of a bee is seen to be slightly barbed, resembling the spine of some very small fish. The sting of the wasp, I believe, is in no case left behind in the flesh. The wasp after stinging, flies off, unless killed on the spot by the person stung, as is often the case. The sting of the bee is left behind, also the venom bag, and a part of the intestines, and the insect soon dies. The wasp retains its sting and its life.

Autolycus.

# UNANSWERED QUERIES.

*The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.*

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# QUERIES.

[72436.]—**Tent-Making.**—Will some friend oblige with practical instructions for making a camping-out tent? Hints as to furnishing would also be acceptable?—W. W.

[72437.]—**Small Boxes.**—Will some person inform me if small boxes, &c., which are to be polished are ever varnished first as a filling-up coat, and if so, what varnish is best? How should I proceed for ebonising?—Scud.

[72438.]—**To Mr. Bottone.**—I have a small dynamo giving two ampères, 30 volts. Please state how many lamps this will light, and what candle-power. What power will it take to drive it? Also what size of wire for the leads, and how far from the dynamo?—Novice.

[72439.]—**Automatic or Electric Fountain.**—I wish to place a fountain in a small fernery, but have no water supply above. Will some one give me working drawings of a simple and effective plan, if possible, without a cistern at top?—Gosh.

[72440.]—**Voltmeter.**—How can I make a voltmeter to read up to 50 volts? Working sketch will oblige. I have 25 storage cells to calibrate it by. Could I alter an ammeter to act satisfactorily?—Gosh.

[72441.]—**Ephemeris of Jupiter's Red Spot.**—I shall be glad if some reader could inform me where I may obtain Marth's Ephemeris of Jupiter's red spot?—H. V.

[72442.]—**Steam Launch.**—Will "T. C., Bristol," please help me? I wish to fit a launch, 17ft. long by 4ft. beam, with paddle wheels in place of screw as at present driven. The engine has a 3in. cylinder, 6in. stroke, and I propose working it at 200 revs. and 70lb. pressure, driving on to paddle shaft by spur gears to reduce the speed. Kindly give diameter of paddles, width, what depth they should be immersed, and what speed they should run.—Rubie.

[72443.]—**Coil.**—Will some reader kindly give me full instructions how to make a medical coil that can also be used for an induction coil? I want one of moderately strong power to work vacuum tubes and other experiments. I presume the draw-out brass tube arrangement will be the best for the medicinal work. Kindly state amount and size of wire, how many layers, best way of insulating each layer, and full particulars as to connections, &c. Also the strength and best battery to work same, and probable cost. I have some knowledge of electricity, having taken the science up some years ago, but have done nothing in this line for some considerable time, so a full description will kindly oblige.—Sulphuric.

[72444.]—**Cleaning and Filling Holes in Drawing Board.**—Will any kind reader inform me what to fill holes made by drawing pins up with, and to clean board ready for use in science class?—H. H. M.

[72445.]—**Electrical.**—To Mr. Allsop.—I have made a pendulum indicator, which, if connected to a Leclanché cell alone, works well, but when the bell is brought into circuit will not move the slightest. I have no relay fixed. Is it necessary to have two wound cores, and what quantity of wire do they require? Any information will greatly assist.—Amateur.

[72446.]—**Depositing Iron.**—Can any correspondent say if it be possible to deposit iron by an electro, or otherwise, up to 3-16in. in thickness, and if so, describe the process? I have used copper, but find it too soft.—No Name.

[72447.]—**Aluminium Plating.**—Can any correspondent kindly give me the formula for making a bath for depositing aluminium on steel or copper? My object is to use aluminium for plating bicycle parts, because it will not rust. This information I cannot find in any text-book on plating.—E. B. I., Dublin.

[72448.]—**Cement for Wood.**—Will some correspondent please give me a recipe for a cement to fix wood and wood together, to stand the action of water? I have some large water-tanks of wood, well-screwed together, and I used red-lead joints, but they all leak, and the putty has not gone hard either. Some putty that could be kept in a semi-fluid state for long periods would best suit my purpose.—Kolulu.

[72449.]—**Duration of Day at Two Stations in N. Latitude.**—Will "F.R.A.S." kindly oblige by a solution of the following? Given two places, one 50½°, and the other at 55½° N. lat., and near the sun's meridian, what would be the time between the sun's rising and setting at each of them on the 17th day of last month (taking into account the effect of refraction)? I regret to trouble with this, but should like to get a solution, and cannot manage it myself.—J. Draconis.

[72450.]—**Scale.**—Will Mr. Bottone or Mr. Allsop inform me if it is possible to remove the deposit of salt (scale) from the copper tubes of a steam evaporator or condenser of which the shell is of iron by the use of an electrical current? If so, kindly say how I am to go about it.—Savory.

[72451.]—**Safe Current.**—What is the formula for obtaining the safe current for dynamo coils? Also what is Sir W. Thomson's rule? In one book I read it is 1sq.cm. per 50amp.; and in another, 1sq.in. per 1,000amp.—Marcasite.

[72452.]—**Brass Mottling.**—Would any of "ours" kindly put me on the right track for brass mottling?—Lector.

[72453.]—**Clay.**—Would someone kindly give a method for analysing clay for silica and alumina.—Student.

[72454.]—**Dynamo.**—Have just made a 20c.p. dynamo, from size given in "E. M." some time back, only I have put 11½oz. 22 d.c.c. on armature, and about 5½lb on. field-magnets, and connected as shunt. Cannot get any current—are wires right? If not, how can I alter?—F. M.

[72455.]—**Bleaching Cotton Goods.**—Will someone kindly answer the following questions approximately? What is the cost of bleaching and finishing cotton cloth, weighing 5½lb. the 32yds.? How much the piece or cwt.? Cost of drugs, fuel, and wages?—A Mexican Reader, Tepic, Mexico, Agosto 29, 1890.

[72456.]—**Magnetic Sheet Brass.**—I should be glad to know, and others will be on their guard, if any readers have come across any cases of magnetism in sheet brass? Such was my lot a week ago. I am getting several pieces tested and analysed; but, meanwhile, it may be of mutual interest if others have met with such facts. The pieces I have possess clear polarity, attracting and repelling a magnetic needle at a distance of one inch or more. The metal came from a first-class house.—W. Moseley.

[72457.]—**Petroleum Burners.**—I require a petroleum lamp to light a small kitchen where I am at present using one of the central-draught patent lamps 41c.p., which is too large for the purpose. And as I am tired of seeking something suitable in shops, I propose to make a strong tin spherical vessel to rest in wall bracket, and am anxious to know if any correspondent can recommend a good burner of this power, and also say whether a good ordinary 1in. flat-wick burner would not be as efficient with same quantity of oil? Any suggestions will oblige.—Perfect Combustion.

[72458.]—**Knock-Knees.**—Can any reader oblige me with a sketch of the apparatus used for the above deformity, to be worn on the outside of the leg? I have a friend who is knock-kneed, and he has been wearing some elastic appliances for a long time, but which have not had the slightest effect of straightening his legs. I can make him a pair of steel instruments if I have the sketch.—Deformity.

[72459.]—**Outside Plaster Work.**—I shall be glad to be favoured with the best composition for plastering the outside panels of timber buildings in the North of England from some one who has had experience. The oak studs are about 7in. by 3in., and the spaces about 9in., filled in with stone slates in V grooves, and plastered inside and out.—Ebor.

[72460.]—**Locomotive Tender.**—If "J. H." would give a few leading dimensions and short description of tender to first locomotive (inside cylinders) described in this journal, he would gratify more than one reader, as you can hardly call the model complete without it.—Cyclist.

[72461.]—**Piano Played by Electricity.**—Is there any arrangement made for playing a piano by electricity, the contacts being made through holes in a strip of paper? If so, where is it described, or where could it be seen?—A. J.

[72462.]—**Neutralising Rods to the Wimshurst Machine.**—Will some practical electricians kindly explain the action of these rods, and why the machine will not act without them?—P.

[72463.]—**Water in Boilers.**—What is the height in inches of the average water level above the tubes of marine boilers and of locomotive boilers, and what height is the bottom of the water gauge usually placed in each of these boilers? I have heard that it saves fuel to work with as small a quantity of water over the flues of Lancashire boilers as can be worked. Is this correct? Will some one please explain why it should effect a saving or not, and will some one who has a boiler please test the matter and report his experiment in the "E. M."—B. C. R.

[72464.]—**Steam.**—1. Would some one kindly give me solutions to the two following questions? 1. The sum of the areas of diagrams from the two ends of a cylinder is 3·5sq.in., and the indicator pencil moves 1in. for 30lb. variation in pressure. Length of diagram = 4¼in., diam. of piston = 18in., stroke 2ft. Find the indicated horse-power when the engine is making 56 revolutions per minute. 2. In a direct acting engine the travel of a slide-valve is 4in. Find the amount of lap on the face of the valve in order to cut-off steam at $\frac{1}{4}$, $\frac{1}{3}$, $\frac{3}{4}$ of the stroke (no lead). Please state formula for lap and lead of steam valves.—Jack.

[72465.]—**Connections for a Watch.**—What connection should be put in a watch, and how should make a case to put it in, to ring an electric-bell at the required time?—Castle.

[72466.]—**Case-Hardening Iron.**—Can any of "ours" give me some practical method of hardening small iron articles, so as to obtain that pretty mottled appearance seen in perfection on gun-lock work? I have tried hardening with bone-dust, but cannot obtain the nice, light mottled surface I should like to get. Can any one help me?—Woden.

**emoving Thick Varnish from** —Will some experienced reader kindly uccessfully remove a thick, hard varnish raving, without injury to the print ?—Old

**nting Press.**—I want to make a small nd-bills, tickets, &c. I thought of making , and purchasing type for same. Could me an idea, and oblige ?—Joiner.

**ld Paint.**—I find bronze powder when al varnish thinned with turpentine turns g mixed a short time. What is the cause is it to be prevented ? Also please say t varnish to use over gold paint to prevent -X. L.

**rnamental Ironwork.** — Thanks to is very courteous and instructive answer . He has evidently had a large amount and I should be glad if he would let me odel heads, foliage, &c., from sheet iron, imilar to that in the beautiful screens by aw, shown in South Kensington Museum, mer and anvil ! I can manage any ornaat would be made from bar or rod-iron. -iron repoussé work that I am inquiring ur old friend, "Jack of All Trades," has . I should feel obliged if he could help

**lephone Systems.**—Will any corren me of the best way in which to run a ecting wires for telephones throughout an room to another, each room to be able to ith any other at will ?—that is, each one ct wire of its own, although they may all return wire.—Volt.

**hromic-Acid.** — To Mr. Bottone.— dly give the weight of chromic-acid to a r for use in a zinc carbon battery, both le fluid ? What effect would it have on sistance if the dilute sulphuric acid be rentrated brine.—A. B. K.

**y.**—I purchased a small toy consisting of ube, about 3in. long, with funnel-shaped l boxwood ball. By blowing sharply down evolves rapidly, or ceasing to do so it falls. plain it ?—Simple.

**ime Clock.**—I have constructed a weight om instructions given in "E. M." in 1880; four gongs. I wish to replace these with nd being much superior. There are now l hammer stalks at back of frame; how ement be altered to strike on four tubes ? ner is similarly placed. When striking on the hammer be prevented from reboundg, and thus causing a confused sound !—

**lass Pens—Toughened.**—Will any one enced readers or contributors enlighten the s to the best way (1) of producing glass with well-known fluted stems), and (2) how m on M. de la Bastie's method, which the involves the dipping the glass pen whilst a given temperature ? The query is, as to il employed, and the temperature for the espectively ? Detailed working instructions will be esteemed a great favour.—Regular

**rench Book on Moulding.**—Can any end a book in English or French (prefer- er) giving the requisite information in ired by a mechanical draughtsman ?—De-

**pur Gearing.**—Will "J. H." or other of s readers tell me something about Walton's le for marking out wheel teeth, as I am told t out on this principle, no matter what size, together, and that it is very simple ?—C. E.

**lectro-Motor.**—I am told that in a motor efficiency is obtained when the field-magnets de of best wrought iron. Will some elecinform if this is so, and at same time give culars as to what the increased efficiency is, ntage of Watts would be saved by using ght iron instead of the usual castings, say, tor ?—D. W. Evans.

**eutral Soap.**—Which is the best way to hard soap that has an alkaline reaction ? est way to prepare a neutral soap ? It is not ouring purposes, but simply as a vehicle for ?—T. J.

**lashing Point.**—What is the best way the flashing point of oils ?—T. J.

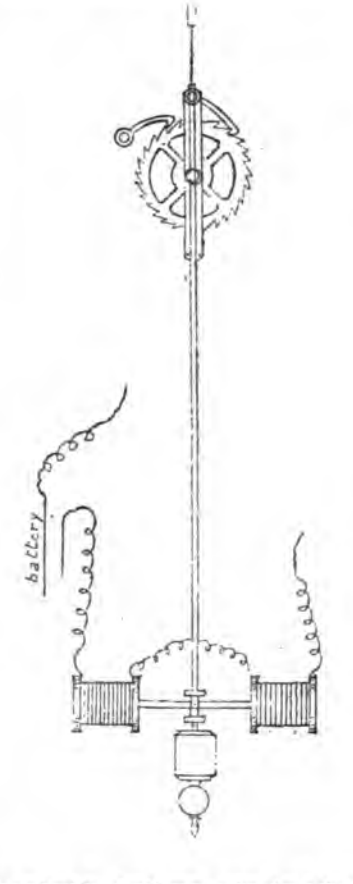
**ultitubular Boiler.**—I have a boiler, n. diam., 32 3in. tubes (two used as stays wed on), shell of boiler ⅜in. thick, ends flat d stayed as before mentioned. The boiler is ler as new, not corroded nor scaled in any t to no scale on. What is the greatest safe sure ? What length and breadth should ues be, and also height and size of chimney, e greatest amount of steam without being in regard to fuel ? What horse-power is supposed to be capable of steaming ? Help who know will greatly oblige.—One Who now.

**crap Leather.**—Can the shavings and leather be made into a cloth grease, or can . be extracted economically to pay, or if se can be done, is there any useful purpose waste leather can be applied other than -One Who Wants to Know.

**he Dialyte.**—To Mr. Herbert Ingall.— number of the "E.M." shall I find instruc- construction of the Dialyte telescope ? If uld Mr. Ingall or any other practical gentleive the necessary information ? What would le outlay required for an instrument of about g. ?—Impecunious.

**L. and N.W. Locos.**—Can any reader tell me in what Nos. of "E. M.," about year 1887, there appeared lists of L. and N.W. locos. ? Also whether the "Canning" and "Bloomer" classes are now extinct ?—Roade.

[72485.]—**Electric Clock.**—I have constructed a clock, as shown in the sketch, using a permanent magnet and two solenoids. Could any reader give a sketch of a good contact-breaker for same, and oblige ?—J. C.



[72486.]—**Honours Organic Theory.**—Will some one kindly advise what I should study for the above Science and Art Department Examination ?—J. H.

[72487.]—**Varnish for Tape Measure.**—What kind of varnish or dressing should be applied to an ordinary wind-up tape measure (mine is 33ft. long) ? My tape is getting rather rubbed by use, and would be much improved by a coat of proper varnish or dressing. I am afraid to apply map varnish, as I fear the tape would stick together when wound up.—Tape.

[72488.]—**Dynamo Governors.**—To Mr. Allsop.—Thanks for your reply. I have one of Ayrton and Perry's voltmeters, which goes up to 130 volts. Suppose I use this instead of a resistance frame—that is, connect it to the terminals of dynamo, and then run my engine until 130-volts are shown, and then close magnetic cut-out by hand. If this will not do will you kindly give me description of your resistance frame, and how connected up to dynamo and cells ?—Wireman.

[72489.] — **Great Northern Railway Loco. Sheds.**—Would some correspondent give a list of the above ? Is there any distinguishing mark on the locomotives of the above line to show to which shed they belong, like the L. and N.W. and L.B. and S.C. Railways ? —North-Western.

[72490.]—**Decorating Wax Candles.**—How are those pretty floral designs one sees on wax candles done ? Will some one give quickest and simplest method and colours used ?—X. L.

[72491.]—**Blow-Lamp for Brazing Cycles.**—Could some of your readers inform me if I could get a blow lamp for brazing cycles with ? I have heard that there is one about that burns with benzoline, and the action of the spirit creates its own blast, but I do not think it can be powerful enough. Could any readers oblige ?—C. S.

[72492.]—**Light Hospital Ambulance Van.**—Will some reader kindly oblige with rough sketch and dimensions of a light hospital ambulance van capable of carrying two patients reclining ? The dimensions to be confined as much as possible to enable it to work on narrow roads, and turn on small space.—Jack of no Trade.

[72493.]—**Great Western and Great Northern of Scotland Railways.**—I should like sketches (without tenders) of G.W. No. 9 single, outside eccentrics, and G.N.S.R. passenger loco. by J. Manson.—Loco. No. 2.

[72494.]—**Electro-Motor.**—I want to make a 1-6H.P. motor to run with a large current at a low E.M.F., and to be self-starting and of the highest efficiency. Will some professional electrician kindly state what type or pattern is considered the very best, and what kind of armature should I have ?—Regular Reader.

[72495.]—**Moon's Atmosphere.**—To "F.R.A.S." —I believe the fact of stars disappearing instantaneously when occulted by the moon is considered strong evidence that the moon has no atmosphere. If so, I shall be glad to know what effect would be produced upon the appearance of a star under the above conditions if the moon had an atmosphere. Is it expected that the star would become less bright before disappearing, or that it would be slightly displaced by its light being refracted in passing through such atmosphere ?—B. R.

[72496.]—**Winter Health Resorts.**—Can any correspondent inform me of the respective advantages of Madeira and the West Indies as health resorts for the winter ?—S. A. B.

[72497.]—**G.N. Railway Locos.**—Can anyone oblige me with a sketch of one of Mr. Stirlings' single-driving wheel, outside cylinder engine ? Also one of his 3-wheel coupled goods ?—G. Bennett.

[72498.]—**Dynamo.**—Will Mr. Bottone please give me dimensions of F.M.'s and armature of a dynamo, capable of lighting brilliantly 120c.p., the best kind of armature ? Also weight and size of wire for F.M., and sketch showing the method of coupling the coils to the commutator ?—A. T. G. R.

[72499.] — **Reduction of Focus of Lens.** — I worked a plano-convex lens of crown glass, the density of which was about 2·7; the convex side being worked 7 tenths, 5 hundredths, radius and thickness of lens in centre 1 tenth. Knowing the density of glass used would shorten the focus, was curious to know how much; and was surprised to find lens above described, instead of being nearly 1in. 5 tenths, 0 hundredths, was 1in. 4 tenths, 8 hundredths; therefore, I presume, by the density, focus was reduced 7 hundredths. Can any of your learned correspondents inform me at what rate per density and thickness the focus of a lens is reduced (say, lenses from 3in. radius, down to 1-10in.) ? Also if the magnifying-power is increased or not ? An answer from Mr. Wenham through the medium of your valuable paper, or from any other good authority, would oblige.—Meniscus.

[72500.]—**Substitute for Putty and Red Lead.** —I have constructed an out-door window-box for flowers. I stopped the nail-holes with a mixture of putty and red lead. I then gave it three coats of paint. I now notice that after heavy rain the putty and red lead mixture has swollen (I suppose by absorption of moisture), and projects above the general surface of the wood in an unsightly manner. As I intend constructing other articles for out-door use, I shall be glad if some reader can inform me how to prepare a permanent cement for stopping nail-holes, &c., which will not swell or otherwise injuriously nor unpleasantly alter by climatic changes ?—Substitute.

[72501.] — **Galvanic Current Generated by Muscular Action.** — Can any of "our" readers kindly give me a short description, or refer me to one, of some experiments in which a galvanic current was generated by muscular action, the hands firmly grasping a conductor ? They were made years ago by (I think) Du Bois Reymond.—V.

[72502.]—**North British Railway.**—I should be glad if "St. Aubyn" could give me a sketch, with description if possible, of Mr. Drummond's 6-coupled 4ft. 6in. tank on the above line ? And I also wish to thank him for his very excellent drawings of the M.S. and L., Midland, and Caledonian locos., which he has given me in the "E. M." lately.—Loco. No. 2.

[72503.]—**Double Bichromate Batteries.**—Will any reader please inform me where the deficiency lies in my double 6-cell battery, as above ? I made the batteries myself, and put 1½lb. of bichromate of potash to 1lb. of sulphuric acid. When sufficiently cool, I charged the cells, and gave a grand light when I connected the whole with lamp of 5 volts. Next evening, I put them together, I could get nothing at all, merely the lamp giving a dull red, and dying away till nothing would be seen. Where lies the waste ? Will any reader please inform me ?—Puzzled.

[72504.] — **Bending Wood Hoops.** — Would any reader who knows kindly tell me the best way of making wood hoops 2ft. in diameter ?—the wood being ¾in. square, and what wood is best for the purpose ? I have used English ash, sometimes boiling it in water for half an hour, sometimes keeping it in steam at 212° for half an hour; but if the grain of the ash does not run straight, the wood generally breaks in the bending.—B. B. B.

[72505.] — **Balancing and Trueing Emery Wheels.**—An emery wheel may be turned true after being fixed on its spindle, and still it may have a heavy side—how can I get it balanced ? What is the best method of fixing a diamond in holder, to be used for turning up large emery wheels ? I shall feel obliged to any reader answering these questions.—Cihparg.

[72506.]—**Spectroscopic.**—I have been trying to experiment with the spectroscope, but with no satisfactory result, and should be glad if any of "ours" who are more experienced with the instrument would assist me. The spectroscope is one of the rainband form, and, though I have endeavoured under all variations of light, I have not been able to detect any absorption lines. To obtain greater dispersion I placed the spectroscope in the tube of the microscope, with the slit in the back focus of the objective, having another slit parallel to the former in the stop of the eyepiece. By this means I obtain a bright spectrum of from 7in. to 10in. long; but I fail to see any absorption lines. Is it possible the lenses in the eyepiece obliterate these lines ? I should be glad of a reference to any books which would assist a beginner.—Zain.

**Forests in Europe.**—The following statistics about the extent of forest land in Europe have recently been compiled. Forests occupy 39·7 per cent. of the total area of Sweden, 36·9 per cent. of Russia, 32·5 of Austria, 28·4 of Hungary, 25·2 of German, 24·5 of Norway, 19·9 of Servia, 19·6 of Belgium, 18·9 of Switzerland, 17·7 of France, 17 of Spain, 15·2 of Roumania, 13·1 of Greece, 12·3 of Italy, 7 of Holland, 5·3 of Portugal, 4·8 of Denmark, and 4 of Great Britain and Ireland. As to the United States, the figure is 19 per cent. of the total area, and the actual extent of the forest land is equal to 15 times the area of Pennsylvania.

# ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

## HINTS TO CORRESPONDENTS.

**1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.**

***** Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

**The following are the initials, &c., of letters to hand up to Wednesday evening, Sept. 24, and unacknowledged elsewhere :—**

Cuttriss and Co.—W. G. Gibson.—S. H. Gillam.—J. Christie.—J. Lawson.—E. M. Langley.—Master Tap.—C. H. Bingham.—R. E. D.—Scud.—H. Hilbrand.—Sapientiæ Cæsarea.—Gas Engine Governor.—A. W. Engineer.—Harrier.—J. G. Tibbits.—Dr. Marshall.—D. Ewell.—A. M. P.—Bofin.—Nemo.—W. S. P.—J. Wilst.—H. C. Braun.—A. B. T.—D. W. Caumanda.—John Bell.—Trabasna.—Jack of all Trades.—Danois.—C. D. Marshall.—Petrotyke.

J. M. (The only way is to advertise fo the address of the makers, or for that of the correspondent who replied. We do not know anything further about it; but several forms of burners for petroleum and the low-priced "dead oils" have been described in back volumes. It would scarcely pay to burn petroleum in this country—that is for generating steam in boilers—unless it could be bought at about 1½d. a gallon.)—P. B. Stoney. (It has been stated over and over again that to "melt" indiarubber is to rob it of its special properties. See indices of back volumes, especially Vols. XXXI. and XXXII., which contain articles on the Indiarubber and Guttapercha Industries. Probably you will find a reply on the subject in this number. Hancock's work on the Caoutchouc or Indiarubber Manufacture may still be in print. It was published by Longmans in 1857.)—R. F. Grundy. (Presumab'y you mean a pantograph—to be seen at any mathematical instrument makers. Please see "Hints" above.)—Telsco. (Please refer to an etymological dictionary and learn the meaning of the word "telescope." We will save you that trouble. "Tele," at a distance; "skopeo," to see. If you had looked through a telescope you would never have sent such a question. Refer to Ganot's "Natural Philosophy for General Readers and Young Persons," Longmans, and' you will find "Telescopes, by which very distant objects, whether celestial or terrestrial, may be observed.")—W. M., St. H. (We do not reply by post. Tinman's solder melts at a lower temperature than lead, but on such thin lead considerable skill must be used to prevent it shrivelling. You might succeed with one of the fusible alloys.)—X. Y. Z. (If you mean a working engineer, he should apply at some shop. There are classes in many towns, and he could enter for the Whitworth Scholarship; but "engineering profession" is too vague for us to give a definite answer.)—Ernest Hancock (Please see some elementary textbook of electricity, or look through your back volumes. The zinc forms the positive element; but its connection is the negative pole. Do not understand what you mean by a "negative current.")—J. de Hoghton. (The discourse on Spinning Tops was given in substance on p. 49. It may, perhaps, be published at greater length in the Report of the Association. 2. The error cannot deceive any one as you will see, for a tube having an external diameter of 1in. cannot have an internal diameter of 3in. Decimal points, especially if they come at the beginnings of lines, are apt to be broken off in printing. 3. Perhaps Heather's "Optical Instruments," Crosby Lockwood and Son, may suit you.)—Basil. (Practical Geometry; but attend the classes at the Finsbury Technical College. 2. Solve the propositions. 3. You must please yourself.)—Apprentice. (Perhaps Maxton's "Manual of Engineering Drawing" will meet your requirements. It is published by Crosby Lockwood and Son in Weale's Series.)—J. R. (What "explanatory remarks" do you want? You will find full explanations of what you refer to in the textbooks or in the back volumes.)—Andrew H. J. T. (Why not show your "magnetic paper" to some firm of electricians?)—A Reader. (Any of the publishers who issue educational works can supply you.)—W. H. Grainger, Boston, Mass. (We do not know where such lamps as that described on p. 482, August 1, can be obtained; but the reference to the cost means the cost of the materials for generating the current.)—T. F. S. T. (Thanks for the papers forwarded. The gas used in the gun is known to be carbonic acid, which is stored in the liquid state. See an article on p. 457, last volume, July 25, and replies on pp. 495, 536.)—Domus. (The meat is preserved by driving out the air and sealing the tins, so creating a sort of vacuum. No chemical is used, so far as we know.)—J. R. Herrmann. (We suppose you mean the tidal motor illustrated on p. 26, Sept. 6, 1889.)—F. Clough. (The only way is to apply for a situation at some engineering works. The junior draughtsmen would get out working drawings for the different departments.)—R. B. T. W. Z. (Often the books are specified in the Syllabus; but the teacher of your class will advise.)—Enquirer. (Very likely. Such legends are found in many of the older languages; but see the indices of back volumes for much information on the subject.)—Warrior. (The best way to prepare damp walls for papering is to cover them with tin or lead foil; but cannot the walls be cured of their dampness? We have given many descriptions of methods that have been tried.)—Steam. (If the light is wanted for only a minute or two use Leclanché form of cell; but see recent back numbers and the indices, as the question has often been answered. The number of cells required depends on the resistance of the lamp.)—Wm. Simpson. (Perhaps the best way to preserve yeast is to press it nearly dry between canvas or hair cloth, and make it like what is known as German yeast. 2. See Allen's "Commercial Organic Analysis," Vol. I. You can buy a small quantity of invert sugar more cheaply than you can make it,)

**More Proof.**—The late Editor of *The Electrical Engineer*, after a thorough examination of Mr. Harness' Curative Electropathic Belts, declares them to be perfect appliances for the self-application of mild, invigorating currents of electricity for the prevention or cure of disease. Copy of his report may be obtained gratis, on application to the MEDICAL BATTERY CO. (Ltd.), 52, Oxford-street, London, W. Book of testimonials, descriptive pamphlet, and consultation free. Rheumatic sufferers and those troubled with any form of nervous, muscular, or organic weakness should call or write at once.—[Advt.]

**The Taxation of Inventions.**—The report of the Comptroller General of Patents for 1889 throws a curious light on the real worth of the staple official objection to a reduction of the "renewal fees"—namely, that without the help of these fees the Patent Office could not pay its way. The income of the Patent Office from fees on patents during the year 1889 was £154,794 4s. 4d. Of this sum, £93,205 was paid by way of renewal fees. But the surplus profit of the office was £93,534 8s. 9d. It appears that, even if the present annual taxes were abolished, the Patent Office might reasonably expect to be self-supporting. American patent law knows no renewal fees; and yet we understand that the Commissioner of Patents had last year at his disposal a handsome surplus of £45,000. We should like to see a competent discussion of the question how far the abnormal taxation of inventors in England is due to the old fallacies that patents are "monopolies" in the injurious sense of the term, and that patent grants still issue in fact, as well as in theory, from "the especial grace, certain knowledge, and mere motion of the Sovereign."—*Law Journal.*

**Iron—Nickel Alloys.**—Dr. J. Hopkinson has been making experiments on the iron-nickel alloys, with some remarkable results. A nickel steel, containing a little less than 5 per cent. of the former constituent, is decidedly more magnetisable than wrought iron, particularly for high inductions. On the contrary, with 24·5 per cent. of nickel, the alloy is non-magnetic at ordinary temperatures; but after being exposed to a very low temperature it becomes slightly magnetic, and remains so up to more than 500° C. With 73 per cent. of nickel, however, an alloy is obtained that is much more magnetic than the preceding, or than a mechanical mixture of iron and nickel in the same proportions. In the specimen of nickel steel first mentioned there were two well-marked "critical points" at temperatures about 150° apart, and all magnetic properties vanished on heating to the higher point, to reappear, on cooling, only at the lower one. All these facts point to some eccentric sort of chemical combination. The non-magnetic alloy contained very nearly three molecules of iron to one of nickel; but the cause of the phenomena observed is by no means as simple as this might indicate, since a small proportion of nickel increases the magnetic properties of the material.

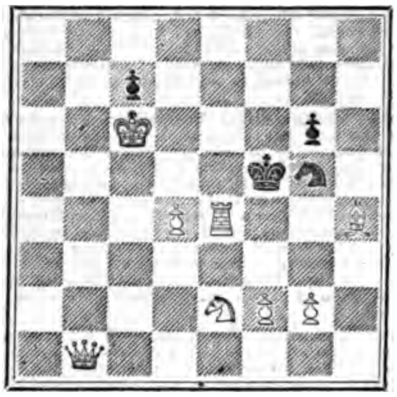
**Street Railways in the United States.**—The Superintendent of Census has issued a bulletin which presents some interesting figures about the street railways in the cities having a population of 50,000 each or over. Fifty-six cities have been included in this census. In 1880 these cities had a mileage of 1,689, while in 1889 they had 3,150. Mileage or length of line is defined to mean length of road-bed or length of street occupied. If double tracks were counted double, the figures would be much higher. Hence Philadelphia appears to have more mileage than New York. The total mileage assigned to the five leading cities is: Philadelphia, 283; Boston, 200; Chicago, 184; New York, 177; Brooklyn, 164. But if we turn to the column which counts double for double tracks and gives the total miles of track, this is the way the five cities stand: New York, 368; Chicago, 365; Boston, 329; Brooklyn, 324; Philadelphia, 324. The length of double track in each of the five cities is: Chicago, 176; New York, 161; Brooklyn, 138; Boston, 104; Philadelphia, 39. The motive power of the total mileage is distributed thus:—Animal power, 2,351; electricity, 260; cable, 255; steam (elevated roads), 61; steam (surface roads), 221; total, 3,150. Only three cities had elevated steam roads, namely: Brooklyn, 24 miles; Kansas City, 5; New York, 32. Steam surface roads are common, but Birmingham, Ala., is away ahead of all competitors with 60 miles. Baltimore is the biggest city that has nothing but H.P. Chicago is all H.P. with the exception of 24, and Philadelphia with the exception of 23 miles of cable. Scranton, Pa., is the only town in the list that has nothing but electricity.

# CHESS.

All communications for this department must b addressed to "J. Pierce, Knollside, Yawl, Lyme Regi Dorset."

## PROBLEM MCCXXI.—(First Tourney Problem).

*Black.*



*White.* [8 + 4

**White to play and mate in two moves.**

Solution to 1219.

| *White.* | *Black.* |
|---|---|
| 1. B-K B 6. | 1. R takes P (best). |
| 2. Q takes R. | 2. Any. |
| 3. Q takes P mate. | |

## NOTICES TO CORRESPONDENTS.

Fr. Fernando, J. Kistruck, W. J. N. Brown, and J. A. Rogers: Entrance fees to Tourneys duly received.

In Solution Tourney, five points will be allowed for author's solution, only the first move need be given in direct mates; but in sui-mates *all* the moves and variations. For Second Solution (if any) two points are scored. For every incorrect solution or variation omitted one point is taken off score. Solutions must be sent within a fortnight after publication of the problem. The judges in direct two-movers are: Messrs. Miles, Keeble, and W. T. Pierce; in the sui-mates, Messrs. Miles and Keeble.

The *Pictorial World* offers quarterly prizes of two guineas, one guinea, and half a guinea for competition among its solvers, commencing Oct. 2. Rules and particulars may be obtained on forwarding a stamped addressed envelope to the "Chess" Editor, 149, Strand.

**Jarrah Wood.**—The *Kew Bulletin* contains an interesting section on the properties and uses of the jarrah wood, a species of eucalyptus, native to Western Australia. The main difficulties in connection with its use in this country are the cost of freight for such heavy timber from Australia and its intense hardness, which makes it difficult for ordinary English carpenters' tools to work it. The tree which produces it grows generally to a height of 100ft., and sometimes 150ft. It is found only in Western Australia, extending over the greater portion of the country from the Moore River to King George's Sound, forming mainly the forests of these tracts. According to Baron Mueller, when selected from hilly localities cut while the sap is least active, and subsequently carefully dried, it proves impervious to the borings of insects. Vessels constructed solely of it have, after twenty-five years' constant service, remained perfectly sound, although not coppered. It has been tried at three places in the Suez Canal, and, after having been down seven years, the trial samples were taken up in order that a report on their condition might be sent to Paris. From certain correspondence between Kew and some London vestries, it appears that jarrah has lately been used by the Chelsea Vestry for paving the King's-road, and by the Lambeth Vestry in the Westminster Bridge-road.

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*** It must be borne in mind that no Displayed Advertisements can appear in the "Sixpenny Sale Column." All Advertisements must b prepaid; no reduction is made on repeated insertions, and in case where the amount sent exceeds One Shilling, the Publisher would b grateful if a P.O.O. could be sent, and not stamps. Stamps, howeve (preferably halfpenny stamps), may be sent where it is inconvenient t obtain P.O.O.'s.

The address is included as part of the Advertisement, and charge for.

Advertisements must reach the Office by 1 p.m. on Wednesday t insure insertion in the following Friday's number.

he English Mechanic
ND WORLD OF SCIENCE AND ART.
*FRIDAY, OCTOBER* 3, 1890.

## BOTANY FOR STUDENTS.

**Edward Aveling**, D.Sc. Lond., Fellow of Univ. Coll., Lond.

### Chapter XXV.—Inflorescence—Floral Organs—Fruits.

HE morphology, histology, physiology of the root, stem, leaf have now been nsidered. We have now only to study se metamorphosed leaves that make up he flower, and to classify the fruits or pened gynœcia. Almost the whole of the atomical side of this work has been done uring the practical dissection and descrip- on of plants. And much of the physio- gical also has been dealt with.

For example, turning to our plan for describing, the next thing after root, stem, leaf have been considered is the Inflorescence. All that need be done here in respect to this is to give the Table of Inflorescences from my Botanical Tables, printing in *small* type the special inflorescences, only six in number, that we have not seen practically, and that are not among those mentioned in the syllabus.

The spikelet, or little spike, or locusta (*locusta*, a locust) of grasses and sedges, consists of several bracts, inclosing two or more flowers that have no calyx or corolla, and are therefore incomplete. Fig. 298 represents the spikelet of wheat, magnified; *g g* are the outermost bracts or glumes, in whose axils are only sterile flowers (*glume*, a husk); *b*, $b_2$ are the outer paleæ (*palea*, chaff), or bracts in whose axils are perfect but incomplete flowers, $B_1 B_2$. At the base of each flower is *ps*, a bracteole; the inner palea. $b_3$, $b_4$, are paleæ, with no flower, or an imperfect one.

The strobile of the Hop differs from the cone in being angiospermous—i.e., in consisting of flowers whose ovules are within closed ovaries.

The umbellate and globose cymes, and the fascicle (*fasciculus*, a little bundle), require no explanation. The glomerulus of the Nettle or of the Box is a few-flowered, closely-crowded cyme in the axil of a bract.

The structure of pedicels and peduncles is the same as that of petioles, and their functions are the mechanical support of the flowers and the transmission of fluids to and from the flowers.

The structure and functions of the bracts are the same as those of the lamina of the leaf plus the protection in many cases of the young flower.

The flower is a metamorphosed branch, a branch whose internodes are not, as a rule, developed (see, however, Chapter XIV.), and whose leaves are metamorphosed into sepals, petals, stamens, carpels.

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TABLE OF INFLORESCENCES.

| | | | | | | | | | | EXAMPLES. |
|---|---|---|---|---|---|---|---|---|---|---|
| CENTRIPETAL. Axillary, indefinite, racemose. | Unifloral | | | | | | | | SINGLE FLOWERS. | *Moneywort.* |
| | Multifloral | Pedicels none or simple | Axis extended | Flowers sessile | Perfect | Flowers complete | | | SPIKE. | *Vervain.* |
| | | | | | | Flowers incomplete | | | *SPIKELET.* | *Grass.* |
| | | | | | Imperfect | Inflorescence bisexual: with spathe | | | SPADIX. | *Cuckoo-Pint.* |
| | | | | | | Inflorescence unisexual | Male | | CATKIN. | *Hazel.* |
| | | | | | | | Female | Gymnospermous | CONE. | *Fir.* |
| | | | | | | | | Angiospermous. | *STROBILE.* | *Hop.* |
| | | | | Flowers pedicellate | Flowers on different levels | | | | RACEME. | *Currant.* |
| | | | | | Flowers on same level | | | | CORYMB. | *Hawthorn.* |
| | | | Axis shortened | Axis expanded | | | | | CAPITULUM. | *Thistle.* |
| | | | | Axis contracted | | | | | SIMPLE UMBEL. | *Cherry.* |
| | | Pedicels compound | Secondary axis extended | | | | | | PANICLE. | *Lilac.* |
| | | | Secondary axis shortened | | | | | | COMPOUND UMBEL. | *Hemlock.* |
| MIXED. | Whorls developed centripetally: flowers of each whorl developed centrifugally | | | | | | | | VERTICILLASTER. | *Dead-nettle.* |
| | Capitula arranged centrifugally | | | | | | | | DIPLOTAXIS. | *Groundsel.* |
| CENTRIFUGAL. Terminal, definite, cymose. | Unifloral | | | | | | | | SINGLE FLOWERS. | *Wood Anemone.* |
| | Multifloral | Without pseud-axis | Branched dichotomously | | | | | | DICHASIUM. | *Chickweed.* |
| | | | Pedicels radiating | | | | | | *UMBELLATE CYME.* | *Pelargonium.* |
| | | | Rounded inflorescence | | | | | | *GLOBOSE CYME.* | *Guelder Rose.* |
| | | | Flat-topped inflorescence | | | | | | CORYMBOSE CYME. | *Elder.* |
| | | | Densely crowded | | | | | | *FASCICLE.* | *Deptford Pink.* |
| | | | Axillary: few flowers | | | | | | *GLOMERULUS.* | *Box.* |
| | | With pseud-axis | Axes all to one side | | | | | | BOSTRYX. | *Hemerocallis.* |
| | | | Axes to right and left | | | | | | CICINNUS. | *Drosera.* |

TABLE OF FRUITS.

| | | | | | | | | | | EXAMPLES. |
|---|---|---|---|---|---|---|---|---|---|---|
| MONOGYNŒCIAL. | Simple | One seed | Parts of pericarp united | Ovary superior | Pericarp horny, separable from seed | | | ACHENE. | | *Lady's Mantle.* |
| | | | | | Pericarp inflated | | | *UTRICLE.* | | *Goose-foot.* |
| | | | | Ovary inferior | | | | CYPSELA. | | *Dandelion.* |
| | | | Parts of pericarp distinct | | | | | DRUPE. | | *Plum.* |
| | | Many seeds | Dehiscing through ventral suture only | | | | | FOLLICLE. | | *Pæony.* |
| | | | Dehiscing through both sutures, ventral and dorsal | | | | | LEGUME. | | *Pea.* |
| | | | Dehiscing transversely | | | | | *LOMENTUM.* | | *Bird's-foot.* |
| | Compound | Apocarpous | On flat or conical receptacle | | | | | ETÆRIO | Of achenes. | *Buttercup.* |
| | | | | | | | | | Of drupes. | *Raspberry.* |
| | | | | | | | | | Of follicles. | *Columbine.* |
| | | | In hollowed-out receptacle | | | | | CYNARRHODUM. | | *Rose.* |
| | | Syncarpous | Each carpel with 1 seed | Superior | Pericarp separable from seed | Fruit of achenes | | SCHIZOCARP. | | *Mallow.* |
| | | | | | | Winged | | *SAMARA.* | | *Maple.* |
| | | | | | Pericarp inseparable from seed | | | *CARYOPSIS.* | | *Wheat.* |
| | | | | Inferior | One celled: with cupule | | | GLANS. | | *Hazel.* |
| | | | | | Two celled: with carpophore | | | CREMOCARP. | | *Hemlock.* |
| | | | Each carpel with more than 1 seed | Indehiscent | Pericarp pulpy | Superior | | *UVA.* | | *Nightshade.* |
| | | | | | | Inferior | | *BERRY.* | | *Gooseberry.* |
| | | | | | Pericarp fleshy | | | POMUM. | | *Apple.* |
| | | | | Dehiscent | Superior | Dehiscing vertically or by pores | | CAPSULE. | | *Poppy.* |
| | | | | | | Dehiscing vertically: carpophore | | *REGMA.* | | *Geranium.* |
| | | | | | | Dehiscing transversely | | *PYXIS.* | | *Pimpernel.* |
| | | | | | | Dehiscing septifragally | Long fruit | SILIQUA. | | *Wall-flower.* |
| | | | | | | | Short fruit | SILICULA. | | *Shepherd's-purse.* |
| | | | | | Inferior | | | DIPLOTEGIA. | | *Campanula.* |
| POLYGYNŒCIAL. | Angiospermous: bracts membranous | | | | | | | STROBILE. | | *Hop.* |
| | Gymnospermous: bracts hard | | | | | | | CONE. | | *Fir.* |

TABLE OF VEGETABILIA.

| ING-DOM. | SUB-KINGDOM. | CLASS. | DIVISION. | SUB-CLASS. | EXAMPLES. |
|---|---|---|---|---|---|
| | Flowerless plants: without stamens and carpels<br>CRYPTOGAMIA. | | | | *Seaweeds.*<br>*Fungi.*<br>*Mosses.*<br>*Ferns.* |
| | Flowering plants: with stamens and carpels<br>PHÆNOGAMIA. | Root adventitious.<br>Wood irregular.<br>Leaves parallel-veined.<br>Parts of the flower in 3.<br>Seed with 1 cotyledon.<br>MONOCOTYLEDONES. | | Perianth none or rudimentary: with glumes<br>GLUMACEÆ. | *Grass.* |
| | | | | Perianth none: with spadix<br>SPADICIFLORÆ. | *Arum.* |
| | | | | Perianth petaloid<br>PETALOIDEÆ. | *Hyacinth.* |
| | | Root axial.<br>Wood in rings.<br>Leaves reticulate.<br>Parts of the flower in 2 or 5.<br>Seed with 2 cotyledons.<br>DICOTYLEDONES. | Seeds not inclosed in ovaries<br>GYMNOSPERMÆ | | *Conifers.*<br>*Cycads.* |
| | | | Seeds inclosed in ovaries<br>ANGIOSPERMÆ. | Petals wanting<br>INCOMPLETÆ. | *Hazel.* |
| | | | | Petals united and hypogynous: stamens epipetalous<br>COROLLIFLORÆ. | *Dead-nettle.* |
| | | | | Petals on calyx: stamens epigynous, perigynous, or epipetalous<br>CALYCIFLORÆ. | *Rose.* |
| | | | | Petals distinct and hypogynous: stamens hypogynous<br>THALAMIFLORÆ. | *Buttercup.* |

### TABLE OF MONOCOTYLEDONES.

| | | | | | | EXAMPLES. |
|---|---|---|---|---|---|---|
| MONOCOTYLEDONES. | GLUMACEÆ (Perianth none, or scaly: glumes) | | | | | Grass |
| | SPADICIFLORÆ (Perianth none: spadix.) | | | | | Cuckoo-pint. |
| | PETALOIDEÆ. (Perianth petaloid.) | Ovary inferior | | | AMARYLLIDACEÆ | Snowdrop. |
| | | Ovary superior | Water plants | | | |
| | | | Herbs ......... | Perianth petaloid, 6 partite: stamens 6 | LILIACEÆ. | Lily. |

### TABLE OF INCOMPLETÆ.

| | | | | | EXAMPLES. |
|---|---|---|---|---|---|
| INCOMPLETÆ. (Petals wanting.) | With Catkins | Trees ............. | With involucre: fruit a glans | CUPULIFERÆ. | Oak. |

### TABLE OF COROLLIFLORÆ.

| | | | | | | EXAMPLES. |
|---|---|---|---|---|---|---|
| COROLLIFLORÆ. (Petals united and hypogynous.) | Placentæ marginal.. | Stamens 5 | | | | |
| | | Stamens didynamous or 2: fruit of 4 achenes: placenta only marginal in fruit | | | LABIATÆ. | Dead-nettle. |
| | Placenta free central ............. | Stamens 5, opposite petals | Utricle 1-seeded | | | |
| | | | Many seeds ... | | PRIMULACEÆ. | Primrose. |
| | | Stamens 2 | | | | |
| | Placentæ parietal | | | | | |
| | Placentæ axile... | Corolla irregular | Ovary 2 celled: stamens didynamous or 2 dumb-bell shaped placentæ ................. | | SCROPHULARIACEÆ. | Foxglove. |
| | | | Ovary 4 celled | Inflorescence cymose | | |
| | | | | Inflorescence a verticillaster: stamens didynamous or 2 | LABIATÆ. | Dead-nettle. |
| | | Corolla regular | Ovary 2 celled | | | |
| | | | Ovary 3 celled | | | |
| | | | Ovary 4 celled | Stamens 5: ovary 4 lobed: style gynobasic: ebracteate | BORAGINACEÆ. | Forget-me-not. |
| | | | | Stamens 4 | | |
| | | | | Stamens 8-10 | | |

### TABLE OF CALYCIFLORÆ.

| | | | | | | | | EXAMPLES. |
|---|---|---|---|---|---|---|---|---|
| CALYCIFLORÆ. (Petals on Calyx.) | Ovary inferior. | Stamens epipetalous | Ovary 1 celled . | Anthers united | | | COMPOSITÆ. | Dandelion. |
| | | | | Anthers free | | | | |
| | | | Ovary 2 celled .. | | | | | |
| | | | Ovary 3-5 celled | | | | | |
| | | Stamens epigynous or perigynous | Flowers perfect | Petals coherent | | | | |
| | | | | Petals distinct... | Flowers in cymes | | | |
| | | | | | Flowers in umbels | Shrubs | | |
| | | | | | | Herbs: fruit a cremocarp: stylopod | UMBELLIFERÆ | Hemlock. |
| | | | | | Flowers axillary | | | |
| | | | Flowers imperfect | | | | | |
| | Ovary superior. | Gynœcium syncarpous | | | | | | |
| | | Gynœcium apocarpous or simple | Flowers regular: stamens definite: five follicles: leaves succulent | | | | CRASSULACEÆ | Stonecrop. |
| | | | Flowers regular: stamens indefinite ........................... | | | | ROSACEÆ. | Rose. |
| | | | Flowers irregular, papilionaceous: filaments united: 1 carpel: fruit a legume ........................... | | | | LEGUMINOSÆ | Pea. |

### TABLE OF THALAMIFLORÆ.

| | | | | | EXAMPLES. |
|---|---|---|---|---|---|
| THALAMIFLORÆ. (Petals distinct and hypogynous.) | Gynœcium syncarpous. | Axile placentæ | | | |
| | | Free central placenta. | Leaves minute, exstipulate | | |
| | | | Stamens 1-5: ovule 1 | | |
| | | | Sepals 2: ovules few | | |
| | | | Leaves opposite: nodes thickened: sepals and petals 4-5: stamens 8-10: ovules many.......................... | CARYOPHYLLACEÆ. | Chickweed. |
| | | Parietal placentæ. | Stamens definite | | |
| | | | Stamens tetradynamous: corolla cruciform: fruit a siliqua or a silicula with a replum: ebracteate ...................... | CRUCIFERÆ. | Wall-flower. |
| | | | Stamens indefinite | | |
| | Gynœcium apocarpous or simple | Stamens definite | | | |
| | | Stamens indefinite ...................... | | RANUNCULACEÆ. | Buttercup. |

That this is the true significance of the members of the floral whorls is shown by the following facts:—

(1) By the development of the parts of the flower; they all develop in the same general way as the leaves, and in their earlier stages are not distinguishable from leaves.

(2) By their morphology. Sepals and petals are very like leaves. A stamen presents filament, the homologue of the petiole; and anther, the homologue of the lamina. The carpel, as it is the innermost part of the flower, and the most pressed upon, is the organ that has undergone most change from the leaf-type. In a legume, however, it is easy to see that the carpel is but a leaf folded upon itself, whose midrib becomes the dorsal suture, whose margins form the placenta, whose adventitious buds are ovules.

(3) By their histology. This will be illustrated directly.

(4) By the transitional forms met with between leaves and the floral organs. Leaves gradate into bracts; bracts and sepals are often almost identical; petals are but coloured, more delicate sepals; in the Water Lily the petals gradate into the stamens, narrowing by degrees below, and acquiring more and more pollen on the upper part, as we pass from without inwards in our examination of the flower. Gradations or transition forms between stamens and carpels, whose functions are so very different, can hardly be expected, but the carpels most frequently furnish the fifth proof of the community of nature of the floral organs and leaves.

(5) By reversion. In cultivated roses, e.g., the stamens revert to the form of petals. Petals and sepals may become leaves. The carpels may revert to the foliar condition; out of the centre of a flower, a branch, bearing leaves, may spring.

If the student will now turn to the syllabus of the Science and Art Department printed in our first chapter, he will see that not only have we cleared off the whole of the general morphology, histology, and physiology, but also under "Special Morphology and Physiology," paragraphs 1 and 2, dealing with inflorescence, and paragraph 4, "morphological comparison of the leaf with the floral organs."

Paragraph 3 is "the enveloping and essential organs of the flower," i.e., the sepals and petals (enveloping) and the stamens and carpels (essential), and "æstivation."

Æstivation (*æstus*, summer) is the arrangement of leaves in the flower-bud. The same general terms are used in æstivation as in vernation, and especially the words "valvate," "imbricate," "induplicate," "reduplicate," "crumpled."

In addition, the æstivation of the papilionaceous corolla is called vexillary (Chapter VII.), that of the Liliaceæ, where two rows of floral leaves regularly alternate with one another, is alternate (Chapter VI.); that of the Buttercup corolla, two outer uncovered petals, two inner covered petals, and No. 3 of the five overlapping an inner petal by one margin, and overlapped by an outer petal as to the other margin, quincuncial.

Paragraph 5, "the modifications of the flower," &c., has been worked out in our dissections and description; and so have the morphology of the sepals, petals, stamens, carpels. Filaments, anther, pollen, placentæ, the various forms of ovule have all been considered. And so have the very important physiological "processes of pollination and fertilisation."

Only the histology of the floral organs, and a word or two on their physiology, need detain us.

And first, the sepals and petals or the leaves of the perianth. Their histology is essentially that of the leaf. Epidermis on both inner and outer sides, with stomata, more numerous on the outer surface (homologue of the lower side of the leaf), two to four layers of spongy parenchyma, two at the edges generally, three or four near the centre; the parenchyma traversed by spiral vessels, the only representatives of the fibro-vascular bundles.

As to the physiology of these floral envelopes, when they are green their functions are exactly the same as those of leaves, plus their protection of the essential organs within. When they are coloured, they still perform the leaf-functions of absorption, transpiration, respiration, but not of assimilation and elaboration (metastasis). And when they are coloured (and often oddly-shaped) they, in addition to their protective functions, attract insects.

Histology of the Stamen. The filament has epidermis without, parenchyma within, traversed by a single central bundle of spiral vessels.

The Anther.—A traverse section across a young anther, say of a Tulip or Lily, presents the appearance shown in Fig. 299B. A central connective of cellular tissue with a single bundle of spiral vessels—compare this with the filament, of which the connective is the top—and four anther-lobes. A little later, the four have become two (see A) by absorption of the partition whose remains e shown at *p*. C, Fig. 299, is a part of one ily of the anther-lobes or pollen-sacs, ghly magnified; *e* is epidermis with stomata the exothecium. εξω (exo), without; θηκη héké), case. *f* is a layer of cells thickened annular secondary deposits, the meso- ecium; *c*, a layer of flat cells, that vanishes rly; *t*, a layer of radially elongated cells, e tapetum or endothecium forming the ner lining of the pollen-sac. This also sappears later on. *Tapete*, a coverlet. *pm* e the mother-cells of the pollen-grains at are to be.

Each mother-cell *p m* divides into two, D, d then into four, E. These are tetrads or ecial mother-cells. These tetrads also give se, by cell-division, to the pollen-grains.

The structure of the pollen-grain, and the ethod of formation of the pollen-tube was ven in Chapter VIII. The disposal of the ollen and its carriage to the stigma is pollination. The passage of the pollen-tube own the canal of the style along the line of e placenta, into the micropyle of the ule is, with the process of pollination, e especial physiological function of the amen, the anther, the pollen.

We turn, lastly, to the histology of the rpel and the ovule. The ovary presents ee Fig. 300, simply the ovary of one of the anunculaceæ) an outer epidermis like that the under surface of the leaf, continuous ith the inner epidermis or epithelium. oth outer and inner epidermis are provided ith stomata. Between the two epidermises is a mass of parenchyma, traversed by solated spiral vessels, *v*.

A section of a style shows the same three tissues surrounding the central pollen-canal, open [Liliaceæ], or loosely blocked with easily-displaced cells. And they are met with again in the stigma, whose surface is generally raised into papillæ, of use in retaining pollen-grains.

The placentæ are cellular structures, and from each of them spiral vessels run into the ovules they bear. Fig. 301 represents an ovule of the Monkshood, another of the Ranunculaceæ. *f* is the funiculus; *r* the portion of it adherent to the ovule—i.e., the raphe. ραφη (rhaphe), a seam. *v*, is the single bundle of spiral vessels; *ch*, the chalaza or organic point of union of funiculus and ovule. χαλαζα (chalaza), a knot. *ie*, the outer coat or primine of the ovule; *ii*, the inner or secondine; *n*, the cellular mass of the ovule or nucellus; *m* is the micropyle. In the nucellus is an enlarged cell, *e*, the embryo sac with a nucleus, *nc*. *o* at the top of the embryo-sac is the oosphere or egg-cell, or germinal vesicle, or embryonic vesicle, the persistent one of three potential masses of protoplasm; *a* are globular cells at the bottom of the embryo-sac, the antipodal cells. αντι (anti), opposite; πους (pous), foot.

Let us now examine our ovule after the pollen tube has reached and fertilised it. Fig. 302 will help us. A is an anatropous ovule in vertical section, *f* is the raphe, *i* the single coat (the ovule is from a gamopetalous Dicotyledon, most of which have only the primine developed). The lower central region is the enlarged embryo-sac, with its three protoplasm masses above, and its three antipodal cells below. The nucellus has been crushed out of existence by the growth of the embryo-sac. In B only the embryo-sac is shown; *nn* are its true nuclei, generally two at first, ultimately only one; *a* are the antipodal cells. At the apex of the embryo-sac *o* is the oosphere, the future embryo, and *s* above it are two temporary cells, doomed, like the antipodal ones, to disappear. They are the synergidæ. συν (sun), together; εργον (ergon), work.

After the pollen-tube has entered the micropyle and its contents have passed into the embryo-sac (fertilisation), the three upper protoplasmic masses—i.e., the two synergidæ and the oosphere become clothed upon with definite cell-walls. The synergidæ, like the antipodal cells, disappear, and the oosphere is now an oosperm. σπερμα (sperma) seed.

The oosperm divides transversely into two cells. The upper cell, dividing again and again, becomes the stalk or suspensor that hangs up the embryo within the embryo-sac. The lower cell of the oosperm also divides, but its future is to be the embryo, and thereafter the plant. Its groups of cells as they divide and divide soon group themselves into those of the embryo root (radicle), embryo stem (plumule), embryo leaf (cotyledon or cotyledons). The radicle always points towards the micropyle.

Endosperm, or "albumen" is formed by cell-division within the embryo-sac below the developing embryo. It nourishes the growing embryo.

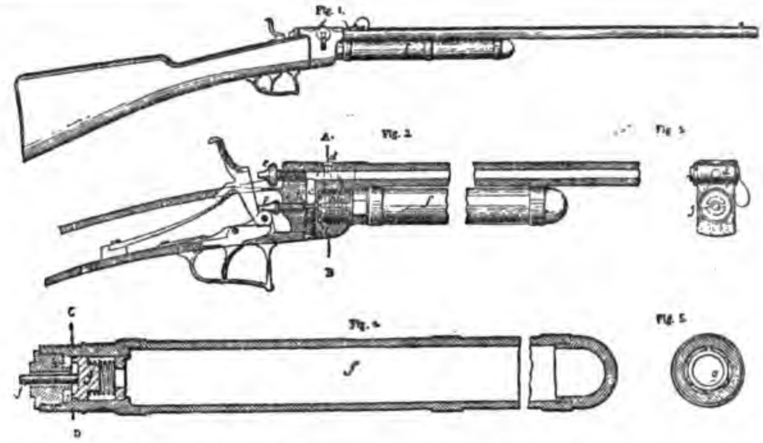
With fruit, as with inflorescences, after our practical work, our table is all that is required.

The seed has also been worked out, with one exception. As a rule (see Chapter IV.), a seed has two coats—the testa outside, the tegmen within. A third is formed in some cases, and this is an aril, when it takes origin from near the hilum or point at which the funiculus and the ovule appear to part company. In the Willow seeds the aril takes the form of long, silky hairs; in the Nutmeg, of mace; in the Yew, of the scarlet, pulpy investment of the seed.

As to germination, or the growth of the embryo into the young plant, its essentials are warmth, darkness, supply of oxygen, moisture. The way in which dicotyledonous and monocotyledonous embryos germinate, with their difference of radicle development and of cotyledons, has been dealt with in our study of roots and seeds.

### Chapter XXVI.

The last and shortest. We have here reproduced the tables of classification of Vegetabilia and of the various sub-kingdoms, classes, divisions, sub-classes, orders, studied in this our Botany for Students. All the terms used in them have been explained in the text, and illustrated on actual plants.



## GIFFARD'S CARBONIC ACID GUN.

IN the annexed engraving we illustrate the rifle designed by M. Paul Giffard, brother of the famous Henri Giffard, the inventor of the injector, the main details of which we described in No. 1322, p. 456, July 25 last. As already explained, the propulsive power is derived from the expansion of liquid carbonic acid which is injected in small quantities behind the cartridge and immediately flies into gas, thus forcing the bullet through the barrel of the rifle. Fig. 1 shows the rifle in elevation, *d* being the opening for inserting the cartridge, while *f* is the reservoir containing the liquefied carbonic acid. Fig. 2 is a longitudinal section, in which *c* is the conduit, while *f* shows the attachment of the reservoir to the butt by the screw *m*, which is secured by hard rubber at *l*. The reservoir where it enters the butt has a valve *g*, which is pressed by a spring and the pressure of the liquid against a hard rubber seat *h* (seen in Fig. 4) fitted with a rod, *j*, which passes through a packing, *i*, of soft leather. Fig. 3 shows a section on the line A B of Fig. 2, and Fig. 5 a section on the line C D of Fig. 4. When the trigger is pressed, the hammer strikes the head of the rod at *p* (the extent of the motion being regulated by the stop *e*), and thus thrusts the valve *g* back, allowing the escape of a small quantity of the liquid, which, passing through *c*, expels the bullet by its sudden expansion into gas. The valve *g*, when the trigger is moved, is at once closed by the pressure of the liquid in the reservoir *f*, and the trigger is re-set.

## HOW BOOKS ARE BOUND.—VIII.

By "Practical Bookbinder."

AFTER we have cut the edges of books, we must next direct our attention to the ornamentation of them. That there are various methods of ornamenting edges need hardly be written, because it is a well-known fact. Probably the most common is that of sprinkling; it is at least the cheapest, and will no doubt readily be resorted to by the amateur, because of its simplicity and the ease with which it can be successfully accomplished.

It is not always for the above reasons, however, that book-edges are sprinkled. There are various styles of binding which require that the edges should be sprinkled, and any other treatment would look quite out of place. The most common sprinkles are red and blue. For red, a little Venetian red mixed with water, to which a little paste has been added, is all that is required. For blue, the ordinary blue ink diluted with water. To apply the sprinkle to the edges, the following method is, I think, the best. Have ready at hand a good supply of sprinkle—it is best to have it mixed in a large dish—a large brush with plenty of hair, and an iron or wooden pin about 12in. or 14in. long.

The books to be sprinkled are laid flat upon the table, with their edges flush with the edge of the table (see Fig. 23). The brush is taken and squeezed out until almost dry; the pin is held in the left hand close to the books, the brush is knocked against the pin. This will cause the colour to fly off in a fine spray, which, falling upon the book, will give the desired effect.

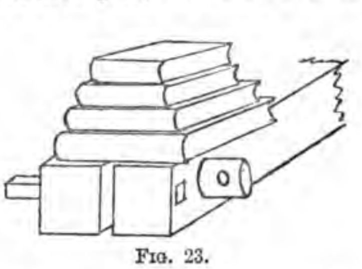


Fig. 23.

It will be best to try the effect upon a piece of paper first, as the sprinkle must be very fine, and if the brush contains too much of the liquid, it will make large blotches, which will not have a nice appearance.

There are various combinations of sprinkles which have a very pleasing effect. Red and blue look very well if both of the colours are bright. A yellow sprinkle on some classes of books is quite a treat; in fact, any colour may be used to suit the fancy of the binder or the style of binding. A design may be cut out on paper and laid upon the edge while sprinkling; when the paper is lifted off, the design will be quite white. Barley sprinkled over the edge before applying the colour gives what is called the barley sprinkle; of course, this is only the large white spots left from the barley lying upon the edge, and keeping the sprinkle off that part. Then there are coloured edges with a gold sprinkle, which I shall describe further on.

Edges of books are often covered all over with the one colour. For instance, there are red edges, blue, yellow, black, and green, all quite common at one time or other. At the present, however, red is the most common, and I will give the *modus operandi* of this process, and the description will, of course, apply to the others.

For the red, get a little dry vermilion and grind it upon a slab until there is not a trace of grain or grit in it; the finer it can be ground the better it will suit. After it has been fully ground, mix it up with water, adding a very little of the white of an egg, a little pick of soap, and the same of bee's-wax. These, of course, must be well mixed with the colour, and for cheap work they can be dispensed with; but if you are not working at sweater's prices, I would advise you to prepare your colour as above directed; it will take a better polish when you come to burnish it.

Having mixed your colour, lay your books flat upon the bench as directed for sprinkling, and place your left hand tightly upon them, exerting as much pressure as possible, so as to keep the colour from running in. Now take up a sponge well charged with colour and draw it evenly over the edge, taking care to go off at the back and front; sweep the sponge well out, as the colour might otherwise gather in a lump at the fore-edge or back, which, when dry, would crack and scale off.

When all three edges have been treated alike, take a sheet of paper and wrap them up to prevent them getting dirtied during the covering of the book. For large jobs of cloth-work this precaution must be dispensed with, as it would take up too much time. Indeed, the process described above would not be allowed in common work. Ordinary red ink is more often used than vermilion; but for jobbing work I would advise using a good colour.

There is a special preparation much used now in the trade called book-edge carmine; it answers admirably, and has only to be diluted with water if not required the full strength. For the other colours mentioned the proper treatment will suggest itself. Avoid inks as much as possible, for being so thin they have a great tendency to run in, and in a valuable book this is very undesirable.

The next in order in the treatment of edges is marbling, and as this is an important part of our subject, I will endeavour to be as explicit in detailing the process as I can, more to help my fellow-tradesmen this time than the amateur, for every binder cannot marble edges. The times demand that he should be able to do so, and if he has any gumption when he can get the opportunity he should learn to do it. We cannot learn too much nowadays, and knowledge is easy carried about when removing from one place to another.

How often we see an advertisement like this in the morning paper.—"Wanted, a letterpress forwarder; well up in stationary; must be able to marble and do a little finishing." Now this means an all-round man, and it is quite necessary to have all the knowledge stored away so that it can be used as occasion arises.

Before I enter upon marbling proper, I will give the amateur one or two methods of marbling—makeshifts they are, no doubt, but not to be despised.

First screw your book up in the lying press, with the edge flush with the cheeks thereof; get a few strips of marble paper a trifle longer and broader than the book edges, a few scraps of waste paper and some hydrochloric acid, and a flat camel-hair brush. Dip the brush in the acid, and pass it quickly over the edge; lay the marble paper down upon it, lay a piece of waste paper over this, take up a flat hammer, and beat evenly and quickly over the edge, lift off the waste, then the marble paper: the marbled design will be transferred to the edge of the book if this has been carefully done. I need not say that all this must be done like winking, for if done slowly the acid will have dried into the book, and will not affect the marble paper. It must not take up so much time as has the reading of the description. There is special paper sold for this purpose by Berry and Roberts, of London.

Another tip: Get a large, shallow dish, big enough to admit the foredge of the book, and fill it with water. Take a little dry vegetable powder, and mix it up with spirits of wine—let it be very thin; lift a little of the colour so mixed upon the point of a table-knife, allowing it to flow upon the top of the water in the dish—it will spread all over in a pleasing form. Dip the book-edge in the water; the colour will adhere to the edge, and the result will be a nice edge without much cost or trouble. Again, apply the colour to the edge by daubing it over with an open-holed sponge. The natural holes of the sponge show very well, and have a pleasing effect. This is sometimes called mottling, and may be varied by covering the edge over with one colour first, as, for instance, red, with a black mottle, or blue and black, or any colour according to taste.

Rollers for marbling are now very much used. The design is cut upon the face of the roller, and the colour is fed by a small roller which is held upon the pattern roller by a spring. By simply passing the roller over the edge the pattern is transferred. This is, of course, very handy, but it is rather cheap-looking for my taste, or for good work.

There are a good many books bound with plain or white edges, and these, under certain conditions, are all that is required. Nearly all cloth work or work published in cloth cases is sent out this way: all that is necessary is to take care, after the book has been cut, to keep the edges clean; a white edge is not improved by being messed with glue. Some styles of binding, such as that in which law books are bound, have always white edges; in this case it would be well to paper up the edges after cutting, so as to prevent any possibility of them getting dirtied.

I think I have now prepared my readers for the process of marbling, having given those few dodges to the amateur, who will no doubt be able to make no end of fine edges from the suggestions. As marbling is of no small importance, and will take up some little space, I will reserve it until a future occasion.

## SERMONS BY TELEPHONE.

As most of our readers know, the telephone has been laid on to opera-houses and theatres and on a few occasions even to churches in the United States. It has also been utilised in that manner on the Continent; but hitherto very little has been done with it in that direction in this country. Experiments have been made, more or less successfully, but perhaps the most interesting attempt was that made last Sunday at Christ Church, Birmingham, when "wires" were laid from transmitters placed in the choir-stalls, on the lectern, and in the pulpit, and taken to various parts of the town. Christ Church was selected on account of its proximity to the Telephone Exchange, and the experiment seems to have been fairly successful, as the singing and the sermon were heard distinctly by those subscribers to the telephone who were switched "on." The organ, it seems, according to a Birmingham contemporary, had a "faint, far-away sound," but the preacher was heard distinctly, as he had two transmitters fitted in the pulpit. If we remember correctly, the first attempt of the kind in this country was made by Mr. Crossley, at Halifax; but the experiment has been tried with success at Bradford, and now we have the Birmingham success to show the possibility of sitting at home and hearing the service and the sermon without attending church. Amongst the towns on the circuits were Burton-on-Trent, Coventry, Derby, Hanley, Kidderminster, London, and Manchester, and in due time we shall no doubt hear how the words of Canon Wilcox came "over the wires." In Birmingham, except during occasional "disturbances," when other subscribers were switched on, the singing (especially the choral work) and the sermon were heard with distinctness at each of three services; but other parts—owing to the fact that transmitters could not be conveniently placed—were missed, or heard only indistinctly. There is a possibility of great development in this branch of telephony, for as the more important patents—the ruling patents, so to speak—run out shortly, inventors will have a free field for the exercise of their ingenuity. There are many who would like to hear our great preachers, but cannot, owing to the difficulty of finding a seat, or from bodily infirmity. In the case of one famous preacher, he boldly asks his seat-holders to "keep away" occasionally, so that "outsiders" may come and hear him; but if the telephone can be made to transmit a sermon, "all London" (that is, all having receivers and a wire) may hear simultaneously our great preachers, and the orders at the Exchange will take the form of "Switch me on to St. Paul's," or to Westminster, or to the Tabernacle, as the subscriber desires. There is one disadvantage, as Canon Wilcox seems to have hinted, the "collections" may suffer; still, those "absent in body but present in spirit" can send their cheques by post. It need scarcely be said that objection has been made to the erection of telephones in churches; but the good sense of the community will right that in time.

## THE DETECTION OF IRREGULAR WORKING IN MACHINERY.

When a machine goes wrong the mischief is generally announced by a change or or modification in the noise which the working parts normally emit. It is usually inconvenient to stop all the machinery that may be running at the time in order to detect the cause of the irregularity. Yet it is obvious that if only the locus of the unusual noise could be ascertained, or the noise itself isolated from the general burr and clatter going on, much time would be saved, to say nothing of the advantages gained.

According to a recent issue of the *Bulletin de la Société de Mulhouse*, Mons. Rodolphe Bourcart has devised a simple method, by means of which, in the midst of a busy workshop full of machinery in motion, any special noise, even though of insignificant intensity, can be distinguished, and its origin traced. In this way even the irregular action of a very small factor in a machine may be discovered.

The apparatus, if indeed it may be designated by such a term, is simplicity itself. It consists of an ordinary indiarubber gas-tube about a yard in length; the length may, however, be varied to suit the nature of the investigation. The tube is unprovided with ear-piece or bell. One end is applied to the ear of the observer, whilst the other is moved about in order to explore the seat of the irregularity.

Since the free orifice of the tube is comparatively small and is applied as closely as possible to the vibrating surface, it practically receives only those sonorous vibrations which are emitted by this surface; other vibrations that may be in progress within the room will scarcely affect the ear-drum of the observer, who will take care to close his other ear as far as possible.

This "test" tube can be made and used by anyone; there is nothing to *learn* about it. Those who have to do with machinery will find it especially useful for observing noises due to irregularities in the working of small parts of machines which may be either difficult or dangerous to approach in any other way.

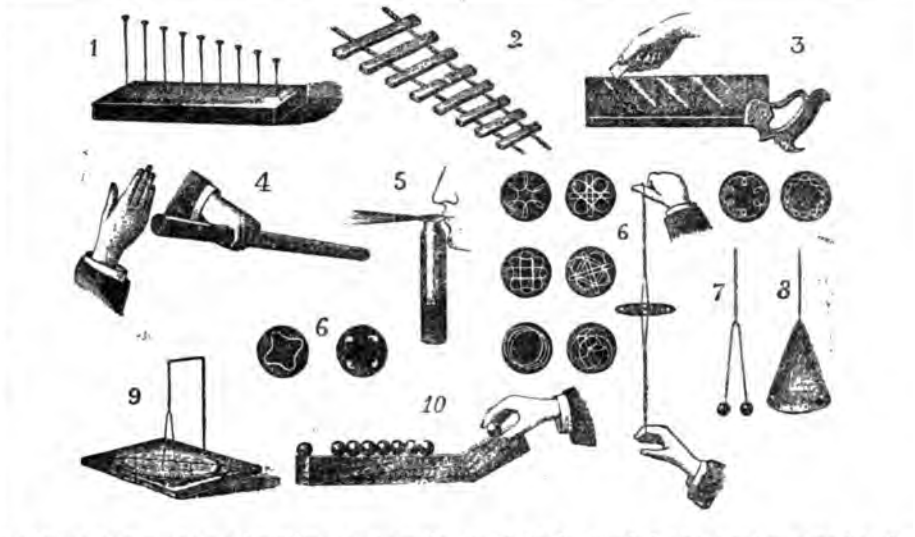
J. T. H.

## WATERPROOFING PAPER, LINEN, &c.

The below-described process of waterproofing paper, linen, &c., which is said to give "marvellous results," has been patented in this country by Mr. A. J. Boult on behalf of [illegible] Macdonald and W. T. Tassie, of Toronto. The object of the invention is to make paper, linen, and similar material impervious to water, and [illegible] the same time present a highly-finished smooth surface; and it consists essentially in soaking the material in oil, then passing it between wringing rollers, after which the material [illegible] dried and then completely covered with an [illegible] or similar material, evenly distributed over surface with or without pressure. The [illegible] object of the invention was to make paper so [illegible] it could be exposed to the worst kind of weather without any fear of being destroyed or even damaged. In developing their ideas, the inventors found that the invention would be of great value for the purpose of imparting a highly finished surface to linen used in the manufacture of children's books; they have also discovered that it may be used to great advantage for rpose of making material used in garments pervious to water. This invention, although ducing marvellous results, is exceedingly aple, and when proper appliances are provided e cost will be infinitesimal as compared with e results. Take the paper or other material, d when in sheets place each in a separate bath, eferably of hot boiled linseed-oil; after allowg each sheet to soak in its bath for, say, twentyur hours, or such time as may be necessary to ow the oil to thoroughly soak through the per or other material, remove the sheet and ss it between a pair of wringing rollers, set th sufficient pressure to thoroughly wring all plus oil from the sheet. The sheet is then ced in a position to dry; for instance, it may placed between two sheets of such material as ll readily absorb the oil remaining on the face of the sheets. This plan will be found quickest way to secure the desired end; but vill, of course, be understood that the inventors not confine themselves to any particular means drying the sheets. When the sheet is suffintly dry, pass it through a cylinder printingchine, preferably a lithographer's printingss, printing over the entire surface of the per with printer's ink, or similar material, ich may be white or such other colour as may desired. The pressure on the sheets while ssing through this press is sufficient to impart ighly-finished smooth surface, which, when e ink is dried, may be printed upon in the dinary way. When the paper or other terial is in a web this process may be carried t by placing the roll of paper or other material suitable bearings, in which case the material ould be carried slowly through a bath of oil tween wringing rollers after leaving the bath, en through a drying-room, and finally through e machine by which its entire surface is covered ith ink or similar material. It need scarcely e added that the ink may be applied to either ne or both sides of the material.

## A PATENT HYDRAULIC CALCULATING RULE.

MR. W. F. Stanley, the well-known instrument maker, of Great Turnstile, Holborn, V.C., has sent us a patent hydraulic calculating le invented by Mr. Arthur Honeysett, C.E., ingenious application of the slide-rule. The le is made of boxwood, highly polished, and aduated with great nicety about 16in. long and n. broad. From a general examination of this le, it appears to us to be a very useful instruent, as it will greatly facilitate the labours of e engineer in calculating the velocities and scharge of his sewers and pipes. The rule constructed according to Bazin's formula $= \sqrt{\frac{K\ R}{s}}$ where $v$ = velocity in feet per cond, R = the hydraulic mean depth, $s$ = stance in which the fall is unity, and K = coicient of the value $\frac{1}{x\,|(y + \frac{1}{R})}$, the values of $x$ d $y$ varying according to the nature of the annel. Eight scales are marked on the rule, B, C, D, E, F, G, and H, the four last ones ing made to correspond to the four classes of coefficients, according to the nature of the annel, the first class being for cement or smooth es, the second class for brick or ashlar, the rd for rubble masonry, and the fourth for th, river courses. By a sliding index the ure (marked 100) is brought opposite the value the hydraulic mean depth on one of the lower les corresponding to the nature of channel, n on another scale (marked D) will be found velocities in feet per second due to the inclinans given on the slide, which comprise falls from n 6 to 1 in 2,000, though inclinations flatter n the last can be obtained. To aid in adjust the sliding index over the lower scales, a ce of talc marked with a line slides over the e. By another adjustment of the slide the ntity discharged can be found. Scale A gives square root of the fifth powers of values, by ans of which the diameter of a pipe to disrge a given quantity can be found. Other les at the back of the rule enable the engineer find the area and hydraulic mean depth of gments of circular and oval conduits. All that needed are a few examples of its application to ke the rule intelligible. For sanitary and draulic engineers and contractors, Mr. Honeytt's rule is especially valuable, as it will solve for them many complex calculations, and enable them to obtain results without the expenditure of unnecessary labour and time.



## THE SCIENTIFIC USE OF COMMON THINGS.

SOME time since the relationship of toys and science was treated in this journal (*Scientific American*). It is possible to go still further in the same direction. Scientific facts and principles may often be illustrated by means of common things, such as may be met with in everyday life.

Pins, needles, sticks, straws, bullets, bottles, hair pins, rubber bands, marbles, are among the things available for experimental purposes. Even a hand saw may be pressed into the service of scientific illustration.

The first figure of the engraving illustrates a piece of apparatus which is doubtless better known to the school-boy than the professor. The writer's attention was first called to this instrument by a professor of physics who confiscated it from a student and used it in a lecture as an illustration. It consists of a board into which are driven eight common pins which are allowed to project different lengths, thus forming a musical instrument which may be played by plucking the heads of the pins. The instrument is tuned by driving the pins into the board more or less. In this experiment it is shown that there exists a certain relation between the length of the vibrating pin and the pitch of the sound it produces. In Fig. 2 is shown a zylophone, a musical instrument formed of bars of wood of different lengths and thicknesses. The particular instrument here illustrated was made of a piece of a pine box cover split up in a haphazard way and tuned by shortening to increase the pitch and reducing in thickness or notching at the centre to lower its pitch. The bars are supported by a loosely-twisted cord. The sound is produced by striking the bars at their mid-length with small mallets.

In Fig. 3 is shown a modification of Savart's wheel, which is in reality no wheel at all, but the effects secured are substantially the same. By drawing the edge of a card slowly along the cutting edge of a fine saw, regular taps are produced, which do not form a musical sound; but when the card is drawn along quickly, the taps are made with sufficient frequency to produce a sound, the pitch of which will vary, of course, with the rapidity of the movement of the card.

In Fig. 4 is illustrated an experiment with a paper tube, illustrating the closed and open organ pipe. When the end of the tube is struck smartly with the palm of the hand, if the hand is allowed to remain in contact with the end of the tube, the air in the tube will be set in vibration, and a tone will be produced which is due to a closed pipe of that length. If, however, the hand is instantly removed from the tube after the blow, two notes will be heard, one due to the closed pipe, the other to the open pipe, and the latter will be an octave higher than the first.

In Fig. 5 is an experiment with a vial, which is made to answer as a closed pipe, the length of which is varied by pouring in water. By blowing across the mouth of the vial, a sound will be produced which varies in pitch with the length of the air space above the water. By closing the mouth of the vial more or less by the under lip, it is found that this also changes the pitch; the smaller the opening of the mouth of the vial, the lower the pitch.

In Fig. 6 is shown a toy which is interesting on account of the great variety of intricate figures it can produce. It consists of a disc of black cardboard, having two holes near and on opposite sides of the centre, an elastic cord inserted in these holes, and four paper fasteners or bright brass nails inserted in the disc at four points equally distant from the centre of the disc and from each other. This toy is used in the same manner as the well-known buzz, by twisting the cord and drawing upon it, and while the disc revolves, first in one direction and then in the other, the cord is made to vibrate laterally. Some of the figures which may be produced in this way are shown in the engraving. These effects are due to persistence of vision.

In Figs. 7 and 8 is shown a simple device for illustrating centrifugal force. Two bullets split to the centre are closed together upon the ends of an ordinary hair-pin, and the latter is suspended by a small rubber band. The band is twisted and then allowed to untwist, thus imparting a rapid rotary motion to the hair-pin, which causes the bullets to fly out by centrifugal force as shown in Fig. 8. The momentum acquired by the bullets during the untwisting of the rubber band twists the band in the opposite direction, so that when it untwists again, the apparatus will rotate in the opposite direction. This operation will continue for a considerable time.

In the apparatus shown in Fig. 9, hair-pins are again pressed into service. One is opened out at a right angle, forming a standard; another is bent up at the ends, forming a double hook. The standard is inserted in a baseboard provided with a graduated circle. The double hook is suspended from the standard by a short piece of twisted catgut cord, and in the double hook is placed a small knitting needle to serve as an index. This forms a hygroscope, which is quite sensitive to atmospheric moisture. By substituting a filament of silk or a fine hair for the catgut cord, the double hook may be used for supporting a straw to show electrical attraction and repulsion, a stick of sealing-wax or a glass rod being used to produce the electricity.

The apparatus illustrated by Fig. 10 shows the elasticity of solids. Two pieces of "matched stuff" are mitred together, as shown, to form an inclined plane and a guide for marbles or lead bullets. A number of marbles are placed in the groove in the horizontal guide, and another marble is allowed to roll down the inclined plane. The blow thus imparted to the first of the series of marbles is transmitted through the entire series to the last, which is thrown forward. This action is due to the compression of the marbles by the blow and their restitution by their own elasticity to their original form. When lead bullets are substituted for the marbles, the force of the blow is expended in permanently changing their form.

## THE ELECTRO-MAGNET.—I.*

AMONGST the great inventions which have originated in the lecture-room in which we are met are two of special interest to electricians—the application of gutta-percha to the purpose of submarine telegraph cables and the electro-magnet. This latter invention was first publicly described from the very platform on which I stand, on May 23rd, 1825, by William Sturgeon, whose paper is to be found in the forty-third volume of the Transactions of the Society of Arts. For this invention we may rightfully claim the very highest place. Electrical engineering, the latest and most vigorous offshoot of applied science, embraces many branches. The dynamo for generating electric currents, the motor for transforming their energy back into work, the arc lamp, the electric bell, the telephone, the recent electro-magnetic machinery for coal mining, for the separation of ore, and many other electro-mechanical contrivances, come within the purview of the electrical engineer. In every one of these, and in many more of the useful applications of electricity, the central organ is an electro-magnet. By means of this simple and familiar contrivance—an iron core surrounded by a copper wire coil—mechanical actions are produced at will, at a distance, under control, by the agency of electric currents. These mechanical actions are known to vary with the mass, form, and quality of the iron core, the quantity and disposition of the copper wire wound upon it, the quantity of the electric current circulating around it, the form, quality, and distance of the iron armature upon which it acts. But the laws which govern the mechanical action in relation to these various matters are by no means well known, and, indeed, several of them have long been a matter of dispute. Gradually, however, that which has been vague and indeterminate becomes clear and precise. The laws of the steady circulation of electric currents, at one time altogether obscure, were cleared up by the discovery of the famous law of Ohm. Their extension to the case of rapidly interrupted currents, such as are used in telegraphic working, was discovered by Helmholtz; whilst to Maxwell is due their further extension to alternating, or, as they are sometimes called, undulatory currents. All this was purely electric work. But the law of the electro-magnet was still undiscovered; the magnetic part of the problem was still buried in obscurity.

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* Extracted from the Cantor Lectures delivered by Prof. SILVANUS P. THOMPSON, B.Sc., before the Society of Arts.

Gradually, however, new light dawned. It became customary, in spite of the mathematicians, to regard the magnetism of a magnet as something that traverses or circulates around a definite path, flowing more freely through such substances as iron than through other relatively non-magnetic materials. Analogies between the flow of electricity in an electrically-conducting circuit, and the passage of magnetic lines of force through circuits possessing magnetic conductivity, forced themselves upon the minds of experimenters, and compelled a mode of thought quite other than the previously accepted. So far back as 1821, Cumming experimented on magnetic conductivity. The idea of a magnetic circuit was more or less familiar to Ritchie, Sturgeon, Dove, Dub, and De La Rive, the last-named of whom explicitly uses the phrase, "a closed magnetic circuit." Joule found the maximum power of an electro-magnet to be proportional to "the least sectional area of the entire magnetic circuit," and he considered the resistance to induction as proportional to the length of the magnetic circuit. Indeed, there are to be found scattered in Joule's writings on the subject of magnetism some five or six sentences, which, if collected together, constitute a very full statement of the whole matter. Faraday considered that he had proved that each demagnetic line of force constitutes a closed curve; that the path of these closed curves depended on the magnetic conductivity of the masses disposed in proximity; that the lines of magnetic force were strictly analogous to the lines of electric flow in an electric circuit. He spoke of a magnet surrounded by air being like unto a voltaic battery immersed in water or other electrolyte. He even saw the existence of a power, analogous to that of electro-motive force in electric circuits, though the name, "magneto-motive force," is of more recent origin. The notion of magnetic conductivity is to be found in Maxwell's great treatise (vol. II. p. 51), but is only briefly mentioned.

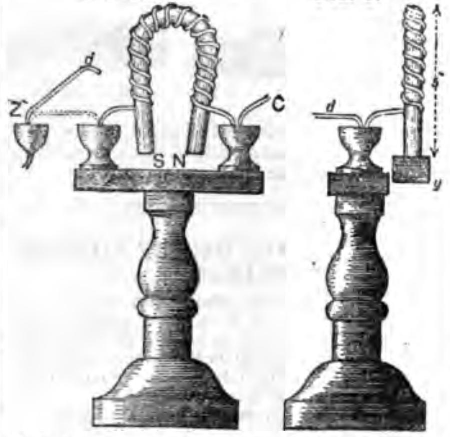
In recent years the notion of the magnetic circuit has been vigorously taken up by the designers of dynamo-machines, who, indeed, base the calculation of their designs upon this all-important principle. Having this, they need no laws of inverse squares of distances, no magnetic moments, none of the elaborate expressions for surface distribution of magnetism, none of the ancient paraphernalia of the last century. The simple law of the magnetic circuit and a knowledge of the properties of iron are practically all they need. About four years ago much was done by Mr. Gisbert Kapp and by Drs. J. and E. Hopkinson in the application of these considerations to the design of dynamo-machines, which previously had been a matter of empirical practice. To this end the formulæ of Prof. Forbes for calculating magnetic leakage, and the researches of Profs. Ayrton and Perry on magnetic shunts, contributed a not unimportant share. As the result of the advances made at that time, the subject of dynamo design was reduced to an exact science.

It is the aim and object of the present course of lectures to show how the same considerations which have been applied with such great success to the subject of the design of dynamo-electric machines may be applied to the study of the electro-magnet.

### Historical Sketch.

The effect which an electric current, flowing in a wire, can exercise upon a neighbouring compass needle was discovered by Oersted in 1820. This first announcement of the possession of magnetic properties by an electric current was followed speedily by the researches of Ampere, Arago, Davy, and by the devices of several other experimenters, including De la Rive's floating battery and coil, Schweigger's multiplier, Cumming's galvanometer, Faraday's apparatus for rotation of a permanent magnet, Marsh's vibrating pendulum, and Barlow's rotating star-wheel. But it was not until 1825 that the electro-magnet was invented. Davy had, indeed, in 1821 surrounded with temporary coils of wire the steel needles upon which he was experimenting, and had shown that the flow of electricity around the coil could confer magnetic power upon the steel needles. But from this experiment it was a grand step forward to the discovery that a core of soft iron, surrounded by its own appropriate coil of copper, could be made to act not only as a powerful magnet, but as a magnet whose power could be turned on or off at will, could be augmented to any desired degree, and could be set into action and controlled from a practically unlimited distance.

FIG 1. FIG. 2.



FIGS. 1 AND 2.—Sturgeon's First Electro-Magnet.

The electro-magnet, in the form which can first claim recognition for these qualities, was devised by William Sturgeon, and is described by him in the paper which he contributed to the "Proceedings" of the Society of Arts in 1825, accompanying a set of improved apparatus for electro-magnetic experiments. The Society of Arts rewarded Sturgeon's labours by awarding him the silver medal of the Society and a premium of thirty guineas. Amongst this set of apparatus are two electro-magnets, one of horse-shoe shape (Figs. 1 and 2) and one a straight bar (Fig. 3). It will be seen that the former figures represent an electro-magnet consisting of a bent iron rod about one foot long and ½in. in diameter, varnished over and then coiled with a single left-handed spiral of stout uncovered copper wire of 18 turns. This coil was found appropriate to the particular battery which Sturgeon preferred—namely, a single cell containing a spirally enrolled pair of zinc and copper plates of large area (about 130 square inches) immersed in acid; which cell, having small internal resistance, would yield a large quantity of current when connected to a circuit of small resistance. The ends of the copper wire were brought out sideways and bent down so as to dip into two deep connecting cups, marked Z and C, fixed upon a wooden stand. These cups, which were of wood, served as supports to hold up the electro-magnet, and having mercury in them served also to make good electrical connection. In Fig. 2 the magnet is seen sideways, supporting a bar of iron, *y*. The circuit was completed to the battery through a connecting wire, *d*, which could be lifted out of the cup Z, so breaking circuit when desired, and allowing the weight to drop. Sturgeon added in his explanatory remarks that the poles N and S of the magnet will be reversed if you wrap the copper wire about the rod as a right-handed screw instead of a left-handed one, or, more simply, by reversing the connections with the battery, by causing the wire that dips into the Z cup to dip into the C cup, and vice-versâ. This electro-magnet was capable of supporting 9lb. when thus excited.

FIG. 3.

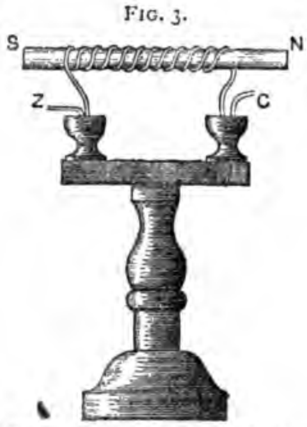


FIG. 3.—Sturgeon's Straight Bar Electro-magnet.

Fig. 3 shows another arrangement to fit on the same stand. This arrangement communicates magnetism to hardened steel bars as soon as they are put in, and renders soft iron within it magnetic during the time of action; it only differs from Figs. 1 and 2 in being straight, and thereby allows the steel or iron bars to slide in and out.

For this piece of apparatus and other adjuncts accompanying it, all of which are described in the Society's "Transactions" for 1825, Sturgeon, as already stated, was awarded the Society's silver medal and a premium of thirty guineas. The apparatus was deposited in the museum of the Society, which therefore might be supposed to be the proud possessor of the first electro-magnet ever constructed. Alas! for the vanity of human affairs, the Society's museum of apparatus has long been dispersed, this priceless relic having been either made over to the now defunct Patent Office Museum, or otherwise lost sight of.

Sturgeon's first electro-magnet, the core of which, weighing about 7oz., was able to sustain a load of 9lb., or about 20 times its own weight. At the time it was considered a truly remarkably performance. Its single layer of stout copper wire was well adapted to the battery employed, a single cell of Sturgeon's own particular construction, having a surface of 130 sq. inches, and therefore of small internal resistance. Subsequently, in the hands of Joule, the same electro-magnet sustained a load of 50lb., or about 114 times its own weight.

Sturgeon's further work during the next three years is best described in his own words:—"It does not appear that any very extensive experiments were attempted to improve the lifting power of electro-magnets from the time that my experiments were published in the 'Transactions of the Society of Arts, &c.,' for 1825, till the latter part of 1828. Mr. Watkins, philosophical instrument maker, Charing-cross, had, however, made them of much larger size than any which I had employed, but I am not aware to what extent he pursued the experiment. In the year 1828, Prof. Moll, of Utrecht, being on a visit to London, purchased of Mr. Watkins an electro-magnet weighing about 5lb.—at that time, I believe, the largest which had been made. It was of round iron, about 1in. in diameter, and furnished with a single copper wire twisted round it 83 times. When this magnet was excited by a large galvanic surface, it supported about 75lb. Prof. Moll afterwards prepared another electro-magnet, which, when bent, was 12½in. high, 2½in. in diameter, and weighed about 26lb.; prepared like the former with a single spiral conducting wire. With an acting galvanic surface of 11 sq. feet, this magnet would support 154lb., but would not lift an anvil which weighed 200lb."

(*To be continued.*)

## IMPROVED WAVE APPARATUS.

THE apparatus shown in the cuts was made several years ago for the purpose of demonstrating to my classses the formation of the compound curves representing the combination of two simpl sound waves. It has answered its purpose so wel that a brief description may be of interest.

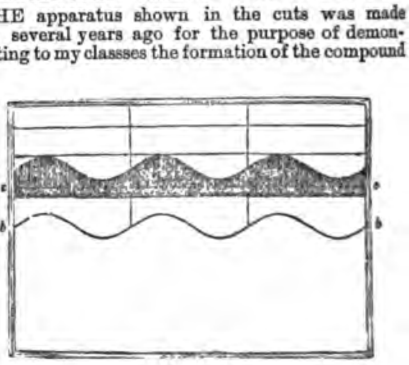


FIG. 1.

The apparatus consists of a frame of whitewood holding some 270 ebony strips whose tops ar trimmed to a sinusoidal form (Fig. 1). The strip are 11mm. wide, about 4mm. thick, and 23 to 31cm long. They are supported on a straight edge projecting 5mm. from the back of the frame. Thre simple waves having a wave length of 36cm., an an amplitude of 4cm. are represented. Vertica white lines mark off the single wave lengths, a lin drawn on the strips parallel to the edge on which ey rest, and the "fundamental" is reproduced in e parallel curve drawn on the front board of the paratus.

Wave forms cut out of thin board can be introduced below the strips (*a a*, Fig. 2), through a slit

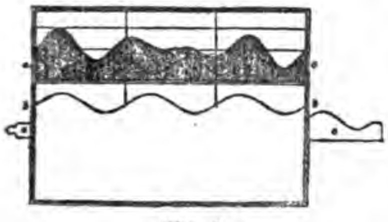


Fig. 2.

the side of the frame, and raised by a simple rangement at the back to a height which is fficient to lift the strips from their supporting lge. This done, the tops of the strips assume the rm of the combination curve, while the white line n the strips reproduces the sinusoid on which they st. As the fundamental is shown on the front oard, one can compare at leisure the component rves and their resultant. The considerable wave ngth and amplitude of the fundamentals as well as e thinness of the ebony strips render the combination curves fairly smooth. Since three waves of the ndamental are given, it is possible to produce a omplete period of the curve representing the terval of the fourth [3:4], and one or more periods f all intervals expressed by simpler ratios. The ffect of difference of phase is readily demonstrated, he straight line representing the "interference" of wo elementary tones of the same pitch and ntensity being sharply produced.—J. T. Stoddart, n *American Journal of Science*.

## USEFUL AND SCIENTIFIC NOTES.

**Tracing Paper.**—It is stated that the Austrian hydrographic bureau adopts the following method of making paper transparent for copying drawings: The sheet of paper being placed over the drawing to be copied, it is lightly rubbed with a ball of cotton saturated with pure benzine. The tracing can then be readily made, owing to the resulting transparency, and the benzine, on evaporating, leaves the paper opaque as before, and without any trace of odour. Absolute purity of the benzine, however, must be insisted upon to secure good results.

**Tin Aluminium Alloy.**—A useful alloy of luminium and tin has been made by M. Bourbouze by fusing together 100 parts of the former with 10 parts of the latter. This alloy is paler than aluminium, and has a specific gravity of 2·85, that is, it s a little heavier than the pure metal, but not too eavy to be formed into parts of instruments intended to be very light. The alloy is not as easily ttacked by the several reagents as aluminium is, nd it can also be worked more readily. Another reat advantage is that it can be soldered as easily s bronze, without further preliminary preparations.

Until lately cotton waste has been cleaned from he oil and re-used, the grease being considered as seless and thrown away. It has, however, been ound, according to the *Papermakers' Circular*, that e oil thus destroyed can be made, after very mple treatment, to yield first-class printing ink, nd it has been ascertained that one ton of this pent waste yields about 14 cwt. of oil, from which k of an improved quality and a reduced price is anufactured. The refuse cotton is placed in steam ambers, and a solution of bisulphate of carbon, n being pumped into vessels, disengages the oil nd grease, and after traversing several heated ppers the grease is soon converted into the varnish om which printing ink is made.

**Composition of Ancient Paper.**—Dr. Julius eissner, who has made a microscopical examination of the paper from El-Faijaune, preserved in e Austrian Museum at Vienna, in the collection own as "Papyrus Erzherzog Rainer," urges at linen rags were used so far back as in the h and 9th centuries. The fibre is chiefly linen; t there are also traces of cotton, hemp, and imal fibres present. The manufacture of paper t of rags is, therefore, he contends, an Eastern d not a German or an Italian invention, as has therto been supposed. Out of 500 Oriental and estern specimens, not a single one was a raw cotton per. All those that were examined had likewise en clayed like modern papers. The material used r this purpose was starch paste, manufactured om wheat, and in some cases buckwheat. It pears that animal substances were not employed r claying before the 14th or 15th century.

## SCIENTIFIC NEWS.

THOSE of our readers who are interested in astronomical spectroscopy may like to know that in Vol. XLVIII. of the *Proceedings* of the Royal Society there are several communications from Dr. and Mrs. Huggins on the spectra of the Orion nebula, and of Sirius.

Small planet 286, discovered by Dr. Palisa, of Vienna, on August 3 last year, has been named Iclea.

D'Arrest's comet has not been re-discovered, although searched for at several observatories, in some with telescopes of the larger apertures—e.g., Vienna, with a 27in. o.g.

*Comptes Rendus* for Sept. 15 contain a note by Prof. Tacchini on the distribution in latitude of solar phenomena observed by him this year up to June. In the second quarter of the year he observed prominences near the poles, and the number of groups of spots indicates, he thinks, that the minimum period has passed.

The same number of the *Comptes Rendus* contains Prof. Denza's account of the observations made in Italy during a few days in August at thirty stations for meteors. The number of luminous meteors was greater, it appears, than in preceding years; the "shower" is later, and now begins on Aug. 11th; the radiant of the principal shower is, as before, between Perseus and Cassiopeia; but other radiants were also noted, especially in Ursa Major and U. Minor, as well as in Cygnus and Andromeda.

The death is announced of Dr. Ernest Hardy at Finisterre in his sixty-fourth year. Besides being a distinguished biologist, he was chief of the clinical work at the Academy of Medicine, Paris, and of the laboratory of the Hotel Dieu, and a member of what may be termed the Sanitary Council of the Department of the Seine.

The Iron and Steel Institute, whose visit to the United States is considered as rather more of a "holiday" than a business or scientific meeting, will nevertheless derive much benefit from the trip, for the principal American ironworks will be visited, and several important papers were read, notably those on "Explosions from Unknown Causes," by Mr. J. C. Bayles, and "Cast-iron Tools for Cutting Metals," by Mr. Oberlin Smith.

At a recent meeting held in Glasgow under the presidency of the Lord Provost, a resolution was adopted declaring it to be expedient that a chair for the teaching of political economy should be founded and endowed in the University of Glasgow as a fitting memorial to Adam Smith and of his connection with the University, and as supplying an important requirement in a commercial and industrial community.

Lord Derby distributed the prizes at the Liverpool School of Science, and, addressing the students, dwelt upon the pleasure to be derived from the study of science, and observed that, although he had known many men, he believed the happiest lives were those which had been devoted to science.

A self-recording anemometer, a rain-gauge, and sunshine recorder have been erected by the Imperial Maritime Customs at the South Cape Station, Formosa. Among the investigations in progress are the collection of information respecting typhoons from the logs of men-of-war stationed in those seas, and an investigation of the climate of Hong Kong from five years' observations; this latter work is nearly ready for press. On May 29th and 30th, 1889, the colony was visited by thunderstorms of unusual duration; above 22·5in. of rain fell in twenty-four hours, causing floods and serious damage to property.

Telephonic communication was practically opened up last Monday by the National Telephonic Company, Limited, between London and Manchester (a distance of 206 miles), and is being continued farther north. The line is not quite ready for use by the general public; but it was placed on Monday at the disposal of the Manchester Field Naturalists' Society. A company of fifty gentlemen, presided over by Mr. Alderman W. H. Bailey (in the absence of the mayor), and including many members of the corporation, was present at the Manchester office of the Telephone Company; and a lively discussion took place on the effect of town fog on animal and vegetable organisms, between Dr. Baily, of Owens College, and Mr. Oglesby (Manchester), and Colonel Mackenzie, superintendent of Epping Forest, Dr. Charles Roberts, Prof. R. Meldola, F.R.S., and Mr. Philip Hartog, at the London offices, Oxford-court, Cannon-street. It was proposed to take measures to make a systematic examination of the composition of the atmosphere, which, both in London and in Manchester, is becoming more and more unfit to support plant life. The Berliner transmitter and the Bell receiver were used; and the voices of the Manchester members were heard quite distinctly in London, and were easily recognisable. After the formal proceedings were over, the London office was connected with the Princess's Theatre, Manchester, and the Manchester office with the Savoy Theatre, London. Owing to the use of complete metallic circuits, a conversation can now be carried on between London and Manchester without any disturbing noises.

We have taken an opportunity to inspect the "electric Bath-chair," driven by a Vaughan-Sherrin motor, and shall soon, we hope, be in a position to give more particulars. It is driven by a couple of batteries, weighing about 45lb. each, and the motor, a modified Gramme, weighs about 45lb. too. That drives a small pinion, and the chain works on a large wheel inside the tricycle wheel, much in the same manner as in Profs. Ayrton and Perry's electric tricycle, which we illustrated in No. 923. The Vaughan-Sherrin motor can be seen at 48, Eagle Wharf-road, as applied to a Bath chair tricycle, and to a boat and a launch on the canal which adjoins the works. The battery is of the zinc-carbon type, and, with the special solution, is said to be very efficient.

Mr. Edison must surely pray to be saved from his "friends." The latest statement about him is that he is endeavouring to catch and record the sounds made in the sun's photosphere by solar spots by means of a "mass of iron ore a mile long, standing perpendicular, and extending into the bowels of the earth to great but unknown depths, said to contain several hundred million tons of magnetic material." Mr. Edison is reported to be erecting telegraph poles on each side of the "Ogden ore hill," on which he is coiling an insulated wire, the two ends of which will be connected to the "receiving telephone."

Several deaths from electricity have recently been reported from America, showing that there is either carelessness (the contempt which comes of familiarity) or an entire absence of safeguards. There is no doubt that the current can kill quickly.

Here is a note which will amuse the Tonic-Sol-Fa people:—"A new system of musical notation has been submitted by the Académie des Sciences, Paris, to the consideration of the Académie des Beaux Arts. It will replace by 27 characters the 203 symbols now employed to represent the seven notes of the gamut in the seven keys."

The *City of New York* and the *Teutonic*, in their last eastward trip made practically a dead heat, but the latter has the advantage, as her course was a little longer. This will create some stir in shipbuilding circles, as the *Teutonic* has the smaller engine power, but finer lines.

**Armour Plates.**—The results of the armour-plate competition just decided in America are very surprising. The Cammell compound plate is said to have been destroyed by being fired at by a 6-in. gun. The plate was 10½in. A French nickel steel plate, containing 3½ per cent. of nickel, is said to have resisted marvellously. Until further details are to hand the failure of the compound plate will have to remain a mystery, as a plate of similar thickness tested with a 10-in. gun on the *Nettle* by our own authorities gave astonishingly good results, better than had ever been attained by any French or other firm, so that the failure now reported is the more surprising. The tests have been continued with the 8in. gun, firing a 210lb. projectile. The results seem to prove the superiority of the steel plates. The shell cracked the Creusot all-steel plate, the projectile being broken into three pieces; that the projectile penetrated the nickel-steel plate, which remained intact, the projectile remaining in the hole; and that the Cammell compound plate was smashed, almost the whole of its 3in. steel plating being carried away from the iron backing, the projectile going through the iron backing and the oak supports, and then through 12ft. of moulded earth behind. These tests will cause the Navy Department to adopt nickel steel armour for the new battleships.

# LETTERS TO THE EDITOR.

*[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]*

*All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

*All Cheques and Post-office Orders to be made payable to* J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

## SCIENCE AND STULTILOQUENCE—PARKHURST'S LOGARITHMS—OF A CONFIDING NATURE—MISS E. BROWN'S WORKS—AMATEUR'S OBSERVATORY—SELENITE—BARLOW LENS—SAPIENTIA VINO OBUMBRATUR—YET ANOTHER ASTRONOMICAL SOCIETY—THE SPECTRUM OF 42 M ORIONIS—LOCAL (?) LUNAR ATMOSPHERE—THE SECTIONAL WORK OF THE B.A.S.—ATMOSPHERE, ETHER, OR EITHER?—EPHEMERIS OF JUPITER'S RED SPOT—DURATION OF DAY AT TWO STATIONS IN NORTH LATITUDE—MOON'S ATMOSPHERE—WINTER HEALTH RESORTS—THE SPECTROSCOPE.

[31651.]—THE extract from Mr. Gladstone's letter to Sir R. S. Ball in your "Scientific News" on p. 79, furnishes yet another example of the manner in which the ex-Prime Minister makes windy verbiage do duty for ideas. Who told the member for Edinburghshire that "our moon does not revolve (rotate?) upon its axis"? Assuredly not the Astronomer Royal for Ireland. What is there peculiar in the description of circular orbits by the satellites of Uranus? Jupiter's moons do precisely the same thing. *The* peculiarity in the Uranian system is the retrograde paths of the satellites. And, once more, it is only Phobos that appears to the inhabitants of Mars (if any) to "travel eastwards." Deimos rises in the east and sets in the west to them, like any other star, although, of course, it travels apparently very slowly. I cannot and will not believe that if Mr. Gladstone had really read attentively any work of so excellent a scientific expositor as Sir R. S. Ball, he could ever have floundered in the way he does in the letter which you reproduce.

Writing paragraph fourteen of letter 31597 (bottom of column two, p. 80) in very great haste, I said with reference to the tables of Logarithms by Parkhurst and Callet, "I have never seen either of these works." But I now recollect that I have seen (though I have never used) Parkhurst's curious little book, with its odd abbreviations and that fine American disregard of the orthography of the English classics, from Addison to Macaulay, which characterises either the authors or compositors on the other side of the Atlantic.

Reading letter 21599 (p. 81) I am tempted to ask if Mr. Packer really does seriously expect to receive fair-play in the columns of the paper of which he is speaking, when he is opposed to a great private personal friend of its editor?

In reply to "Country Solicitor" (letter 31604, p. 81), Miss Brown's first little book "In Pursuit of a Shadow," is published by Trübner and Co., and costs eighteenpence; while the publishers of "Caught in the Tropics" are Griffith, Farran, Okeden, and Welsh, and its price is a shilling.

As to my querist's expressed intention of building an observatory above his house, I would emphatically repeat *Punch's* familiar advice to persons about to marry—"Don't." In my humble opinion you cannot have astronomical instruments too near the ground, or on too solid a foundation. But still, for purposes of mere star-gazing and recreation, it is quite possible to mount a telescope (by all means equatorially) in a tower, and "Country Solicitor" should obtain Vol. II. of the new edition of Chambers's "Handbook of Astronomy," in which he will find a description of one so erected by its author at Eastbourne. He cannot do better than follow Mr. Chambers's specification in its details. He will also find ample information on the construction of isolated observatories of various types in the same valuable work. It is published at the Clarendon Press.

I do not know whether it will help Mr. Bottone (query 72419, p. 90) if I say that many years ago I obtained Crystals of Selenite from the London Clay in the Isle of Sheppey, where they are (or were) pretty plentiful.

"W. H. S." (query 72430, p. 90) had better look through the back volumes of THE ENGLISH MECHANIC, where he will find the Barlow lens described over and over again. To say nothing of numerous other correspondents, I know that I myself have from time to time given a description of, or referred to, it; beginning with letter 17083, Vol. XXXI. p. 109, and finishing with letter 30115, Vol. XLIX. p. 413. By the way, a detailed account of the theory of this lens will be found on p. 109 of the volume last mentioned.

It would be amusing, were it destitute of the element of the pitiable, to study the progress of Sir Somers Vine, who, in the *rôle* of a glorified bagman, is travelling round the world to cadge for the Imperial Institute. The story of the arts and devices by which it was sought to promote that precious Brompton job in this country is trite enough. I can assuredly speak from my own personal experience; for, occupying as I do an official position, entreaty and expostulation were alike employed in vain to induce me to become Chairman of a local Committee to send the hat round for this spontaneous (?) outburst of loyalty, while I remember at the time to have mentioned in these columns the disgraceful docking of wretched Tommy Atkins's pay, that the devotion of the army to the—well, let us say, South Kensington ring, might be made conspicuously manifest. But credulous idiot that John Bull is, there are limits even to his folly; and when all the money that could be wheedled out of the snob and sycophant, or bullied out of the dependant in this country, had been extorted, the amount needed for the erection and endowment of the Brompton palace was still wofully in defect. And now, to make up as far as may be possible the deficiency, Sir Somers Vine has been started on his mendicant tour. If we may believe the telegrams, he is succeeding; but I think it a great pity that our brethren in the colonies, before parting with their hardly-earned cash, do not obtain trustworthy information from some wholly unprejudiced and disinterested source in this country as to the inception of this "Institute" and the manner in which the whole thing has been worked here.

In a letter addressed to the *Belfast News Letter* of September 18th, Mr. Redfern Kelly, referring to the establishment of the British Astronomical Society, suggests the formation of an Ulster Astronomical Association, as a nursery or feeder to it. Here again we have evidence of that interest in astronomy which appears to be advancing by leaps and bounds; and it is gratifying to find it taking so practical a form, for there can be no doubt as to the value of organised effort in furthering discovery and research. The British Society for the extension of University Teaching has happily secured the services of that most able and brilliant orator, the Astronomer Royal for Ireland, to give a course of lectures in Belfast during the session 1890-91. It may reasonably be hoped that the delightful discourses of Sir R. S. Ball will excite sufficient enthusiasm to render Mr. Kelly's suggested society a conspicuous success. For my own part I see no reason why it should not be affiliated to the British Astronomical Society.

I spoke in letter 31597 (p. 80) of Dr. Huggins's triumphant refutation of an acrimonious attack made on the results obtained by himself and Mrs. Huggins in their spectroscopic examination of the Great Nebula in Orion. Anyone who may be interested in seeing how crushing Dr. Huggins's reply really is should study his paper read before the Royal Society on June 12th. It is entitled "On a Re-determination of the Principal Line in the Spectrum of the Nebula in Orion, and in the Character of the Line." It will be found in Vol. XLVIII. of the R.S. *Proceedings*. It is needless to add another word beyond the mention of the fact that Dr. and Mrs. Huggins are corroborated in every respect by such great but diverse authorities as Dr. Copeland, Mr. Keeler, Prof. Liveing, Mr. Maunder, and Prof. Young.

I will merely say, in connection with letter 31623 (p. 100), that I have hitherto imagined—apparently erroneously—that the steam from a railway engine was discharged into an atmosphere surrounding our globe.

The very excellent letter (31628) by Mr. Waugh, on p. 100, deserves all the prominence that can be given to it; and I do hope that it will be read, marked, learned, and inwardly digested by every one who has joined, or may be about to join, the British Astronomical Society. The day has gone by for an astronomical "Admirable Crichton." If a man hopes to do any good, and really to contribute to our stock of scientific knowledge of the heavens, he must, as Mr. Waugh so well points out, be content to take up some specific branch of his subject, and to work at it. Smyth's remarks in his "Prolegomena" to the "Bedford Catalogue," anent "the furore of the green astronomer," were never more applicable than they are in these days of the multiplication of telescopes.

Mr. Stooke has saved me any trouble in showing how seriously he has misread and misapprehended his authority on the subject of Crookes's Vacua by his last letter (31648) on p. 105. In his original communication he distinctly alleged that so perfect was the vacuum in the Crookes tubes that no light was visible *in* or *through* them. Now I would appeal to any impartial reader whether, taken in connection with their context, any other interpretation whatever could be put upon those words than that the tubes looked dark against the sky because they did not contain air enough to transmit light? Why, of course, the whole of the experiments were made in the dark!—and the emission or transmission of ordinary light never entered into them for an instant.

"H. V." (query 72441, p. 110) can obtain the R.A.S. *Monthly Notices* containing Mr. Marth's Ephemeris of Jupiter's Red Spot, either of Williams and Norgate or at the rooms of the Royal Astronomical Society at Burlington House. I do not know the price of a single number of the *M. N.*

"J. Draconis" (query 72449, p. 110) might have solved his own question by reference to the description I gave a few weeks ago to another correspondent of the method of obtaining the time of moonrise from the top of Snowdon, and the appended example. I will, however, show him how to calculate the time of sunrise and sunset for himself, or so to find the length of the day. To this end we require the co-latitude of the place of observation, the sun's north polar distance at the time his upper limb is on the horizon, and his zenith distance at the same instant. This last quantity quite evidently is made up thus: 90° + sun's semidiameter + horizontal refraction. On August 17th this would be 90° + 15′ 50·4″ + 34′ 54·1″ or 90° 50′ 44·5″. At the time of sunrise on the day specified in latitude 50° 30′, the sun's declination was approximately 13° 27′ 53″, or, in other words, its north polar distance was 76° 32′ 7″. Now we first add these three quantities together, i.e., the co-latitude, the sun's north polar distance and his zenith distance, and divide their sum by 2. The quotient we will call S. From S we take the co-latitude, and also the sun's north polar distance. Then we add together the sines of these two results, the co-secant of the co-latitude, and the co-secant of the sun's north polar distance, and divide the sum by 2. The result will be the sine of half the hour-angle in arc. Doubled and turned into time, this gives the hours, minutes, and seconds from the time the sun rises to his passage over the meridian; and, of course, computing from the sun's north polar distance at setting, we get the interval between apparent noon and sunset. Let us work all this out for August 17th, latitude 50° 30′, co-latitude 39° 30′, sun's declination at rising (about) 13° 27′ 53″. Consequently his north polar distance = 76° 32′ 7″. Sun's zenith distance 90° 50′ 45″.

| | |
|---|---|
| Co-lat. .......... | 39° 30′ 0″ |
| Sun's N.P.D. ..... | 76 32 7 |
| Sun's zen. dist. .. | 90 50 45 |
| | 2)206 52 52 |
| | 103 26 26 |

103° 26′ 26″ − 39° 30′ 0″ = 63° 56′ 26″
103 26 26 − 76 32 7 = 26 54 19

| | | | |
|---|---|---|---|
| S − Co-lat. | 63° 56′ 26″ | Sin. | 9·953440 |
| S − N.P.D. | 26 54 19 | Sin. | 9·655635 |
| Co-latitude. | 39 30 0 | Cosec. | 0·196489 |
| Sun's N.P.D | 76 32 7 | Cosec. | 0·012104 |
| | | | 2)19·827668 |
| | | Sin. | 9·908834 |

54° 9′ 35″ half-hour angle
2

108 19 10 hour angle
In time 7h. 13m. 16·67s.

At setting the sun's declination was only about 13° 16′ 22″, and substituting this quantity in the formula above, we shall get 7h. 11m. 11·47s. as the interval from the time of the sun's southing to that of his setting. Finally, 7h. 13m. 16·67s. + 7h. 11m. 11·47s. = 14h. 24m. 28·14s., the length of time from sunrise to sunset in latitude 50° 30′ on August 17th.

But there is much needless refinement in all this, as refraction varies with the height of the barometer and the temperature, and it is idle to attempt to find the hour of actual sunrise within a good many seconds. Hence, it practically suffices to take the declination of the sun at noon, and work with that for the hour angles to the east and west of the meridian. Employing this abundantly accurate method, we find that in latitude 55° 30′ on August 17th, the sun was 14h. 55m. 1s. above the horizon, or the day was longer by some 30m. 33s. than it was in latitude 50° 30′.

In reply to query 72495 (p. 111) as it is admitted on all hands that a lunar atmosphere, if existent at all, must be of very great tenuity, no dimming of an occulted star would be perceptible. The way in which an atmosphere would operate would be in causing a star to disappear too late and to reappear too soon from behind the moon for her known diameter and rate of motion, just as our own tmosphere causes the sun or moon to appear above the horizon when they are really geometrically beneath it.

"S. A. B." (query 72496, p. 111) will not find Madeira nearly so relaxing and enervating as the West Indies.

It really looks as though "Zain" (query 72506, p. 111) had never attempted to focus the eye-piece of his spectroscope for absorption lines! He should get Schellen's "Spectrum Analysis," published by Longman and Co.

**A Fellow of the Royal Astronomical Society.**

### SECTIONS OF THE B.A.S.

[31652.]—As you kindly inserted my last letter on his subject, I am encouraged to hope you may find pace for this.

The sub-committee appointed by the provisional ommittee of the B.A.S. have already appointed directors to eight sections, which are now in the ourse of formation. Several members have, I elieve, given their names as workers in the same. The sections are as follows:—Meteoric, Solar, Lunar, Specteoscopic and Photographic, Coloured Stars, Variable Stars, Double Stars, Jupiter. Now we enture to think there should also be the following sections: Mars, Saturn, the other planets grouped, Nebulæ, Cometary and Comet-seeking. The grouped planets might include search for the roblematic Vulcan, which some of us have not yet uite lost faith in. The practical difficulty is to btain suitable directors. We think those who, n consultation with competent friends, are disposed to undertake the responsibility, should at nce come forward and offer their services as directors, and there are many who could satisfactorily assist the B.A.S. in completing its sectional arrangements. We trust a false modesty will not keep the consciously competent reticent in this important matter. We should rejoice to see the B.A.S. in full sectional swing at its public inauguration in October. From the little experience we had in connection with the L.A.S., we can promise any who accept direction an amount of pleasure of which they have little conception until they methodically aid their co-workers in our interesting science. The writer would like to see an astro-mathematical section to cover the initial needs of members in all the sections; but I suppose that is too much to expect at present. Meanwhile there is no doubt that the B.A.S., when thoroughly organised, will greatly advance observational astronomy in Britain and its colonies.

**W. R. Waugh.**

[31653.]—The Rev. W. R. Waugh (letter 31628, p. 100) has done good service in calling attention to the advantages of sectional work under the British Astronomical Society, and it is to be hoped that members will give his reasons the careful consideration they deserve. May I supplement his remarks by stating briefly what we propose to do in the "Coloured Star" section?

The immediate object proposed to be undertaken is the formation of a catalogue of standard star colours, such as shall be worthy of a high degree of confidence. To do this effectually it is essential that a considerable number of observations of each star be made by a strong staff of observers. The personal and instrumental errors peculiar to this class of work will therefore be minimised, and the final mean result must be pretty near the true value. To carry this work to a successful conclusion will be an ideal well worth striving after; and every member who has taken part in it will be able to point with pardonable pride to the solid and enduring fruits of his and his fellow workers' labours—such a happy consummation being only possible as the outcome of earnest, united, and systematic action.

For the present only the brighter naked-eye stars will be selected for observation; that is, all those above 5·0 magnitude (according to the authority of the "Harvard Photometry,") which may be fairly accessible in these latitudes. The circumpolar zone will form the first part of the work; as, from being always visible, its colours, when well determined, are intended to furnish standards of comparison for the remaining zones. During this period of the work an observation of Polaris is to be made on each night of observation, so as to furnish some clue to the "personal equation" of the observer. The star-maps to be recommended are those contained in the smaller Atlas of Proctor (London: Longmans) or the "Tabulæ Cœlestes," of Schurig Leipzig: Karl W. Pfall), either of which can be safely named for accuracy and cheapness. And the system of nomenclature to be used for the estimates of star colours is that published in Vol. XLVII. No. 5 of the *Monthly Notices* of the Royal Astronomical Society. Members wishing to join the section are requested to state the aperture of the telescope (o.g. or speculum) they propose to use, and whether the instrument is equatorially mounted or not; the circulars containing the necessary instructions, nomenclature, and list of stars will then be forwarded to them.

I am especially desirous that some observers in the southern hemisphere will co-operate in the work; as the southern sky, so far as star colours are concerned, is a practically unexplored region. If any so situated will communicate with me I shall be pleased to furnish the necessary star lists and instructions.

**W. S. Franks.**

62, Belgrave-gate, Leicester.

### THE BRITISH ASTRONOMICAL SOCIETY.

[31654.]—We are greatly obliged to you for the space you have from time to time placed at our disposal for the purpose of reporting the various steps in the formation of the above society. Will you kindly allow a further inroad on your valuable space for the purpose—first, of reporting progress, and secondly, indicating the steps we propose to take next?

The first *public* intimation of the intended formation of a new astronomical society was given in a short note from my brother in your issue of Aug. 8, just seven weeks ago. We have now nearly 250 members on our books, and fresh applications are coming in daily. This result, considering that it is the holiday season, when so many who are sure to sympathise are away, is not merely gratifying—it is astonishing.

The programme which appeared in your issue of Aug. 15 was the first official business of the provisional ccommittee, and included, of course, the name of the society, the scale of fees, &c. These are matters which will require the formal ratification of a general meeting; but the society may be taken to have virtually accepted them, as, of course, every member has joined on the basis of the published programme.

Three methods suggested themselves for placing the society on a constitutional basis. First, that the provisional committee should itself select the council; second, that the provisional committee should select a list of names from which all the members of the society should be invited to elect the council; third, that each member of the society should compile a council list from a list of all the members furnished for the purpose. There were obvious advantages in the first plan. It would have been simple and speedy, and so far representative that every member who has joined has by so doing practically recorded a vote of confidence in the committee. It was felt, however, that a more popular method was desirable; at the same time there were obvious difficulties in the way of suggestion number three. It would have involved the closing of the list of members on some arbitrarily fixed date, and would necessarily have caused considerable delay and expense. The second plan was, therefore, after full discussion, adopted. On the 15th September the secretaries prepared a list of all who had joined the society up to that date, and despatched a copy to each member of the committee. From this list the committee selected thirty names, a sub-committee nominated beforehand meeting to count the votes on September 22nd. On the following day the secretaries issued copies of this list of thirty names to each member of the society, with the request that twenty-two names should be selected from it, who should form, together with the eight directors of the observing sections, whose names were likewise given, the future council of the Society. Two well-known members of the society, Mr. Edwin Dunkin, and expresident of the R.A.S., and formerly chief-assistant at the Royal Observatory, Greenwich, and Mr. E. E. Baly, Deputy Chief Cashier of the Bank of England, have been nominated as scrutineers, and will count the votes on October 1. The first meeting of the council will be called for October 8, when the officers of the society will be elected and arrangements made for the holding of a general meeting to be called as soon as possible. It will be part of the duty of the council to draft a scheme of by-laws for the discussion and decision of the general meeting, and in otherways to provide that the heavy amount of business which that meeting will have to dispose of shall be dealt with, with the utmost facility and speed possible. The general meeting will have to confirm the election of officers and the directors of sections, decide on the by-laws, approve, if it so decide, what has been done so far on behalf of the society, and prepare a programme of what is to be done in the future.

The proposal that votes for the council should be counted, and the officers elected before the general meeting is not, of course, in accordance with the usual precedent; but to have delayed the proceedings of the first general meeting while the votes were being counted, and to have had then to elect officers, and to proceed to the discussion of by-laws which had received no previous consideration, could only have resulted in confusion and delay. The present arrangement will not form a precedent, or bind the society's action in any way.

I append a list of the directors of the Observing Sections as at present nominated. Mr. W. H. Maw, F.R.A.S., has acted as temporary treasurer, and my brother and I have continued to act as temporary secretaries.

*Directors of Observing Sections.*—D. Booth, Meteoric; Miss Brown, Solar; T. G. Elger, F.R.A.S., Lunar; Rev. T. E. Espin, F.R.A.S., Spectroscopic and Photographic; W. S. Franks, F.R.A.S., Coloured Stars; J. E. Gore, M.R.I.A., F.R.A.S., Variable Stars; K. J. Tarrant, F.R.A.S., Double Stars; Rev. W. R. Waugh, F.R.A.S., Jupiter.

**Thos. Frid Maunder.**

55, Sydney-road, Brixton, Sept. 30.

[31655.]—Along, no doubt, with others who have announced their intention of joining the above Society, I received the circular dated Sept 23rd, and also the list of names submitted for election to the council. I must confess that I was rather surprised at the contents of this circular, as in it we were informed that the provisional committee had "decided that the council shall consist of thirty members, of whom eight are to be *ex-officio*, as being directors of the observing sections, and the remaining 22 are to be elected by the Society from the list herewith submitted to you."

Now, Sir, upon reading this, it seemed to me that the provisional committee was proceeding rather too hastily, and was indeed exceeding its powers in this matter, for it has no right either to fix the number of the council, or to select a list from the whole body of members for election to the council without being first authorised to do so.

The proper course was to summon a general meeting of members, and to submit to it a draft series of rules for adoption or alteration as might be considered advisable, and leave it to those present at the meeting either to elect a council there and then, or to take what steps might seem proper to them for that purpose.

While giving all credit to the provisional committee for their desire to get the new society into a concrete form as soon as possible, I think that a general meeting was a necessary condition at the commencement, and I still think that one ought to be called before any further steps are taken. A large number of country members would, no doubt, endeavour to be present at the first meeting, and thus have some voice in the formation of a society in which they are much interested; but when they find that the fundamental points are all settled, and everthing cut and dried already, it is quite possible that their interest in the society may to some extent fall away.

Sept. 26. **Yorkshireman.**

### β 648—REFLECTORS.

[31656.]—If Mr. Bramley will turn to M. Gaudibert's letter, 31502, on page 9, he will see how we found the pair I mentioned having divided. As M. Gaudibert split it with only 6in., it cannot, I fancy, be β 648. I estimated the star pointed out to us to be at least twice as wide as B.'s measure of his 648, as given in Gledhill. I am putting my 6½in. mirror into a wooden tube 10in. clear inside diameter, to see if one can check-mate those air-currents, and will report result for benefit of all interested in this vexed question.

**Tenebris.**

### REFLECTORS.

[31657.]—"Tenebris" is not open to conviction. He has condemned all reflectors *a priori*, and if any evidence is produced in their favour, it is only so much the worse for the evidence.

I refrain, therefore, from arguing further; but permit me to state my eyepieces are not overrated, as he hints. I will give him any proof he likes of this. They have been carefully and repeatedly measured by myself, and result is accurate within 5 per cent.

I think he must be very unfortunate in his experience with reflectors. I have not been so fortunate with refractors. I once with a 6in. proposed to look at Vega, and the owner objected that Vega was not a fair object for a refracting telescope: it was as bad as Venus. "No refractor will do well with Vega." I objected that I did not care what object my reflector was put on, and I did see Vega in o.g.; but what an exhibition compared to the splendid object it is in a reflector!

"Tenebris" omits to notice that Nasmyth's mirrors were much larger than his o.g., and therefore would necessarily make worse weather. I doubt if any aperture beyond 9in. improves definition except on rare occasions. The air would seldom permit either Nasmyth's mirrors or an o.g. same size to define well. I have heard of a 21in. o.g. in this country which only performed well on one night in several years if I remember rightly. It would have been little use to make an appointment to look through that.

**H. E.**

### DEWING OF MIRRORS.

[31658.]—In reply to your correspondent's letter on this subject, the dewing of mirrors is caused, as he will be aware, by the mirror being colder than the surrounding air. As the air changes in its temperature more rapidly than the glass, this will take place in the morning. It is, therefore, undesirable to uncover the mirror in the morning. Some years since I uncovered mine in the morning, and found, or thought I found, it often dewed;

but I ascertained that this was the cause, and I now never open it until my thermometer inside my observatory is one or two degrees higher than the air outside, and until the mirror has had time to get the same. With this precaution, I have never found it dewed during the three or four years I have had my present instrument.

I would say that any telescope which is too large to take in after observing should have a house of some sort. A roof to run off on rails is the simplest of all, and, if the observer does not mind the open air, the best; but the "Romsey" is the most sheltered from the wind, and if well formed, with large shutters and air space underneath, canvas roof, and thin board walls, is as nearly as possible equivalent to the open air.

I cannot say that I am conscious of any disadvantage in definition arising from this cause. My observatory is one of this construction: 12ft. square, circular roof, shutters 4ft. by 9ft. 6in., 6in. air space under the joists of the floor, with 2ft. of cinders under this.

Fordingbridge. **T. Westlake.**

## REFLECTOR OR REFRACTOR—B.A.S.

[31659.]—I USE a refractor, as I consider it most useful to myself, as Mr. Calver knows. Not long ago two persons came to have a look through my telescope. One said the moon, &c., showed all sorts of appendages (I could not see them); the other with the 150 e.p. divided Pi Aquilæ. The first afterwards had a look through a 5¼ Calver, and was enchanted, and, of course, chose accordingly. I consider the question, Refractor or Reflector? quite a personal one. If a man knows their peculiarities, and under what circumstances he will generally use the instrument, makes his choice, and has his mounting, &c., as best suits his own convenience, he will be satisfied with the results when his eye and instrument have become familiar.

I hope that members of the B.A.S. who are inclined to take part in the work of observation, will send in their names to the directors of sections as soon as possible. Surely the members must have enough interesting notes of Mars to make a report for an early number of the *Journal* if there was someone to take charge of them.

Would it not be advantageous to hold the ordinary meetings in London alternately in the afternoon and evening. The general meeting, I think, should be in the afternoon; thus country members would have an opportunity to attend a fair number of times. As I think the regular subscriptions to the B.A.S. ought only to be applied to the regular current expenses, and that the preliminary expenses up to and including all incurred up to the first ordinary meeting of the Society, should be defrayed out of entrance fees so as to start fair; therefore, I hope my fellow members, who can afford it, will think rather of the welfare of the Society than of the option granted to original members.

Reading. **G. T. Davis.**

## THE GASSNER DRY BATTERY FOR BELLS AND LAMPS.

[31660.]—I HOPE Mr. A. E. Ball will not construe my delay in answering his letter (31595) into an act of discourtesy. Truth to tell, I have not continued the experiments with this battery as detailed in a former letter (31316), so cannot say how the recharged cell would behave when subjected to the severe tests mentioned in that letter. I have only used the cell on occasional bell-ringing and with others in electric-lighting experiments since it was recharged. I do not think it was sufficiently recharged for another long run, as I only had it in circuit with the dynamo for a few hours, and I estimate that it should have had a charge of 60 watts at the least to fit it for another long run of 118 hours at bell-ringing. Respecting the E.M.F. of the cell when received from the agent, I tested it in comparison with several Leclanché cells, and found it superior to any of them. After it had been recharged, I estimated its E.M.F. to have been considerably improved, but this has fallen since. From a report I have of some tests made by Prof. Gérard, I see that the E.M.F. of a recharged cell is 2 volts. This falls on a closed circuit to 1·54 volt in one minute after closing the circuit, and down to 1 volt at the end of 6 minutes. This being the case, it would take six cells in series to sustain the light of a 2½c.p. 6-volt lamp for 5 minutes. I have only tried five cells in series on a 2½c.p. 6-volt lamp, and these fully light up the lamp long enough to see the time by a watch held near the lamp. I think it possible that the newly-made cells are an improvement on those made about a year since. I have recommended these cells to the notice of "Ours" because they are so clean and so well suited to use in a bedroom. As I have but scant leisure and opportunities for experiments, I shall be glad to see published results of experiments with this battery from other readers of the "E. M." Will Mr. Ball kindly give us an account of his experience with the Gassner cell?

**G. E. Bonney.**

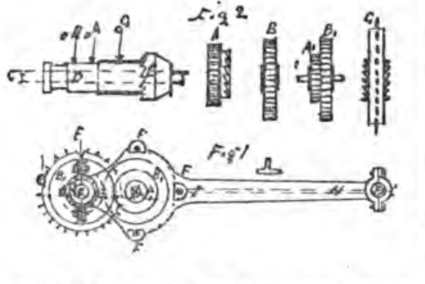
## MOTORS FOR CYCLES AND CYCLE CONSTRUCTION.

[31661.]—"W. G. F.'s" suggestion (31620, page 84) to have safeties fitted with a second gear for hill-climbing is not new, as I have made and fitted gear exactly as described. My machine has now been in use several months, with entirely satisfactory results.

Brighton. **P. C.**

## AUXILIARY POWER FOR TRICYCLE—HILL CLIMBER.

[31662.]—I HERE forward a sketch of an arrangement that may be a help, and it may be improved upon. The affair, if made of malleable cast iron, or steel, or Mitis metal, section $\frac{3}{16}$in., section throughout, will, I calculate, come within 12lb. weight, and T section, Fig. 1, shows the affair coupled up. H I J is the carrier, or frame-work, C is the axle shaft, and D the crank-shaft. A B and $A_1$ $B_1$ are four cog-wheels; we will say two A's and two B's. A's pitch line, 2½in. full, ⅜ pitch, 18 teeth; B's 3in. pitch line, 25 teeth, the same pitch. Now we will refer to Fig. 2: A is one of the 2½ wheels, with a face collar on, milled out for a clutch coupling, B, one of the 3in. wheels, with a slightly raised boss on either side. $A_1$ and $B_1$ are one of the 2½in. and one of the 3in. pinned together, and G is the chain wheel, with a ratchet boss upon both sides. There need not be more than 5 or 6 teeth on either side, ¼in. deep. Now, C is the axle, D the sleeve keyed upon it. The ratchet E had better be independent, to facilitate the getting of it up, and put upon sleeve with three screw pins right through the sleeve. Now, G goes upon G O. A goes on next to it at A*o*, and B goes on next to that at B*o*. This is keyed. A works loose up against the shoulder, and G run loose likewise. That is the chain-wheel in the recess at the end of D to the left. The end of the carrier is coupled on (see 1) just under it. Now the two coupled wheels run on a pin at X. Now the chain-wheel, when at work, engaging with the clutch to the right of the sleeve, drives the shaft direct; but, when it is set over to the left and engages with the clutch upon the loose wheel A, that engages with B1, and the fixed one to B1 wheel A1, engages with the fixed one B*o*, which still drives the axle; but through two pairs of wheels thus getting more power, the other end of carrier couple upon the crank-shaft for stay and leverage (Fig. 1 F.F.F.) are lugs and bolts or screw-holes to box it all in with a cover. There is a great deal said about bad castings in steel, malleable iron, &c.; but if these slate nails and others can be cast so slender, an inch and two inches long and sound, there is no reason why good, sound castings cannot be had reasonable. In my opinion, it is only the penny-wise and pound-foolish job or carelessness. **Jack of All Trades.**



P.S.—The next sketch will be a frame or carrier for a pair of fixed or oscillating cylinders, the same weighing 6 or not more than 7lb.; and following will be the building of cylinders, jack-steel, that will not run into more than another 7lb. This will give you time to put your considering-cap on, or digest what is put forth.

[31663.]—THERE is no difficulty in applying steam to locomotion on roads, *except the law*. Some years ago I had a steam-tricycle. I was not allowed to *travel* without a man walking 20 yards ahead, or to go more than five miles an hour, or to blow off steam in the streets, and I never did, *in sight of a policeman*. I got more dirt than fun out of it. It weighed 17 tons, and I used it chiefly for rolling roads. But electricity applied to cycles is now an accomplished fact. I saw yesterday a tricycle, a Bath chair, and several boats fitted with electric motors. The tricycle motor weighs about 62lb., and works with two batteries, weighing a little more, for nine hours, at a cost of 1s. 6d.—so I am told—I did not see the motors working, but intend to. I was told the tricycle and Bath chair would go up any hill.

Anyone interested can go and see for himself, or write to the Vaughan-Sherrin Electric Engineering Company, 48, Eagle Wharf-road, City-road, London.

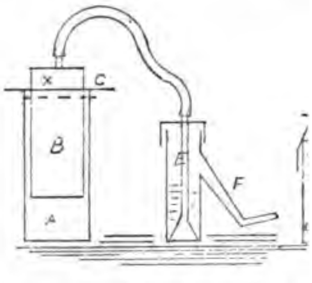
Sept. 23. **Bofin.**

## CYCLES.

[31664.]—ABOUT the year 1880, a p
began manufacturing tricycles tried
wheels for gearing, but could find no
whatever over circular wheels. He als
out a double-driving tricycle (on the
suggested by "W. G. J.," letter 31620,
with fast and slow motion, and the feet co
on the treadles while running disconne
hill; its brake was also extremely pov
was heavy, and not elegant-looking, v
caused it to go out of date, yet a good m
rough work.

## SMALL MOTORS.

[31665.]—I HAVE given a sketch for air
For testing air charged with the light
spirit, &c., as for many that will pr
difficulty, I here forward another tha



little and serve to illustrate what can be
to a certain extent. At the present day
lack of material in the shape of tins—
tins, cocoa tins, &c. Now, what is re
1lb. coffee tin, a ½lb. coffee tin, and
Van Houten cocoa tins, or something like t
of the small indiarubber tube such as i
children's feeding bottles, and a milk tir
cut up. The following sketch will illu
1lb. coffee tin that is filled with water ver
is the ½lb. coffee tin with a hole in th
bottom, and a small tin tube soldered in.
made through across the centre with a br
a piece of wire, C, passed through and s
both sides: this may be done as near t
as possible. This is to keep the
going down into the large one; an
is put in the bottom as shown a
this is to put your finger on to act a
when you are manipulating this as a
affair for a bellows D in the rubber tube
¼lb. cocoa tin. Now for the milk tin—ta
edge off and the bottom, and unsolder tl
make a little tunnel as shown inside
fit the canister easily), and place as sl
downwards, and that cone is to be perfor
quantity of small holes, and the small
come out an inch through a hole in the
pipe D to fit on this and B. Now cut a
of tin that will make a long tube from
⅛in. at the other end, and about 1in. fr
file a nick across it, and bend up (of cou
be soldered before and after the crank piec
Now file off slanting the large end, an
hole inside the tin, pass it through as s
solder it. This tin is charged with cotto
in on the top of funnel, and this
with petroleum, spirit, benzoline, or
you like to use to carburet the
The other tin is a ¼lb cocoa tin
with a hole about a ¼in. or ⅜in. from the b
the nose of the spout F can be inserted
the lid of same cut out at the crown,
soldered on or passed from the inside.
in the cone that can be covered by
just as the rim laps over. Now get some s
—a teaspoonful of good vinegar, and in t
dissolve a piece of salprunella, about ⅛in.
twine up in lengths about 1½in. long,
these in it, or lay them upon a plate and
and dry; now get some firewood tha
well and fine; put these into the
thoroughly dry, and when dry and w
paraffin candle over them or a piece o
and lay by; these your torches for exploc
having all ready and charged, take the
then insert F into the hole; then with th
take the nose C in between the thumb a
finger, and lift B; then place the
the hole X, and let down—the
pass through the tube D into an
the funnel, and through the cotton
through the spout F, through the hole in
this steadily, now take G away, and
candle alight some distance off, take
pieces of string and put between a pi
stick; ignite by the candle, and insert
and see if you can explode by such me
take one of the pieces of wood and light
the hole, and see which can be done.
explode either, or both ways, put the c

en put a farthing on, and a halfpenny, and ·, and see what can be done in a small way. or edge of the tin E should be made warm, ›bed around with beeswax, or equal parts of .d resin, and the tube that comes through it ıe funnel looped around close to the hole piece of darning cotton, and some of the plied with a hot wire, to make it tight. Take · when exploding it, and don't forget you are · with edge tools rc dangerous compounds, that your tins are soldered at joints, and

**Jack of All Trades.**

## RITHMS TO TWELVE PLACES.

56.]—In Gauthier-Villars' Catalogue of ıatical works occurs:—Namur—Tables de ımes à 12 decimales jusqu'a 434 milliards ation de l'Academie Royale de Belgique), :nc. In Hoepli's Catalogue 49, Peter Gray's for the formation of logarithms and anti- ıms to 12 places (alluded to by a corre- nt) are advertised at 2fr. 50c. (Hoepli, Corso o Emanuele 37, Milan).

**E. M. Langley.**

## SAP OF TREES.

57.]—I quite agree with Mr. J. A. Reeves 31639) in not believing that the sap in trees ı those small tubes which are formed in the vithout some kind of movement of the cells. made an experiment with a chrysanthemum and found that its power to draw up moisture ual to sixteen times its own weight. I came › the conclusion that although the pressure air on the flower-pot and mould would assist, ıat there must be some movement of the xpanding and contracting to draw in and up the sap. If we suppose that by the ation by the leaves a partial vacuum is ›ed in these pipes, how is it, then, that a tree is tapped the sap does not merely › to that part where it is tapped, but flows ely? Does that not look as if it is forced ıd against the pressure of the air? The ılars of my experiment are stated in "Ours" r 25th, 1884.

**J. H. Schucht.**

## A CURIOUS EXPLOSION.

68.]—The incident related by Mr. Robottom idently the result of imperfect annealing of ıss mortar. I have had several of these ı, of different sizes, made in the works to I am attached, for use in the laboratory, but ever been able to get one of any considerable "stand" for any length of time, though r ones, made of exactly the same kind of I have had in use for years. The cause, as I lready said, is imperfect annealing; and it is t very easy to remove in the case of such as glass mortars, which are of considerable ess, and are usually extra heavy at the base. f course, causes unequal contraction, and sets essive tension in some parts of the article, a very slight touch or scratch is sufficient to › its equilibrium, with the result stated. The ırt's drops" and "Bologna phial" are well- ı illustrations of this curious phenomenon. It possible that the vessel may have been sub- to the "Bastie" process of tempering, and ell known in the trade that goods so treated ry liable to the fate of the article described by . The subject is a very interesting one, and ›eived, as it merits, a great amount of atten- ı the hands of those more immediately con- , but up to the pressent time without a ctory solution of the problem.

**Mons.**

## STEEL AXLES IN INDIA.

69.]—I see by Indian newspapers that steel ıre a complete failure in that country—that are to be thrown away and iron ones put in lace. Surely this is very strange when steel so well in this country. I hear that the steel ıst iron sleepers have much to do with the , and that the axles have some sharp corners. ıps some of our mechanical contributors will eir opinions on the cause of the failure of . India.

**Railway-man.**

## E THERMO-DYNAMICS OF THE VACUUM BRAKE.

70.]—Since the letter of Messrs. Archbutt eeley, p. 13, stating that the vacuum is a ırake," several further cases have occurred of ıccumulating in the pipes.

North-Western Company has been engaged various amounts of vacuum, and are taking small ejectors and putting on pumps. Col. ın his Carlisle report, advised the company to 25in. of vacuum. They have tried, and it ›t do in practice. The brake can be applied 5in., but the large ejector will not take it :ow is this?

e have been cases where the larger ejector was kept open until it reduced the boiler pressure 40lb., and yet the brake will not come off.

In view of the statement that water does not get into the brake, it is somewhat strange to find at Clapham Junction, L. and S.W. Railway, an inspector and ten men, whose duty it is to keep the brakes in order, and who are constantly employed in drawing off water from cylinders and ball valves.

**Practical.**

## A CONTRADICTION.

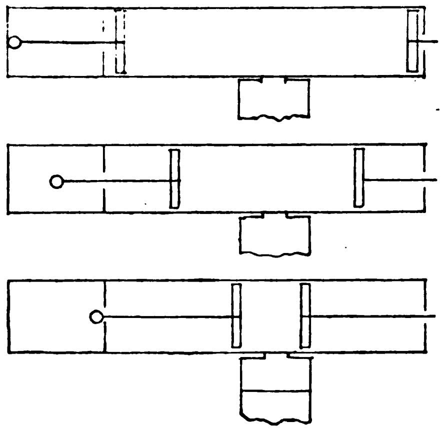
[31671.]—Please record my protest against the reception as authentic of the statements of Dr. Gaertner, of Pittsburgh, Pa., in the article reprinted by you in No. 1323 from the *American Monthly Microscopical Journal*, relative to the Cronin trial. I was an expert in that case, and state *positively* that no expert for either State or defence even pretended to be able to demonstrate that the blood found in the Carlson cottage was human, much less that it belonged to Dr. Cronin. As to the "brain matter," the evidence showed that the brain was so decomposed that not even the cause of death could be determined from it; and it was not subjected to microscopic examination. The writer drew upon his imagination for his facts; and to allow such statements to go unchallenged would be to disgrace science.

**Marshall D. Ewell, M.D.**

97, Clark-street, Chicago, Sept. 11.

## THE "PETROTRYKE" ENGINE.

[31672.]—With reference to the remarks which have been made on the "Petrotryke" engine, those of your correspondents who have taken notice of it do not seem to have understood the principles of same. When the pistons have arrived at the position shown in Fig. 1, the exhaust and inlet valves open, so the engine exhausts and receives a fresh charge until pistons arrive at the position shown in Fig. 2, when both exhaust and inlet valves are closed, and the charge is compressed until pistons arrive at the inward end of their strokes. The charge is now fired, and the pistons, under the pressure of the expanding gas, move outwards until they arrive at the position shown on Fig. 1.



Now this is really an honest attempt to solve a problem in the economy of gas engine improvement. Thus, in the Otto, which is the best-known, and hitherto the most successful type, the tale of work done is something like—Heat converted into work, 22·91 per cent.; heat taken by water jacket, 50·16 per cent.; heat carried off by exhaust, 27·93 per cent.

Now it will be evident to the average mind that if the charge in the Petrotryke is the same as in the Otto, that the compression will be the same also, but the expansion of the charge will be double. The Otto engine exhausts at a very high pressure, and any attempt to utilise that high pressure is surely to be commended. But the improvement in the Petrotryke does not end there, as you will see by a reference to the figures quoted—50·16 per cent. of heat taken by the water jacket. Now by a reference to the figures you will see that when the pistons have moved from their position Fig. 3, to that shown on Fig. 2, that the charge has been expanded as far as it could have been done in an Otto cylinder with the piston arrived at the end of its stroke. What advantage is gained then? Well, say that the speed of each engine was equal, the expansion of the charge has been done in the Petrotryke in exactly half the time, so that the water-jacket ought only to have had time to take 25·8 per cent. of heat taken by the water-jacket of the Otto—viz., 50·16. Besides, if we were to put an engine on a cycle of the Otto type, the bark of the exhaust would be intolerable. But the Petrotryke expands its exhaust until it is past barking. These engines will be tried in a very few weeks, and, what is more, they will start work first trial. Specialists in the line have also pronounced in their favour, and the writer hopes that next summer he will be in possession of a tip-top Petrotryke.

We do not mean that this engine will be 160 per cent. more efficient than existing types, if it should be 25 per cent. on the right side it will make its mark. It is not a question of taking more out of the cylinder than is put in. Neither is it a steam-engine we are speaking about, which is usually jacketed to keep in the heat; but a gas-engine, which is usually jacketed with cold water lest the engine should do too much work. I do not think that the heat of the cylinders exceeds 100° F. Why should they not be kept at 250, or even 350° F.?

**Petrotryke.**

## ELECTRICITY AND ETHER.

[31673.]—"Sigma" states in your last issue that we have not a particle of evidence of the transmission of magnetic or electric force through space. If he will refer to Sir John Herschel's lecture on the sun ("Fam. Sci. Lect." p. 79-81), he will find that at the instant of a violent outburst upon the sun's surface (observed by two astronomers independently on Sept. 1, 1859) the needles of the recording magnetic instruments at Kew were violently dashed aside, that telegraphic communication was interrupted, and operators received severe shocks, whilst a station in Norway was set on fire, and at another in America a flame followed the pen of Bain's telegraph. Moreover, auroræ were seen at night in latitudes usual and unusual, even near the Equator and in South Australia. In my own experience I observed the sunspot, visible to the naked eye, which broke out in Nov. 1883 (I think), and ventured to prophesy an auroral display for the evening, which display actually took place. Sir John Herschel gives much evidence to prove that terrestrial magnetic phenomena are intimately associated with solar action, so that there is a good deal for "Sigma" either to disprove or recant. He must either give the explanation, since it is full time for it, or admit the transmission of magnetic and electric force through space.

If all the facts as to induction which are deduced from the result of experiments made on the "ether" basis prove to be correct in actual working, surely that is a proof, so far as it goes, that the basis was correct. If "Sigma" can prove that, for instance, the specific induction capacity of dry air is not to that of mica as 1 to 5, he will do more thereby to upset the "ether" theory than by whole volumes of academical arguments. I am only a biologist, neither an electrician nor a mathematician, and could not define induction to save my life, nor could I even solve a quadratic equation; but it does seem to me that when a man discovers that $2 + X = 4$, he is fairly well justified in assuming that $X = 2$, and in using that value as a basis for further calculations. Is not this exactly what has been done with the "ether"? "Sigma" concludes by saying that mathematics have shown that opaque bodies should not possess inductive capacity. Nor do they, for the very simple reason *that they do not exist*. There is in all nature no such thing as an opaque substance; transparency is not to be limited, as "Sigma" would evidently limit it, to power of transmitting luminous rays. Alum, for instance, he would regard as transparent, yet it is opaque to the heat-rays in a very high degree. Vulcanite stops off the luminous rays entirely, but is as transparent to the non-luminous rays as alum is to the luminous ones. A really opaque body, one which stopped the heat-rays absolutely, could never be warmed, since if it allowed them to penetrate its substance ever so little, that would prove its non-opacity, *ipso facto*. Thus, to establish his closing position, "Sigma" must first find an opaque body, and then prove that it does, in spite of mathematics, possess inductive capacity.

Much yet remains to be done. It may, for instance, be discovered that the lines of magnetic force obey some law related to that which governs the circular polarisation of light. It may be found that induction and conduction are related in some such way as reflection and absorption. This I leave to more skilled hands, and await with much interest the explanation of the *facts* above mentioned on the anti-ether hypothesis.

**Edward C. Bousfield.**

[31674.]—"Sigma" is wrong in supposing that four-dimensioned space may first be used to explain certain so-called "spiritualistic phenomena." The consideration of space of any number of dimensions arises by analogy from that of one, two, or three dimensions, and had nothing whatever to do with the attempt of poor Zollner to explain the knot-tying rubbish of the "mediums." Zollner was, I believe, by no means a mathematician of a high order, and was at the time the subject of brain disease in all probability. His mathematical conclusions were also, I believe, incorrect.

If they had been correct, and the phenomena to be explained had really occurred, then there would be some ground for supposing that four-dimensioned space really existed. The mediumicians were supposed to be able, by "an effort of the will," to pass from one kind of space to the other. But the phenomena did not exist, and the circumstance, if true, that an hypothesis could be framed to explain such phenomena, does not demonstrate their existence. I quite agree with the extremely profound remark of "Sigma" that all the hypotheses emitted by the inhabitants of Bedlam need not be subjected to the criticism of the "higher mathematics," or, indeed, as I should say, to any criticism at all. But if "Sigma" intends by this that the ideas of such men as Sir William Thomson and the late Clerk-Maxwell in this country, not to speak of many foreign mathematical physicists, are to be classed with Bedlamite ravings, then I can only suppose that "Sigma" must stand on an inconceivably higher plane than the rest of humanity, or that he himself paid a visit to Bedlam and adopted the views of some of the inhabitants of that place. The only way to overthrow the hypothetic law of gravitation is to show that the mathematics are wrong which have been considered to show that the law explains the facts, or to point to certain facts which either invalidate the law or render a modification necessary. The same remark will apply to the electro-magnetic hypothesis. Either the phenomena in question do not take place in any medium at all, or in a medium which must possess certain characteristics, no matter whether it be called ether or anything else. These characteristics in a matter so complicated can only be determined by the very highest mathematics wielded by experts. Of course one has heard *usque ad nauseam* of the "mathematical mill" and all the rest of it; but such remarks are either meaningless or irrelevant. It was at first but a "speculation" that the earth was not flat; then that the earth was not the centre of the universe; then that the stars were in many cases suns somewhat like our own.

Universal gravitation was but a "speculation" at first in the hands of Newton, and it was not till the "highest mathematics" of the period had been employed in testing that speculation that the "Principia" was published. Huyghens formed the "speculation" that light phenomena were due to the undulations of the "Nonsense Ether," and numbers of the best mathematicians since his time have been employed demonstrating that the Huyghenian speculation or hypothesis colligated various groups of facts. In short, it is only by "speculations" and their verification that a chaos of facts becomes a well-ordered science. By such means great groups of facts in the regions of static and current electricity, magnetism, electro-magnetism, magneto-electric induction, self-induction, light, the electro-magnetic action on polarised lights have been reduced to orderly enclaves.

Moreover, a grand generalisation is looming in the distance which shall unite in one group, covered by one "speculation" or hypothesis, all the phenomena appertaining to the above-mentioned subjects, including, perhaps, gravitation and the constitution of matter, under which may fall the theory of heat. To show the absurdity of such "speculations," results, and expectations will require very much more than the utterance of such words as "nonsense—ether," "mathematical mill," or "Bedlam."

The probability that a "speculation" or hypothesis is a true explanation of a group of facts depends, of course, upon the number and importance of the facts explained thereby. Faraday's hypothesis of dielectric strain must be judged in the same way as other speculations.

"Sigma" makes the extraordinary statement that we know the ether "does not possess any of the properties of matter as known to us," and "that calculations are applied derived from those properties." The latter part of the quotation is to me unintelligible, and with regard to the first part the ether could not be used as an explanation of the various facts for which it has been used, unless it possessed all the essential properties of matter.

It is usually supposed to have all the properties of a perfect gravitationless material, incompressible, fluid of great elasticity, which simplifies the theoretic treatment. But it is not necessarily free from an extremely small viscosity, gravitationless, or absolutely incompressible.

"Sigma" says the "electric theorists" have invented the ether to explain the facts. And why should they not do so? What do we know of "ordinary" matter distinct from its properties, and what are its properties but "inventions" to explain phenomena? But, after all, has not "Sigma" done too much honour to the theorists in ascribing the invention of the ether to them? "Sigma" admits its existence, and that it is necessary "in a sense" to explain light. I am unable to explain the distinction between ether pure and simple and ether "in a sense." I am happy to say that there is one thing in which I agree with "Sigma,"—that an hypothesis which explains a fact that does not exist is not strengthened thereby.

**W. C. E.**

## LITHANODE.

[31675.]—Peccavi! And I am very much obliged to Mr. FitzGerald for setting me right with regard to the mode of manufacturing the lithanode plates. I presume, however, that I am virtually correct in considering the finished lithanode plate to consist chiefly of peroxide of lead. To this opinion I was led before perusing Mr. FitzGerald's letter by the appearance of the lithanode plates.

I am sure Mr. Fitzgerald will exonerate me from desiring to suggest "that lithanode can be replaced, or has been superseded by, compressed peroxide of lead." I fully coincide with the opinion that lithanode is "the negative element" for batteries.

**S. Bottone.**

## PHOTO-MICROGRAPHY — MOTOR FOR CYCLES.

[31676.]—I have been trying photo-micrography at intervals during the past twelve months, with more or less success. The microscope I use is one of Zeiss's, and the best method of fine adjustment so far has proved to be a band placed round a large wooden pulley attached to the fine adjustment screw, thence over a small pulley at the end of a long rod, which rod extends the whole length that the camera will extend—viz., 5ft. The band is a piece of ½in. tape.

The best focussing screen tried is an "Alpha" lantern plate, and the most easily-managed focussing glass a theodolite eyepiece, the focus of which is just the thickness of the glass of the lantern plate distant from the front lens of the eyepiece.

The "Alpha" lantern plate unexposed (it discolours after a time) has a singularly thin and translucent coat of emulsion, the image can be seen on it without the use of an eyepiece, and there is no perceivable grain.

I have succeeded fairly well with Zeiss's A and D, but on trying Zeiss's D D objective (I work without eyepieces) I find that I am unable to get a focus with a camera extension of, say, 18in., as the front lens of the objective touches the cover-glass.

Will some of your correspondents, learned in such matters, kindly say how they work with such powers, and with those of shorter focus? Is a projection eyepiece necessary?

I tried an experiment with regard to focus the other day. The object on the stage was focussed, using Zeiss A objective, on the ground glass of the camera 38in. distant, and a negative taken. The camera was then shortened to 36in., and another negative taken without altering the focus; it was then lengthened to 40in. and another negative taken, the focus still being the same as at first.

Result: All three negatives are sharp, and except for the difference in size, it is impossible to say which of them was taken at the best focus, as found for 38in. extension.

My subjects have been mostly sections of lung prepared for me by a medical friend (my share of the work is photographic, as I don't understand much about the microscope), and I have continually to complain of sections which are not flat, but corrugated. Would it be any objection in mounting to place a small weight on the cover-glass so as to press the section flat?

Is there any table published giving the ratio of aperture to focus as expressed for photographic lenses by $\frac{f}{8}$, &c., as I want to compare the speed of the lenses? The lenses used so far are not supposed to be corrected for photography, but no difference can be detected in the visual and actinic foci.

If the cyclists want a motor, why not try a small gas-engine and a bottle of compressed hydrogen, as used for the optical lanterns? It might be heavy, and rather expensive, but would be safer than some others I have seen suggested.

**Microbe.**

[31677.]—As statements have been made in former numbers of this paper impugning the good faith of MM. Zeiss as to the new objective of 1·6 N.A., I wrote them requesting an authoritative statement on the subject. They have very kindly sent me a copy of a letter which their Prof. Abbe has written to Mr. Mayall in consequence of my communication to them. Their letter is dated 10th September, and in it Prof. Abbe says:—"Please to take notice of a journal assertion from *my* part that the objective has *not* undergone any alteration whatever, while in Jena *that every lens and every piece of the mounting was in exactly the same state at the second departure to London in which it was at the first departure.*"

The italics are the Professor's, not mine.

Prof. Abbe further states: "Though I have not myself looked up the lens all the time over, I am in a position to give this assertion quite *positively* on these grounds.

"1. Nobody in the workshop had any sensible interest in making an alteration and *concealing it to me.* For *nobody* except myself was responsible for whatever defect of the objective. The computations had been made under my personal direction, and I had approved of the optician's work after execution. If a defect of any kind had happened to come out afterwards the fault would have been *mine only.*

"2. Nobody *could* try to change or improve the system without consulting me, because no other person was *au fait* with regard to that particular construction.

Prof. Abbe further states:—"The objective had not been tried *photographically* by us, neither Van Heurck's sample, nor the other one. I was therefore *quite prepared to admit* that a 'chemical' focus could exist, owing to an insufficient approximation in uniting the violet ray with the other rays (in our computation) under the condition always that in Van Heurck's sample *the same defect must exist,* as both objectives had shown the *same* degree of achromatism of the *visual* light. Though it appeared rather strange that Dr. Van Heurck should *not* have observed the fault, I supposed that he could perhaps have overlooked it, or had not found it hurtful, owing to his particular mode of illumination or photographic operation.

"In *this* spirit I advised Dr. Czapski to measure the residual difference of the chemical focus, and to compute a correcting lens, to be added to the system, in order to compensate for the expected difference.

"Having left the matter to Dr. Czapski, as I am not versed in photo-micrography, I was *much astonished* to hear from him—a *short* time after arrival of the lens—that he could not find a difference of focus. In face of the positive assertion about the result of *your* trial, I felt doubtful about the accuracy of Dr. Czapski's observation, and I requested him decidedly *to repeat the trial* with all possible precautions, though *he* considered this as useless."

These are the main points in Prof. Abbe's statement. There is therefore no longer any doubt that the objective was untouched by the makers while at Jena. Nor can there longer be any doubt that Messrs. Mayall and Nelson's want of success in photographing with it the first time was faulty manipulation. Dr. Van Heurck had no difficulty in getting his lens, a precisely similar one, to work to focus, as is clearly shown by the very fine photomicrographs which he has published as illustrations to his paper on the lens in the "Annales de la Societé Belge de Microscopie" T. XIII. 3rd fascicule, 1890. Dr. Van Heurck, however, is the undoubted *facile princeps* in this particular work. Any accusations, therefore, made by Dr. Bousfield must fall to the ground, and he ought clearly to apologise for having made them.

Allow me to say further that I regret "Microscopist" should have made such an ado about my *lapsus pennæ* in writing the word "actinic" for visual in my first communication to you on this subject.

**F.R.M.S.**

[31678.]—As Mr. Bousfield told us (31526, p. 15) that we had had his last contribution to this discussion, I fully expected when I again saw him coming forward that he would take the opportunity to point out, as I asked him to do in my last letter (31563, p. 57), the charge I made of incompetence or deception against any one of the gentlemen referred to. As he does not do so, I presume he has the same difficulty about this which he has about the existence of Mr. Nelson's "successful" negative about which he told us. Mr. Bousfield makes, however, fresh assertions which are as utterly without foundation as those already referred to. For my part, I have *no interest whatever* in any of the parties concerned, which is perhaps more than he can lay claim to: and as for my acting as the substitute of "F.R.M.S." in these columns, I may say that there is not the slightest foundation for the assertion. My communications have been made entirely on my own responsibility, and no one having the slightest knowledge of or interest in the subject, knew anything about them until they were in the hands of the Editor. I decline, however, to satisfy Mr. Bousfield's curiosity as to whether I know "F.R.M.S." or not. It is a matter which does not affect the matter under discussion, and one with which Mr. Bousfield has nothing to do.

In regard to the results which Mr. Bousfield says will be published shortly, and about which he is not at liberty to give details (Mr. Bousfield should not find fault with other correspondents being in league when he is so deeply involved himself), I may say that until I know what they are I can say nothing about them; but I trust they will throw more light on the matter than the report which has already been issued does.

As to what Mr. Bousfield says about the fine adjustment, I do not think that the fact of his not being suitable for a string-and-weight arrangement proves that that is not the most perfect arrangement; for it does not necessarily follow that a stiff-working screw is the most accurate any more than it does that a screw which works easily is necessarily "loose."

My experience of eyepieces is not that of Mr. Bousfield. With the same Wray-lens which I referred to as being perfect photographically, the use of a certain Zeiss No. 4 eyepiece causes very serious deterioration of the photographic image when focussed for the visual, clearly proving, I think, that Prof. Abbe is right in what he says about nding to separate the chemical and visual

r last letter (31563, p. 57) the word "com- ' in line 9 from the top of column 3 should ignificant." **Coarse Adjustment.**

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## SUMMATORY INTEGRATION.

9.]—THE following easy examples of sum- integration, which I have lately worked ggested by question 72176; see "E. M." of ), may interest some readers who are un- ted with the Integral Calculus. The pro- ms to me to be applicable to a very limited of cases only. Here I have applied it to ermination of certain areas and volumes.

*of Parabola.*—Let $y^2 = 4\,a\,x$ be the equa- the parabola O P R (Fig. 1). O$x$, O$y$, the

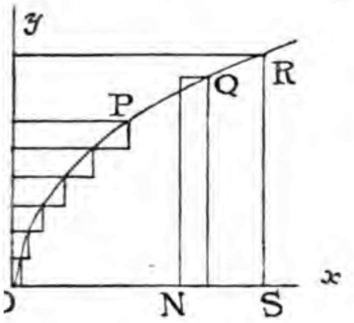


Fig. 1.

co-ordinates; O T $= h$; O S $= b$. Now to area O R S we must first find the area and then subtract that from the area of the le O T R S.

e O T into $n$ parts, each equal to $t$, and ct on these parts rectangles, as in the Then, area O R T = sum of the rectangles here $R$ is some quantity which may be tely diminished by making $t$ sufficiently The area of the $m^{th}$ rectangle from O is ly $\frac{m^2\,t^3}{4a}$. Hence, giving $m$ all integral from 1 to $n$, we have—

of rectangles $+ R$.

$$= \frac{t^3}{4a}\,(1 + 2^2 + 3^2 + 4^2 \ldots + n^2)$$
$$= \frac{t^3}{4a}\left(\frac{n}{6} + \frac{n^2}{2} + \frac{n^3}{3}\right)$$
$$= \frac{1}{4a}\left(\frac{h\,t^2}{6} + \frac{h^2 t}{2} + \frac{h^3}{3}\right).$$

put $t = o$. Then $R$ and the quantities of is a factor all vanish, and we get—

$$\text{R T} = \frac{h^3}{12\,a} = \frac{2}{3}\sqrt{a\,b^3}\ (\text{since } h = 8\,(a\,h)^{\frac{3}{2}}).$$

$$\text{Hence, area O R S} = \frac{4}{3}\sqrt{a\,b^3}.$$

ollows from this that $\text{O R T} = \frac{1}{2}\text{O R S}$.

*ne of Paraboloid.*—By revolving round O$x$, a O R S will generate a paraboloid. To ne its volume we divide O S into $n$ parts, ual to $t$, and suppose rectangles based on rts—of which Q N is one—to revolve round ach rectangle will generate a cylinder; the on for the volume of the $m^{th}$ cylinder from $4\,\pi\,a\,m\,t^2$. Hence, giving to $m$ all integral rom 1 to $n$, we have—

of vols. of cylinders

$$= 4\,\pi\,a\,(1 + 2 + 3 + 4 \ldots + n)\,t^2$$
$$= 2\,\pi\,a\,(n^2 + n)\,t^2$$
$$= 2\,\pi\,a\,(b^2 + b\,t).$$

$t$ is indefinitely small, or, as we write it, $= o$, the sum of these volumes equals $V$, the of the paraboloid. Hence—

$$V = 2\,\pi\,a\,b^2$$

—The volume of the paraboloid is half that ylinder generated by the rectangle O T R S g round O S, which is called the circum- cylinder.

*of Cubical Parabola.*—This curve, the to which is $y = \frac{x^3}{a^2}$, passes through the which is a point of inflexion, and is convex xis of $x$ throughout. To find the area lying the positive branch of the curve and the , we must take a length $b$ on O$x$, and into $n$ parts, each equal to $t$; and on each struct a rectangle, just as in the case of the common parabola. The area of the $m^{th}$ of these rectangles from O is, evidently, $= \frac{m^3 t^4}{a^2}$. Hence—

Sum of rectangles

$$= \frac{1}{a^2}\,(1 + 2^3 + 3^3 + 4^3 \ldots\ldots + n^3)\,t^4$$
$$= \frac{1}{4a^2}\,(n^4 + 2n^3 + n^2)\,t^4$$
$$= \frac{1}{4a^2}\,(b^4 + 2bt^3 + b^2 t^2).$$

Make $t = o$, and obtain for the area required—

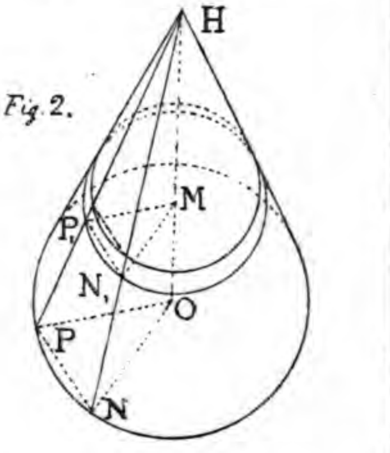
$$\text{Area} = \frac{b^4}{4a^2}.$$

The area between the curve and the axis of $y$ is found by subtracting the above quantity from $\frac{b^4}{a^2}$, the area of the circumscribing rectangle.

$$\text{Hence, this} = \frac{3}{4}\,\frac{b^4}{a^2}.$$

*Volume of Cone.*—Let the height O H of the cone (Fig. 2) $= h = nt$ — this line being divided into $n$ equal parts. In the figure the base is elliptical; but the same analysis applies to cases where its periphery is of any form. Let H N R be one side of a pyramid inscribed in the cone, which cuts the base in the chord N P, and a section parallel to the plane of the base, through a point, M, in O H, in the chord $N_1P_1$. The sections of the pyramid, being similar polygons, are to one another in the duplicate ratio of their homologous sides. Hence, if H M $= m\,t$, it follows that—

Fig. 2.



$$\frac{\text{Section on plane through M}}{\text{Section on base}} = \frac{N_1P_1^2}{NP^2} = \frac{MN_1^2}{ON^2} = \frac{m^2t^2}{h^2}$$

The same being true whatever number of sides the pyramid may have, it is true when that number is infinite, or when the pyramid becomes a cone. Let $A$ denote the area of the base of the cone, and $v$ that of the section through M. Then, $v\,t = \frac{m^2t^3}{h^2}\,.\,A$ is the volume of the cylinder circumscribing the slice of which $v$ is the base. Therefore, if $V$ denote the volume of the whole cone, we have, by adding together the volumes of the $n$ cylinders—

$$V + R = \frac{A}{h^2}\,(1 + 2^2 + 3^2 \ldots + n^2)\,t^3$$
$$= \frac{A}{h^2}\left(\frac{n}{6} + \frac{n^2}{2} + \frac{n^3}{3}\right)t^3$$
$$= \frac{A}{h^2}\left(\frac{h\,t^2}{6} + \frac{h^2 t}{2} + \frac{h^3}{3}\right)$$

Make $t = 0$, and $R$ vanishes. We then have—

$$V = \frac{A\,h}{3}$$

If the base be an ellipse whose semi-axes measure $a, b$, then $A = \pi\,a\,b$, and $V = \frac{\pi\,a\,b\,h}{3}$.

N.B.—By a horizontal displacement of the elementary cylinders a right cone may become oblique; but, the height $h$ remaining the same, the volume of the figure is evidently constant.

*Volume of Ellipsoid.*—Let O A B C (Fig. 3) be a portion of an ellipsoid contained between the co-ordinate planes, the complete solid consisting of eight similar portions, O, the origin, being the centre. Let O A $= a$, O B $= b$, O C $= c$ be the semi-axes; and suppose O C divided into $n$ parts each equal to $t$, so that $c = n\,t$. Planes parallel to A O B, through the points of division, will cut the ellipsoid into $n$ slices, of which P R S $S_1$ $R_1$ $P_1$ is one, and if O P $= m\,t$, the volume of its inscribed cylinder will be—

$$\pi\,t \times \text{P R} \times \text{P S}$$
$$= \pi\,t\,\frac{a\sqrt{c^2 - m^2t^2}}{c}\,.\,\frac{b\sqrt{c^2 - m^2t^2}}{c}.$$
$$= \frac{\pi\,a\,b\,t}{c^2}\,(c^2 - m^2t^2).$$

The sum of the vols. of all the cylinders $+ R$, where $R$ is a quantity which vanishes with $t$, is equal to $V$, the volume of the semi-ellipsoid. Hence, giving to $m$ all integral values from 1 to $n$, we get—

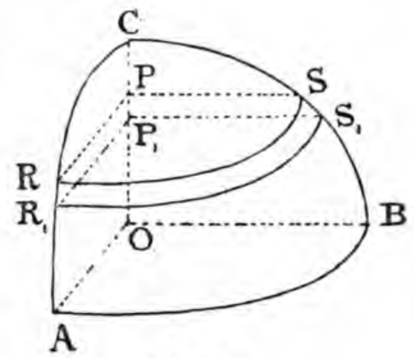


Fig. 3.

$$V - R = \frac{\pi\,a\,b\,t}{c^2}\left\{n\,c^2 - \left(\frac{n}{6} + \frac{n^2}{2} + \frac{n^3}{2}\right)t^2\right\}$$
$$= \frac{\pi\,a\,b}{c^2}\left(c^3 - \frac{c\,t^2}{6} - \frac{c^2\,t}{2} - \frac{c^3}{3}\right).$$

Make $V = o$, and we have—

$$V = \frac{2}{3}\,\pi\,a\,b\,c.$$

Hence the volume of the whole ellipsoid is—

$$\frac{4}{3}\,\pi\,a\,b\,c.$$

N.B.—When $c = b$, the volume is that of a spheroid, and when $c = b = a$, it becomes that of a sphere. Observe, also, that the volume of an ellipsoid is twice that of a cone on an elliptical base equal to its equatorial section, and of an altitude $= 2\,c$; and that its volume is two-thirds of that of a cylinder on the same base, and of altitude $= 2\,c$. Of course, the dimensions $a$, $b$, $c$ are interchangeable—e.g., we might take $2\,a$ for the height of our cone, $b$ and $c$ being the semi-axes of the elliptical base.

Charing, Kent. **J. R. C.**

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## HOMŒOPATHY.

[31680.]—I REGRET that I cannot echo the optimism of "Innominate," in letter 31641, which he shows when he says that, if true, the principles of homœopathy will be accepted. I do not think that this could be said with confidence of any truth connected with medicine, however true it might be, if once the true facts have been overlaid and hidden by the utterly false conceptions of professional bitterness.

The British Homœopathic Society have only power over their members, and these are forbidden to advertise or to connect their names with any secret remedy; members are requested to retire when, as happened very recently, they permit their names to be used in connection with any medical treatment in which the names and natures of the drugs used are kept secret; it is the public who encourage the quacks, not the members of the Society. Can "Innominate" say who is responsible for all the nonsense perpetrated in the name of orthodox medicine?

But we do not object to any of our members writing books on first aid to the sick, domestic treatises, which many experienced parents are quite able to make very good use of; when we strut and crow over our great knowledge in this "noble profession" of ours, we often have to stand aside and see the unscientific common sense of some old nurse or some thoughtful parent put our boasted science to the blush, even though they have not been trained "as the State requires."

"Innominate" asks why do we not plead our cause before the tribunal of the profession? We have tried to do this for fifty years, and are farther from a hearing now than at any time; it is a fact that no calm and reasoned statement of homœopathy has ever reached the tribunal in question, because the profession, persisting in connecting us with the nonsense and quackery of men who are not really scientific homœopaths, have for ever given us a name of reproach; the separation comes from the side of the orthodox school: we detest the hateful sectarian position, but cannot avoid it unless we yield our conscientious convictions by denying our beliefs. Does "Innominate" think that there can be anything but discomfort and irritation in the sacrifices one has to make in avowing the belief in homœopathy? All the misconception, loss of friendship, imputations of dishonesty, self-seeking, deceitfulness, and worse, which one has to put up with from men who were once willing to ask one's opinion in professional matters, go far to make one wish that the fate of being a member of such a profession had never been our curse; it is not an easy thing to bear. Not only is all hope of ultimate professional advancement to be given up, but all such skill and knowledge as we have, and all the work we may do in matters quite apart from this one point of therapeutics, goes for nothing, after once we have been tied in the minds of the profession to the crude dogmata and erroneous theories of men with whom we have nothing in common, and whose beliefs are not ours. There is a specimen in the English Mechanic of this week of a writer who not only makes this misconception as to homœopathy, but actually says that for fourteen years he practised upon the erratic lines he revives, (72026, p. 106), the great fetish of the invisible and non-existing doses, and I understand him to say that for fourteen years he tried to deal with illness by giving doses of alkaloids of $\frac{1}{8,000,000,000}$ of a grain; of course he got into as big a fog as "Innominate" confesses to in therapeutics. Why does he connect such nonsense with the name of homœopathy? This dose question in homœopathy needs some decided death-blow. I will take this opportunity of saying that the only claim we make in this matter is, that the dose of medicine used in a case of disorder must be less than the dose which would add the drug action to that of the disease; a homœopath may give as big or bigger doses than an allopath, if his experience teaches him that he will succeed by so doing; but if he has got hold of the right drug, he will only aggravate the sufferings of the patient if he gives more than the dose which can produce those same symptoms; and in practice it is found that very much less than would be supposed will act promptly and successfully, where a larger dose works no more slowly, and often fails.

Finally, let me thank "Innominate" for his courteous letter, and assure him that so long as I continue convinced of the truth of the utility of specific curative action of drugs upon the lines I have several times mentioned, so long will I "not cease to plead my cause before the tribunal of the profession," though I do not know of a single journal of the medical press which would admit one word to be said in favour of my views.

**Gerard Smith.**

Craigholm, Upper Clapton.

### THE "TRUTH" ABOUT THE COMPASS.

[31681.]—Some of the information in *Truth* is decidedly peculiar. Here is a specimen from the last number, with regard to which I should certainly prefer the opinion of "F.R.A.S." to that of the coming Jacobin Premier:—

"A few days ago I was standing by an American gentleman, when I expressed a wish to know which point was the north. He at once pulled out his watch, looked at it, and pointed to the north. I asked him whether he had a compass attached to his watch. 'All watches,' he replied, 'are compasses.' Then he explained to me how this was. Point the hour-hand to the sun, and the south is exactly half-way between the hour and the figure XII. on the watch. For instance, suppose that it is four o'clock. Point the hand indicating four to the sun, and II. on the watch is exactly south. Suppose that it is eight o'clock, point the hand indicating eight to the sun, and the figure X. on the watch is due south. My American friend was quite surprised that I did not know this. Thinking that very possibly I was ignorant of a thing that every one else knew, and happening to meet Mr. Stanley, I asked that eminent traveller whether he was aware of this simple mode of discovering the points of the compass? He said that he had never heard of it. I presume, therefore, that the world is in the same state of ignorance. Amalfi is proud of having been the home of the inventor of the compass. I do not know what town boasts of my American friend as a citizen."

It seems a pity that some one did not invent the watch before the mariner's compass—doesn't it?

**Cantankerous.**

### JOSHUA.

[31682.]—I have read with much pleasure Mr. Calver's able letter in the English Mechanic of September 25. If he or any others interested in the question of the origin of the Pentateuch, or rather Hexateuch, for the book of Joshua is closely associated with those commonly called the "five books of Moses," have access to the ninth edition of the *Encyclopædia Britannica* they will find the whole matter fully discussed in an article by Prof. Wellhausen, entitled "Pentateuch." In this the complex nature of this set of books is well pointed out. The conclusion arrived at is that the Hexateuch consists of three portions: Firstly, the "Jehovistic" narrative containing the traditional and legendary history of the Patriarchs and the Israelites, written certainly before the days of Josiah's reforms when the local shrines were destroyed; secondly, the "Deuteronomic," of later date than the former, but dating from the days of the kings of Israel and Judah; and thirdly, the "Priestly Code," the chief part of which may be found in Leviticus, and Exodus xxv.—xxxi. and xxxv.—xl., and in certain chapters in the book of Numbers. If this view is correct, Mr. Calver's argument with respect to the legendary character of the account of the sun's standing still at Joshua's command are well supported. But in any case the account is so evidently traditional and poetical that to take it literally seems as absurd as it would be to think a miracle is recorded when we read in Deborah's song that "the stars in their courses fought against Sisera."

An article in the same edition of the *Encyclopædia Britannica* on the "Gospels" signed "E. A. A.," gives much information about the origin of these books, the authorship of which many consider as well made out as that of a book published this year with the author's name on the title-page.

**Clericus.**

## REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

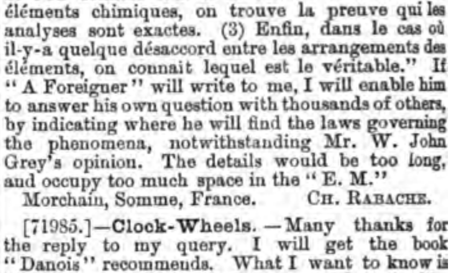
[71874.]—**Cupric Sulphate.**—I read, with great pleasure, in your issue No. 1327 the very interesting questions put to Mr. W. John Grey by "A Foreigner," and I was anxiously waiting for this learned gentleman's reply—the more so as I was under the impression that no satisfactory answer would be given by him, although there is no difficulty in so doing. But proper answers are possible only to persons knowing: (1) Physical stœchiometry; (2) the composition of light, its two physical constituent elements, their nature and their number (84); (3) the physical constituent elements of spectrum colours, their nature, their respective numbers 72, 69, 64, 60, 56, 54, 51, their special arrangements, the difference between them and light, and their mode of production; (4) the chromatogenic law in accordance with which all colours are produced or modified in material bodies —knowledge which Mr. W. John Grey not only owns not to possess, but believes unknown, a belief which is absolutely erroneous. He himself might have possessed them long ago if he had wished. Seven years since he received a letter which contained the following lines: "Je n'ai par l'avantage de vous connaitre, mais votre écriture, votre style, l'état de vos connaissances chimiques, l'ardeur que vous mettez à vous occuper de toutes sortes de questions scientifiques, même de plusieurs dont vous n'avez peut-être pas fait une étude complète, tout me fait croire que vous êtes jeune, fraichement sorti des grandes écoles Anglaises, où vous avez reçu l'enseignement des plus illustres professeurs Britanniques, lesquels ont trouvé en vous un élève digne d'eux, qui, sans examen, sans contrôle et de confiance s'empressa de dire: 'Magister dixit—Credo.' D'où il suit qu'à coté de la *Science* réelle qui vous possédez il y a chez-vous beaucoup de *foi, confiance, de croyance*, qu'il serait peut-être utile de remplacer par le *savoir* . . . . . . . Quante á moi, je suis vieux . . . . . . . . Je ne crains pas d'avancer, que si vous étiez mon voisin, et consentiez à lire avec soin sans parti pris, devant moi, l'œuvre de cet homme, immense, incomparable, impermettant quelques observations utiles, avant un on vous seriez, non pas seulement le plus capable des chémistes d'Angleterre, mais l'homme le plus universellement instruit de l'Europe, pouvant répondre à toutes les questions de science par des equations, selon la loi cosmique ou physique universelle absolue des phénomenes. A mon âge . . . . . mais pour vous se serait un jeu . . . . . ." After having received this letter, Mr. W. John Grey behaved most ubecomingly towards its author. The learned chemist says that it is obvious that the five (not fine) molecules of water are the cause of the colour. This is not doubtful; but "A Foreigner" asked how colourless water caused colour, and according to what chromatogenic law, and if the number of molecules had any effect? This received no answer. Yes, the number 5 is the sine quâ non cause of the green, by its arrangement 3 : 2, and another arrangement 4 : 3 causes the blue; hence the bluish-green, &c. In admitting that the querist has committed an error respecting the cupric sulphate, which can be produced by several processes, this does not alter in any way the nature of his queries respecting colours, &c. Our present knowledge is, in that respect, not quite so limited as Mr. John Grey supposes. The following lines are extracted from the 3rd volume of a work published 23 years ago, page 760, sec. 419. "Partie Chromatique.—Combinés colorés des atomes, et Rapports harmoniques.—Les couleurs sont une proprieté constante des corps terrestres. Elles sont en rapport direct avec leurs éléments chimiques. Les corps colorés se distinguent des corps incolorés par les rapports harmoniques dans lesquels entrent les quantités des atomes chimiques pour former les combinés dont ces corps sont composés. (1) Production des couleurs des combinés dûe aux atomes incolorés. (2) Corps composés de deux ou plusieurs combinés chimiques. (3) Teintes produites par le mélange des couleurs. Connaissant les sept rapports harmoniques 2 : 1, 15 : 8, 5 : 3, 3 : 2, 4 : 3, 5 : 4, 9 : 8, et leur concordance avec les longueurs $h^{vii}$, $h^{vi}$, $h^{v}$, $h^{iv}$, $h^{iii}$, $h^{ii}$, $h^{i}$, des atomes $r, v, j, v, b, i, v$, des sept couleurs, si l'on connait le nombre des atomes ou des éléments chimiques de chaque espèce qui entrent dans un combiné, on en determine la couleurs. (2) Si l'on connait la couleur d'un combiné, on en determine le rapport, dans lequel les éléments chimiques entrent dans la combinaison. Si l'on connait tout à la fois la couleur et les éléments chimiques, on trouve la preuve qui les analyses sont exactes. (3) Enfin, dans le cas où il-y-a quelque désaccord entre les arrangements des éléments, on connait lequel est le véritable." If "A Foreigner" will write to me, I will enable him to answer his own question with thousands of others, by indicating where he will find the laws governing the phenomena, notwithstanding Mr. W. John Grey's opinion. The details would be too long, and occupy too much space in the "E. M."

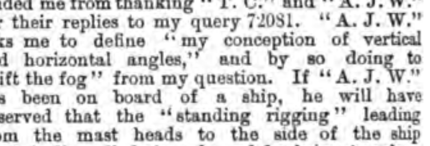
Morchain, Somme, France. Ch. Rabache.

[71985.]—**Clock-Wheels.**—Many thanks for the reply to my query. I will get the book "Danois" recommends. What I want to know is how many teeth to the inch I can safely put without getting them too fine, and to get the diam. of the different wheels. It is an eight-day chime clock, seconds pendulum, gravity escapement. Is the four-legged best for this? I prefer lantern pinions to cut ones, as they run much easier with fewer teeth. Would it be asking too much for you to describe or give a rough sketch of the dividing machine? Could it not be fitted to my lathe? I can make tools, and should very much like to make up the pinions. How are they fixed; tightly driven on or soldered? See my address.

Amateur Clocky.

[72081.]—**Statics.**—Absence from home precluded me from thanking "T. C." and "A. J. W." for their replies to my query 72081. "A. J. W." asks me to define "my conception of vertical and horizontal angles," and by so doing to "lift the fog" from my question. If "A. J. W." has been on board of a ship, he will have observed that the "standing rigging" leading from the mast heads to the side of the ship (technically called shrouds and backstays) make a vertical angle as shown in Fig. 1. There are four, five, and sometimes six on each side of the lower-mast, the foremost one being abreast of the mast; the next one raking aft about four degrees, and so on until the last one may make twenty degrees, what sailors call horizontal angle—see Fig. 2. I trust this will be quite clear. The point of my query was: That in addition to the downward pressure on the spar (mast), what would be the (so-called) horizontal pull of the single shroud aft in the direction of the arrow, Fig. 2. My next question, perhaps, might not be quite clear. Fig. 3 shows the post with the rope round it and a pull of three tons on





end of the rope. The effect of that is to le the rope at what I call the neutral point, :h appears to me to be the weakest part of the . If it is of the same strength as the rest of rope kindly say how this is, seeing that the ion is in opposite directions. SAILOR.

2106.] — **Galvanometer.—To Mr. F. C.** sop.—You can wind the quantity coil outside intensity, but should put one or two more rs than if inside. The nearer to the needle the s of wire are, the greater effect upon the needle, as there are only a few turns of the quantity, best to wind the quantity first, as by this means galvanometer becomes more sensitive for testing condition of your batteries. When outside the isity, the quantity coils are a good way off the le.

5, Queen Victoria-street. F. C. ALLSOP.

2114.]—**Electrical Executions** (U.Q.)—I quite of the same opinion as Mr. Edison, that current should have been applied from hand to l. It is singular that the Americans, who kill n average about four linesmen a month, did not it by their experience. Probably there is a great rence between accidentally receiving a power-hock and receiving one while fully prepared expecting it. In experimenting with induction , I have found that when happening acci-ally to touch the handles, I receive what ars to be a very strong shock; while, if I berately take hold of the handles, the shock not appear anything like so strong. However may be, the first electrical execution having red a failure, let us sincerely hope it will be the F. C. ALLSOP.

2140.] — **American Organ and Concert** ch.—It is most unlikely that any American n is below "concert pitch," as it is called, ss the reeds have all flattened; but what does querist understand by "concert pitch"? How-, he can sharpen in the usual way by scraping free end of the vibrators. He won't do very h harm to the 8ft. C, but he will have to be careful with the reeds in the upper part of the register. Why does he not write to the agents he makers and ask if they will exchange or send ner to bring the instrument up to concert pitch? ORGANON.

2141.] — **Magic Squares.**—The following ing from the *Echo*, September 24, appears to wer this question:—A *nasik* square is a magic are, all the diagonals of which (not the central s only) give the peculiar summation. That is ay, the square may be altered by transposing first column or row to last place (or *vice versâ*) number of times without altering the sum-ion of the central diagonals.

| | | | | |
|---|---|---|---|---|
| 1 | 7 | 13 | 19 | 25 |
| 14 | 20 | 21 | 2 | 8 |
| 22 | 3 | 9 | 15 | 16 |
| 10 | 11 | 17 | 23 | 4 |
| 18 | 24 | 5 | 6 | 12 |

above is a magic square, every row, column, diagonal adding up to 65. It is also *nasik*. example, the first column may be lifted bodily, were, and carried over the other columns, and down in the last place of all, and the new gonals 7, 21, 15, 4, 18 and 24, 17, 15, 8, 1 will sum 65. And so on, any number of times. T.

2142.]—**Tallow Bleaching.**—There is not a ple process of bleaching tallow; but see Watt's k on "Soap-making." Of course the querist ns bleaching fat for making it into tallow. The stion has been answered in back volumes, but ssarily is of little interest to readers. NUN. DOR.

2153.] — **Wire Springs.** — What does this rist mean? What sort of wire springs does he it? He will find them all described in back mes. It is scarcely likely there is a book on a subject. BLACKY.

2162.] — **Documentary Agreement.** — greements," of course, require stamps accord-to their nature and value. The stamping is e at Somerset House; but in such matters, if don't know, you are very much ex-wisehead ou don't employ a solicitor. NUN. DOR.

2179.] — **Sand-blast Paint.** — If querists ld only make it clear what it is they want to w, they would probably get answers more kly. Wondering what "sand-blast paint" ld be, I came to the conclusion that it is the nish used to protect parts from the action of the d whilst others are being eroded. Well, any ap elastic varnish will do—even well boiled eed oil with a little "thickening" of whiting or ber. NUN. DOR.

72181.]—**"Ghost" in American Organ.**—is query is incorrectly headed. An organ which s a ciphering note is not necessarily afflicted with "ghost"; for a "cipher" is a thing that can be opped on at once. What is meant by a "ghost" some sound the cause of which cannot be readily detected. The pallet spring in this case may have slipped; the plunger may stick; or a particle of dust may have got on the leather of the pallet. Try blowing hard and pressing down adjoining keys at same time as the digital which governs the refractory note. ORGANON.

[72185.]—**American Organ Bellows.**—The best arrangement is, perhaps, to reverse the motion of the feeders at the back and make them pull the feeders at the front by means of gut bands running over pulleys; but it is a troublesome arrangement, and personally I have no sympathy with the idea, for the "expression" is obtained as much by the skilled use of the feet of the player as by the manipulation of the keys. As to size of bellows—that depends on size of case; make as long as possible, not more than 9in. opening, and with at least two 24lb. springs. But seriously, is the man who asks such questions going to make the organ? ORGANON.

[72268.]—**Spiral Turning** is done in a pole lathe. The two heads have a spiral saw cut that work on flat steel discs—one at each head—that makes the work slide to the right when the cord is pulled, and the gouge, held firm, cuts the spiral. The open work is only deeper cut. The best way to space a cylinder is to cut a strip of paper and paste it round. Drawing if wanted. JAS. ELLIS.

[72278.] — **Division of Land.** — Perhaps the following would do:—Difference of the two upper and lower bases divided by the number of the plots required, adding the quotient to the upper base, gives the next one, and so on until all the bases of the plots be found. Then divide the superficial area of the land by the number of plots; the quotient is the area of each plot. Divide this by the mean of the bases of each plot, which will give the height of the plot.

Cairo. MOHAMED SHAFIK, Daïra Sanieh.

[72286.]—**Electro-Coppering.**—May I suggest as a supplementary reply to this query, that it will perhaps be advisable to first coat the iron in an alkaline copper bath, with a thin deposit of copper, then transfer it to an acid bath of copper sulphate to finish the deposit to the required thickness of $\frac{1}{16}$in. Copper can be deposited more cheaply from a copper sulphate solution than from an alkaline copper solution. G. E. BONNEY.

[72312.] — **Dissolving Nickel off Copper Plates.**—You should have no difficulty in doing this with strong sulphuric acid, to which has been added a small quantity of nitrate of potash in pinches as required. Perhaps you had the acid too hot, or put in too much nitrate of potash at once. In either case the acid would pit the copper as well as dissolve the nickel. The process must be watched closely and conducted carefully to ensure success. G. E. BONNEY.

[72339.]—**Gas from Paraffin Oil.**—The volume of gas which may be obtained from, say, one gallon of petroleum oil, will depend upon the quality and specific gravity of the oil, as well as upon the temperature at which it is decomposed, and the candle-power of the resulting gas. Dropping the oil slowly into a retort heated to dull redness, from 90 to 100c.ft. of gas may be obtained per gallon of oil with a lighting power of from 55 to 65 candles. "T. J." (72479) can best neutralise an alkaline soap by melting it and stirring in very dilute sulphuric acid till it becomes neutral. If required for any detergent purpose, boracic acid may be advantageously employed instead of sulphuric acid. H. B. F.

[72348.]—**Chemical Analysis.**—The point the querist wished to obtain comment on in the qualitative analysis of a mixture of ammonium oxalate and potass. chromate was the modification he should adopt in the scheme of analysis as set out in Thorpe and Muir's book. According to the scheme, Cr comes along with Fe and Al in the third group, as thrown down by ammonia only in presence of am. chloride. In reference to the said mixture, Cr cannot thus be dealt with by ammonia only, and if the correspondents would suggest how the scheme of analysis should be modified they would oblige. As to the quantitative analysis of a bromide, would "Sm." oblige by saying how he applies the indicator ammonium thiocyanate and iron alumn.—i.e., is it by testing a drop taken from the mixture applied to a drop of the alumn. on a white slab? "F. T. S." says bromine can be estimated by distillation of the Br into KI, and ascertaining the free I. Distillation with manganese dioxide and sulphuric acid would set free half the Br I take it. Is not this so? Thus:

(1) $2KBr + H_2SO_4 = K_2SO_4 + 2HBr$.

(2) $MnO_2 + 4HBr = MnBr_2 + H_2O + Br_2$.

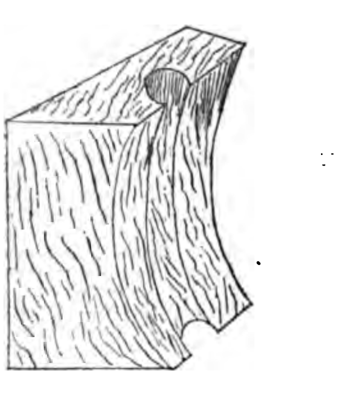
A.

[72358.]—**L. and S.W. Tank Locos.**—Mr. C. F. D. Marshall makes a slight inaccuracy in his sketch of No. 517 which, with his permission, I will rectify. Nos. 415 to 432 are like the sketch; but Nos. 77, 78, 82, 104, 123 to 126, 129, 169 to 173, 479 to 495, and 517 to 525 have side tanks coming to within an inch of the driving-wheel splashers, therefore carry more water than the 415 class and also have larger domes. NORTH-WESTERN.

[72374.]—**Silver-Plating.**—Soft-soldered joints in brass articles should be first coated with copper, either in an alkaline coppering solution or by means of the following simple process. Make up a saturated solution of copper sulphate and paint the joint with this. Then stroke the wet joint with a small brush of iron wire. Copper will be deposited on the solder of the joint. Repeat the process until the joint is coated uniformly with copper, then rinse in clean water, quick with mercury as usual, and immerse in the plating solution. If you have an alkaline coppering solution or a brassing solution in working order, it will take less time to coat the whole article with copper or with brass in one or the other of these, than to doctor up the joint by the above process. G. E. BONNEY.

[72389.]—**L. C. and D. Railway.**—All or nearly all the engines now rebuilt had names originally. I give some first express engines: 1 Brigand, 2 Corsair, 5 Heron, 6 Stalk, 7 Swift, 8 Dartnall, 9 Swallow, 17 Gorgon, 21 Panther, 26 Xanthus, 37 Vigilant, 44 Reindeer, 45 Elk, 46 Champion, 47 Templar, 50 Enigma, 51 Mermaid, 52 Lothair; all these have been rebuilt without names. There was also 143 Hercules, which has been broken up. Then there are still in their original form 53 Europa, 54 Asia, 55 Africa, 56 America. In the matter of tanks, I believe most of the following have been rebuilt: 60 Sittingbourne, 61 Chatham, 62 Faversham, 71 Æolus, 72 Bacchus, 73 Vulcan, 74 Comus, 81 Iona, 82 Bute, 83 Jura, 84 Arran, 85 Islay, 86 Staffa, 87 Ulva, 88 Clyde, 89 Kelvin, 90 Spey, 91 Annan, 92 Tay, 93 Nith, 94 Esk, 95 Albion, 96 Thanet, 97 Erin, 98 Cambria, 99 Mona, 100 Scotia. Of goods there were the following: 113 Acis, 114 Calypso, 115 Diomede, 116 Fortuna, 117 Gordius, 118 Pyramus, 119 Amphitrite, 127 Adrian, 128 Trajan, 129 Vespasian, 130 Tarquin, 131 Pertinax, 132 Constantine. C. F. DENDY MARSHALL.

[72391.]—**Rounding Edges on Glass Plate.**—Mount emery-wheel between your lathe centres, drive at good speed, and "chamfer" (as it were) the square edges of your plate. Remove stone and turn two discs of wood, ¼in. diam. less than glass; centre one on face-plate and fix. Give it a coating of turner's cement (ordinary pitch will do); warm your glass, and centre same on it (edge will project ¼in.) Prepare the other wooden disc with cement, and treat similarly; prepare a block of wood, as sketch; smear recess with emery and turps, apply to projecting edge of plate, using finer emery as you proceed, and finally finish with rouge or putty powder. TRABASNA.



[72395.]—**Heat from Electricity.**—It will be sufficient to give the cost of one electric horse-power, as applied in furnace work, knowing which, the querist may, as he says, "infer about what other results can be got." In an electric furnace installation costing £8,000, equipped with 400H.P., the cost of one electric horse-power is as follows:

With coal at 7s. 6d. per ton = ·0402 pence per lb. A good compound engine, under a somewhat variable load, will consume 3lb. of coal per H.P. Allow ¾lb. for losses in dynamo, waste, &c.:

| | | |
|---|---|---|
| 3¾lb. of coal at ·0402 pence.. | = | 0·1507 pence. |
| Wages at 21s. 4d. per hour ÷ 400 .. .. .. .. .. .. | = | 0·0535 ,, |
| Oil and Stores at £3 per week | = | 0·0320 ,, |
| Carbons .. .. .. .. .. .. | = | 0·0500 ,, |
| Depreciation and interest per H.P. per hour .. .. .. | = | 0·0160 ,, |
| Total cost of one electric horse power per hour .. | = | 0·3022 ,, |

Or about ⅓ of a penny per hour. H. B. F.

[72397.]—**Tooth-Stopping.**—If you are a molar, ask your owner to have you filled with "Sullivan's." I have seen lots that have stood twenty years. The charge should not exceed 5s. or 7s. 6d.

If a central or front tooth, any metallic filling will turn dark, if not black. Gold is the best, but costly. White cement fillings seldom last more than two or three years. By the bye, there is a grand field for experiment for the readers of "Ours" to invent a white plastic filling, which shall be permanent in the mouth. A sure fortune for the lucky discoverer. H. C. Braun.

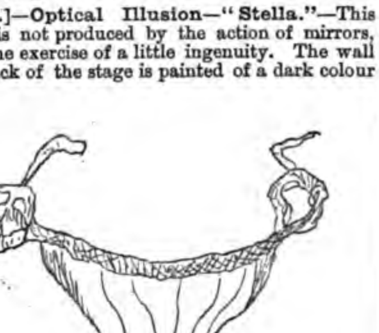
[72397.]—**Teeth-Stopping.**—The best material for filling teeth is undoubtedly gold. This metal is used in two forms, cohesive and non-cohesive. In cohesive gold filling the gold is introduced into the prepared cavity in small pieces, and each layer, or piece, is welded to the preceding portion by being smartly struck with a mallet. The result of this mode of operating is to produce a solid plug of gold, and a skilful dentist can by this means restore a considerable portion of the missing contour of a tooth. Non-cohesive gold will not unite as above, and is used only where the sides of a cavity are well defined. The merits and demerits of these two forms of filling have received animated discussion for many years—each method has its advantages in certain cases. I may here say that gold-filling, well done, is of necessity expensive. A dentist may spend as long as four and five hours over a single tooth, engaged in this most difficult of all dental work, and often standing with back bent in a very trying position. The other forms of tooth-filling may be divided into amalgams, osteo-plastics, and guttapercha. Pure tin is sometimes used, either alone or in combination with gold. The amalgams form very excellent fillings in all cavities where gold is inadmissible, and where the tooth is not too sensitive. They should, however, never be used in front teeth, as they almost invariably blacken the tooth after the lapse of a short time. In cases where a tooth is inclined to give pain, owing to the near approach of the decay to the nerve pulp of the tooth, a metal filling of any sort is a mistake, owing to the property of metals to conduct changes of temperature. A nearly-exposed pulp is kept in a state of chronic irritation when covered by a metal plug, and hot tea or cold water becomes painfully apparent. It is in these cases that guttapercha and the osteo-plastic fillings are so valuable, and many a troublesome and "doubtful" tooth is restored to the desired standard of comfort and utility by the judicious use of these materials. In conclusion, I would add that the increased knowledge of micro-organisms, together with the more careful study of histology relative to tooth-structure, has rendered the choice of filling-materials for any special case one which should only be undertaken by a professional man. Otherwise, one fears that a series of disasters will attend the unhappy patient, and cause him to almost welcome the inevitable grasp of "cold steel," so sure, yet not always so expedient.

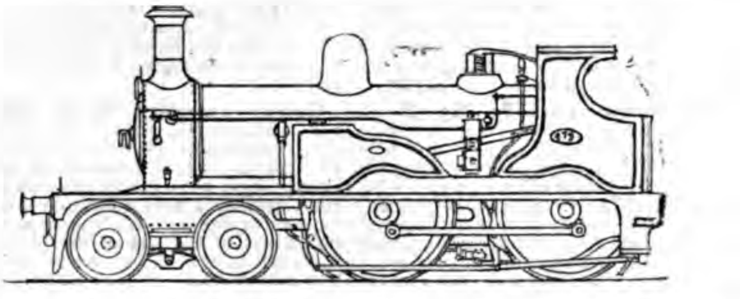
J. West.

[72401.]—**Electric Bell and Battery.**—Take one wire from carbon pole battery to bell; now take the other wire from zinc-pole to the farthest room press-button. Now scrape two suitable places in covering, and solder two branch wires and lead them to the other two rooms. Now run one return-wire from farthest room press-button to bell, scrape two suitable places in this wire, and solder two return-wires from other two rooms. Get a penny stick of marine glue, make warm and cover joints with. On pressing either of the buttons the bell will ring. A. W., Engineer.

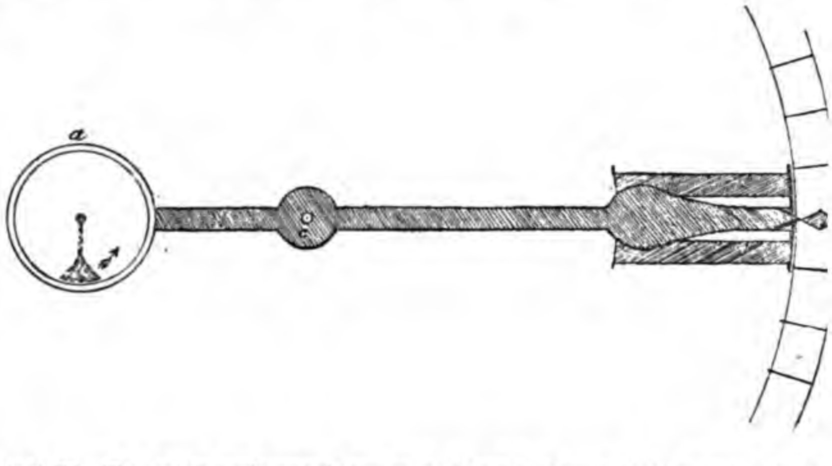
[72408.] — **Varnishing Drawings.** — If "Draughtsman" will add a small quantity of alum with his colours before using, he will find the colours stay much better. I have tried this method myself, which answers very well. Be careful to not add too much alum, or you will spoil your drawing. A. B. T.

[72413.]—**Optical Illusion—"Stella."**—This illusion is not produced by the action of mirrors, but by the exercise of a little ingenuity. The wall at the back of the stage is painted of a dark colour (black), and there are two sets of side-curtains, so as to cast a large shadow within. The gas is for the same purpose placed outside the stage, and in front of the side-curtains. The interior thus is very dark; in it, and about in the middle, is hung, by means of two thin chains, a board, and it is on this board that the bust of "Stella" makes its appearance. It is produced by a lady, who stands in a bag which is painted black and placed against the back of the stage; this bag reaches to the board, and is so arranged that only the head and down to the waist of the lady is visible. She presses against the board, and an assistant places a cardboard bust in front of her and fastens it to the suspended board. This gives the impression that the lady is fixed on this board, because you see what you take to be the real bust of the lady fastened to the board; her head appears above, and the bust is so made that it fits close to her neck. R. B. T. W. Z.

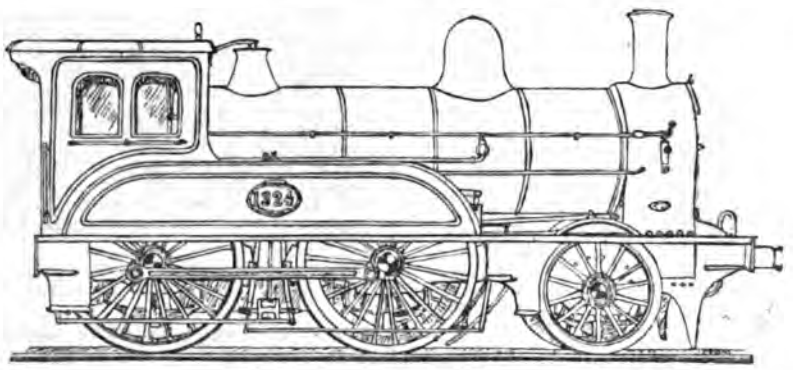




[72414.]—**Transparent Clock.**—This is what generally is termed a mysterious clock, and has in this case the movement concealed in the hands. I have seen such a clock with two movements, one in the hour-hand and the other in the minute-hand; but I believe they are also made with one movement only, which has to drive the two. The minute-hand turns freely on a smooth arbor at *c*; in the counterpoise *a* a watch movement is fixed, face towards dial. Instead of the minute-hand a small weight is attached to the set-square and the whole is in equilibrium, so that when the weight is in the position indicated in sketch, the hand points at III. The motion needs scarcely any explanation. When the watch goes and causes the weight to take another position, the centre of gravity changes and causes the hand to revolve on its axis. The hour-hand must have the weight attached to the hour-wheel, unless it is preferred to drive it from the minute-hand. In this case a cannon-pinion should be fixed on the tube of the minute-hand and gearing with the concealed motion work in the hour-hand, the hour-wheel being firmly fixed to the hand. Danois.



[72421.]—**North-Eastern Railway.**—I send a drawing of the compound engine at the Newcastle Exhibition, 1887. C. F. Dendy Marshall.



[72422.]—**L. C. and D. R. and N. S.** inclose sketch of one of Mr. Kirtley's fine motives, which I hope will be of use to " No. 2." Douglas Le

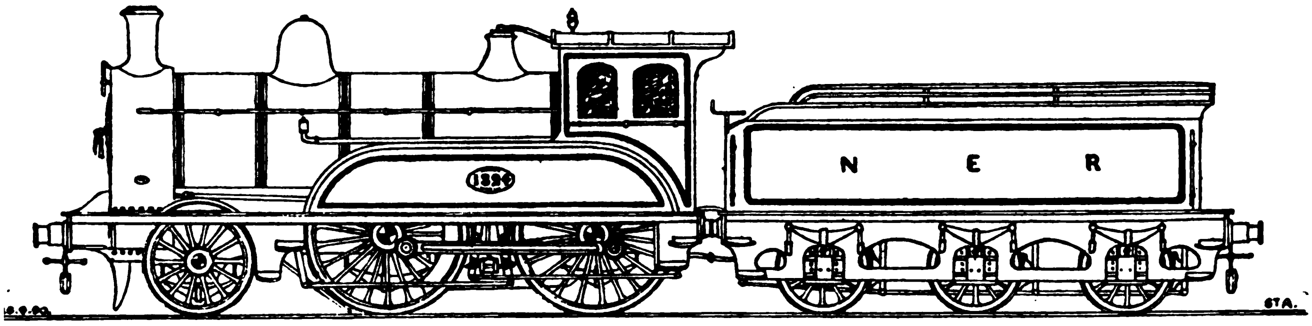
[72418.] — **Compound Oscillating P Engines.**—To "Jack of All Trades."- that is the class of engine I mean; but it detail of the trunnion and pedestal that I w get at. There mnst be, I suppose, some k gland, together with some arrangement for up wear. I understand that the ports in pe are straight, while in the trunnion they are c How are they made to correspond? The tru I suppose, is of very large diameter.

A. F. Shakesp

[72437.]—**Small Boxes.**—Yes; shellac v is used, or knotting. If open-grained mah fine plaster of Paris and red ochre, wet up raw linseed oil, paper off with fine glass-paper proceed to polish. To ebonise, see that your is free from grease, and give it a coat of lo stain, and then a coat of nitrate of iron. T be made by putting a few drops of aquafort china or glass vessel, with a tablespoon water. You can put the nitrate on first, and the other after. Jack of All Tra

[72438.]—**Power of Dynamo.**—To Mr tone.—A dynamo giving 2 ampères at 3 pressure should be capable of lighting two la about 10 c.p. each, and taking 28 to 30 volts in parallel. It will take about $\frac{1}{8}$H.P. to The leads, if the distance does not exceed may be of No. 16 wire. S. Bott

[72439.]—**Automatic Fountains** are by compressed air. They may often be seen windows and in exhibitions dispensing pe water. You pump the air by means of a into a metal vessel containing water; the d tube rises from the bottom of the vessel dicularly, and the exit is governed by a tap.



121.]—**North Eastern Railway.**—Herewith rard a rough sketch of Mr. T. W. Worsdell's ɔund engine, No. 1324, as requested by your pondent "Loco. No. 2." ST. AUBYN.

433.]—**Stringed Instruments.** — Strings ı owing to the gradual disintegration effected nstant tension. I imagine that the drying of slatine, which is an important constituent of ut, materially assists this disintegration. At ents, I have found that, where the strings are excessively dry, not only do the main strands ne readily separable, but their own constituent become so also. On examining the disrupted of my strings, I have often found them broken to mere threads, which can be easily unwound nsiderable lengths. (I am speaking of cello s.) I have never known a string to wear so as to utterly lose its power of resisting tion; mine have always succumbed to tension e that. Strings would last longer if the ne could be preserved in its normal condition. an advocate for oiling the strings, and believe it does lengthen their life, and repays the le of wiping for use. With regard to wired s, the wire covering loosens from the con- on, through dryness, of the gut. I do not there is any cure for this, though I believe , *ab initio*, to be a preventive: it is the one I know of. Mr. Doery might try leaving pace between the end of the finger plate and e unoiled, or oiled only on the underside. ever, I find that good wired strings from a good will stand till you wear the wire off without ning. My C C string has lasted since March, and is still sound. With regard to notes on ed instruments, I fear I cannot claim to be a ient authority on the subject, and I think I better confine myself to answering queries n my humble capacities.

CHARLES J. TAHOURDIN.

443.]—**Coil.**—If you wish your coil to give effects with vacuum tubes, &c., you had not use a brass tube regulator, as that res the primary so far from the core, and fore wastes much power. It will be better to water-regulator. The following proportions nake a good little coil to work any tubes from o 8in. in length, with a single pint bichromate Core, a bundle of No. 18 wire, 5in. long, ¾in. eter; heads, 3in. square, ½in. thick, 3¾in. ; primary, two layers No. 22 double silk- ed copper wire, separated from core by a layer of paraffined brown paper (stout). primary two layers of same paraffined brown r. Secondary, ¼lb. No. 36 or 38 single silk- ed copper wire, each layer carefully separated the one below by a layer of thin demy paper d in melted paraffin wax, and each layer of tested for continuity electrically after being on, and then basted with hot paraffin wax. enser, 50 sheets of tinfoil, interleaved with fined paper. See also, for fuller directions, my , "Electrical Instrument Making."

S. BOTTONE.

444.]—**Cleaning and Filling Holes in wing Board.**—If you will get your boards d you will find they are cleaned, and free holes also. It will take time to do them rly. I should peg the holes afterwards left planing. A. B. T.

444.]—**Cleaning and Filling Holes in wing Board.**—Make some pegs of pine-wood, lip them in japanners' gold size, and drive them Cut them off flush, clean your board well with glass paper, and give it a dressing with one japanners' gold size and two of turpentine. thoroughly dry, paper down with fine glass- . I have some that have been in use for years were served this way, and they are better than

JACK OF ALL TRADES.

445.]—**Electrical.**—Try adding another cell o, as you must remember that when the bell use there is the extra resistance of the bell in circuit. The make-and-break of the circuit e bell however prevents the pendulum of the ator getting a good swing, so I always prefer e a relay with a pendulum indicator. If there is only one drop of the indicator it is, of course, hardly worth while having a relay for this alone, so I should increase the battery power as advised above. Whether two cores are necessary depends upon the construction of the movement pendulum; there are one or two forms having one core that work exceedingly well. See my book "Practical Electric Bell Fitting" for more information.

F. C. ALLSOP.

[72446.]—**Iron, Electro-Deposition of.**—It is perfectly possible to deposit iron electrolytically to any desired thickness. The process has been described in "Ours" quite recently, see ENG. MECH., pages 221 and 429 of Vol. LI. You will find full details in Watt's "Electro-Deposition."

S. BOTTONE.

[72447.]—**Aluminium Plating.**— There is not as yet any trustworthy process known by which aluminium can be deposited electrolytically on another metal. S. BOTTONE.

[72448.]—**Cement for Wood.**—You should have run a split rush and tallow along your joints. The next best is some narrow stay-tape, dressed with one part of yellow soap and two parts of white lead. Cramp up tight, and bolt together. As you have got it together, the best thing you can do is to caulk it with oakum and a stick of tallow.

JACK OF ALL TRADES.

[72450.]—**Scale.**—TO MR. BOTTONE OR MR. ALLSOP.—A friend of mine, in the Navy, has been experimenting in this direction for the last two years, and has recently, I believe, succeeded. I understand that he has patented this method of removing scale. This process consists essentially in connecting the boiler to one terminal of the dynamo, and an insulated metallic conductor which dips into the water to the other terminal. How far this process is a commercial success, I am unable to say. S. BOTTONE.

[72451.]—**Safe Current.**—It is usual to calculate that every square inch of section will carry safely (without injurious heating), 1,000 ampères of current. For applying this rule to the winding of armatures it must be borne in mind that if the armature is of the drum, ring, or disc form, in which the commutator is of several sections, the resistance falls to ¼, and the carrying power increases to double the above value, since the current has always two paths open to it. S. BOTTONE.

[72452.]—**Brass Mottling.**—This can be done with a stick of ordinary slate-pencil, snake stone, a stick of boxwood and powdered pumice, Arkansas slip or Turkish stone, or a scraper of steel, according to what you want and what it is.

JACK OF ALL TRADES.

[72453.]—**Clay.**—I should advise you to purchase Thorpe's "Quantitative Analysis" (Textbook of Science). SM.

[72453.]—**Clay.**—Mix one or two grains of finely powdered clay, previously dried at 100° C., with four to six times its weight of fusion mixture (equal parts soda and potassa carbonates). Heat over Bunsen burner in a good-sized platinum crucible, gradually increasing heat till fusion is complete. Care must be taken to avoid lous by spurting. When cooled, extract with hot water and hydrochloric acid, transfer to platinum dish, evaporate to dryness over water-bath, and gently ignite. Extract again with hot water and hydrochloric acid. Filter, wash, dry, ignite, and weigh precipitate which consists of silica and trace of titanic acid. Evaporate filtrate with a little nitric acid till most of acid has disappeared; precipitate alumina as hydrate by means of ammonia in the usual way. Collect, dry, ignite, and weigh precipitate, which will also contain a little sesquioxide of iron. ASSOC.N.S.S.

[72453.]—**Clay.**—In determining the amount of silica and alumina in clay you will have to estimate the silicate in two forms: (1) that which is present as sand, and (2) that which is present as aluminium silicate. There are also present in most clays, iron, lime, magnesia, water, alkalies, and also a small quantity of organic matter. The following is a brief synopsis of the procedure:—Dry about 5grm. of the clay at 100° C., for one or two hours, so as to completely get rid of all the moisture present. Weigh about 2grm. of this dried clay, put in a platinum vessel, moisten with water, and add about 25c.c. of sulphuric acid. Warm on some bath until all free acid has escaped, moisten the residue again with water, and add sulphuric acid, then evaporate once more; boil residue with hydrochloric acid, filter, ignite, and weigh the residue. The residue contains the silica and the sand; the filtrate contains the aluminium, iron, magnesia, &c. To obtain the weight of silica and sand from the residue proceed as follows:—Boil with strong solution of sodium carbonate and filter hot; add more sodium carbonate and boil, pour through the filter, wash the residue thoroughly, dry, ignite, and then weigh. The weight of this represents the weight of the sand present, and if this weight be subtracted from that obtained before the treatment with sodium carbonate, you will get the weight of the silica present. To obtain the aluminium from the filtrate (obtained before the treatment with sodium carbonate): Add ammonium chloride, ammonia in slight excess, and ammonium carbonate, boil, and filter (you may discard the filtrate, as it contains the magnesia). The ppt. contains the aluminium and iron. Dissolve it in hydrochloric acid, boil until all carbon dioxide is expelled, add ammonium acetate, and then ammonium succinate, warm, and filter. Dissolve the ppt. in hydrochloric acid, and reppt. the iron with caustic soda, filter; the filtrate contains the aluminium. Add to it hydrochloric acid in excess, and then ammonia in excess, boil, filter, and dry. Then weigh for alumina. R. B. T. W. Z.

[72454.]—**Dynamo not Working.**—The proportions of wire are about right for a small shunt-wound machine. As you mention neither type nor mode of winding, I am at a loss to advise. Still, the following are among the probable causes of failure:—1st, F.M. coils wrongly connected to each other; 2nd, F.M. coils wrongly connected to brushes; 3rd, F.M. coils leak through to iron; 4th, F.M. not sufficiently magnetised; 5th, armature coils leak to iron; 6th, brushes not set properly with regard to pole pieces; 7th, direction of rotation wrong with regard to polarity of F.M. If you can't get it to work after having remedied any or all of the above defects, send it to me, carriage paid, to Wallington Station, and I will tell you what is amiss gratis. S. BOTTONE.

[72456.]—**Magnetic Sheet-Brass.**—This depends on the presence of *iron* in the brass.

S. BOTTONE.

[72456.] —**Magnetic Sheet-Brass.** — In the *Electrician* for the 12th ult. mention is made of magnetic sheet-brass compass-cases. In one sample the polarity was well defined and strong, whereas in the others ill defined, irregular, and weak. The cases were made by a good maker. It is pointed out that the magnetic property is doubtless due to the presence of particles of iron in the brass. In the next issue of the same journal, we find a letter from Mr. Sidney Evershed, saying he has found both cast and rolled brass magnetic. Another correspondent, who has had experience in instrument-making, says he has found cast brass magnetic, but never rolled. I am anxious to know the exact cause of this phenomena. Perhaps someone can get at it and tell us.

Brymbo. T. G. L.

[72459.]—**Outside Plaster-Work.**—Three parts of sand to one of good fat lime; that which is burnt in a kiln with wood is best. Screen sand, make a bank or pool, put lime in centre, slake, and work up hot, and put in a close heap for use.

JACK OF ALL TRADES.

[72461.]—**Piano Played by Electricity.**—I have never seen such an arrangement, but should think it was perfectly feasible.

F. C. ALLSOP.

[72462.]—**Neutralising-rods to the Wimshurst Machine.**—The function of these rods is precisely the same as the touching the cover of the electrophorus with the finger—viz., to remove the electric strain or stress set up by the inductive action of the inducing portion of the opposite plate. I should strongly advise you to read Gray's "Influence Machines." S. BOTTONE.

[72463.]—**Water in Boilers.**—Place the vanishing line of water gauge 2in. above the crown of firebox or tubes. Jack of All Trades.

[72465.]—**Connections for a Watch.**—These can be obtained with connections for attaching electric bell. The rim holding the glass is insulated from the body of the watch, and carries a small platinum contact, which makes contact with the hour-hand of the watch. The different times at which the circuit is completed is adjusted by turning the rim round. The watch hangs on a special watchstand at night, to which the battery connections are made, and can be worn in the ordinary way in the daytime. F. C. Allsop.

[72466.]—**Case-Hardening Iron.**—Place the articles in a box with a mixture of bone or leather carbonised, and bone burnt to whiteness, granulate these coarsely and sift. Put a layer in the box of the dust, then some of the coarse mixed and pat down solid; then pack your articles in, and some more coarse upon top, then finish with the fine; place box in fire, and get it up to a dull red heat, take out and slack in clean water. Another way is to pack in animal charcoal and subject to a red heat for an hour, and then take out, and, before slacking, dredge them with some prussiate of potash powdered very fine, and the dredger must be very fine to make a good job of it. Dredge quick, and slake in clean water quick.

Jack of All Trades.

[72467.]—**Removing Thick Varnish from Engraving.**—I think you are what they term "licked." Jack of All Trades.

[72468.]—**Printing Press.**—You will not succeed well with wood on account of liability to warp. I used to use an iron press by Francis, of Rochford, and found it answer admirably. The presses are very cheap. Sm.

[72469.]—**Gold Paint.**—It has been said in "Ours" that take one part good copal varnish and two parts of turps, well shaken up with some powdered caustic lime; when settled it is fit for use. Will remedy this evil.

Jack of All Trades.

[72469.]—**Gold Paint.**—Bronze powder being made from brass and the varnish being acid necessarily results in the solution of the "gold," which turns green owing to the formation of a salt of copper. You must use a varnish free from acid. Try gold size. Sm.

[72469.]—**Gold Paint.**—The bronze powders are mostly sulphide of tin, and those denominated "gold" vary in price from 5s. to 36s. a pound, according to fineness or "covering" power. They should be mixed as wanted, not kept mixed, and the varnish should be the best pale copal, free from lead, diluted with about six times its bulk of turps, and it should be dosed with quicklime and decanted when clear. If there is any lead in the varnish the "gold" is sure to grow "dark," no matter what coating varnish is used; but try size first, and then a coat of copal or white hard. Nun. Dor.

[72472.]—**Chromic-Acid Battery Solutions.**—To Mr. Bottone.—The following are good recipes:—For single-fluid batteries, take water 1 gallon, chromic acid 1½lb.; dissolve, then add in a fine stream, constantly stirring with a glass rod, sulphuric acid, sp. gr. 1·840, 10 fluid oz. For double-fluid batteries, take water 1 gallon, chromic acid 8lb., sulphuric acid 4lb. If the battery is to be used out of doors, or stands in a stink-cupboard, the addition of 1lb. of nitric acid to the above will add considerably to the staying powers of the solution.

S. Bottone.

[72475.]—**Glass Pens Toughened.**—Why not try for yourself? Thus:—Take some Russian tallow and make hot to 400° to expel water; then make pens red-hot and dip into it; leave there until cold, then clean with sharps or sawdust.

Jack of All Trades.

[72475.]—**Glass Pens—Toughened.**—I have seen these "pens"—in fact, I am writing this note with one—made by a travelling (lamp) glass-blower; but do not think that any description I could give of the method would be of much service to the querist. By far the best way would be for our friend to visit and see at work one of these artists, and, if possible, take a few lessons from the "professor" (it will be a wonder if he does not so style himself). As for toughening, the process is mostly applied to hollow goods, though it might answer for such small solid articles as "Regular Subscriber" (why does he not use some less cumbrous signature?) proposes to make; and for his purpose, at any rate, a simple contrivance could very easily be rigged up for an experiment. The main point to aim at is to have the glass and the cooling fluid at as nearly the same temperature as possible, and to this end oil, having a high boiling point is used, into which the finished article, which must be of a uniform temperature throughout, is dropped. The oil will require heating up to, and kept nearly at, the boiling point, by external heat, or by that of the articles made. I question whether the pens would be of much use when so made, because of the unstable character of the glass so treated. See my note *re* "A Curious Explosion" in this number. Mons.

[72478.]—**Electro-Motor, Wrought Iron for.**—The difference between the magnetic permeability of good wrought iron and ordinary grey cast iron is as much as 40 per cent., in favour of the wrought iron. Therefore, if the weight of the iron carcase is for any reason to be limited, wrought iron will be 40 per cent. more efficient than an equal bulk of cast iron; but if the weight of the carcase is immaterial, equal results can be got by using a carcase 40 per cent. heavier. S. Bottone.

[72479.]—**Neutral Soap.**—Theoretically, more fat is required. A neutral soap is made with slight excess of fat, or rather, with care that the alkali is all neutralised. Sm.

[72480.]—**Flashing Point.**—There is a special piece of apparatus sold for the purpose, price 7s., from apparatus makers. Sm.

[72482.]—**Scrap Leather.**—I would suggest that it is possible to work the scraps up into a kind of "shoddy" leather that could be used for filling in the soles of boots and shoes. Sm.

[72482.]—**Scrap Leather.**—If you have any quantity of it I dare say the makers of prussiate will find a use for it. How it is to be made into cloth grease I do not know. It used to be used for case-hardening formerly, but bone-dust, charcoal, and prussiate have, as a cleaner and better material, wiped it out. Jack of All Trades.

[72484.]—**L. and N.W. Locos.**—I do not believe that any complete list of the above has appeared in the "E. M.," as it would take up too much room. There are still some of the "Bloomer" class running, also of the "Canning" class; but both classes are numbered above 3000 and between 1800 and 1900. North-Western.

[72485.]—**Electric Clock.**—I suppose your clock is to be governed by another at a distance? On the axis of the escape wheel fix another wheel with the requisite number of teeth, which as they pass a certain point press forward a spring, which makes contact between platinum points. Sm.

[72486.]—**Honours Theoretical Organic Chemistry.**—The "Science Directory" states that for honours the candidates will be required to show a thorough and satisfactory acquaintance with all the more important organic compounds, including the latest discoveries. Especial attention should be paid to methods of organic analysis, vapour density determinations, organic synthesis, isomerism in the paraffin and benzine series, metamerism, and polymerism. The candidates should study the primary, secondary, and tertiary alcohols and their derivatives, orientation in the aromatic series, constitutional formulæ, and the physical properties of organic bodies. This syllabus is pretty extensive, and will require very hard work to master. Fownes's "Organic Chemistry," very thoroughly studied, might perhaps be enough for the general reading; but "J. H." should also read the chemical journals, so as to keep himself up in recent researches. I presume he has passed first class in the advanced stage. If he will communicate with me direct, I may be able to give him further information.

Wm. John Grey, F.C.S.,
Newcastle-on-Tyne. Analytical Chemist.

[72486.]—**Honours Organic Theory.**—With regard to the above examination of the Science and Art Department, a young chemist of my acquaintance gives the following as his experience. He was a clerk in a London bank, and becoming fascinated with the beauties of modern chemical theory as set forth in some popular lectures by Prof. V. B. Lewes, he joined the evening classes at the Finsbury Technical College in 1888. He spent all his evenings reading books, such as those by Reynolds and Remsen, which, although chiefly for experimental purposes are admirably clear in their expositions of organic chemisty as depending on the valency of carbon—the modern against the Gerhardt school. In 1889 he thought of trying the exam. in question, but found himself in the same position as the querist. The examiners want more knowledge of recent research, both in synthesis and molecular physics, than is found in most textbooks; and the only book he found perfectly suited to these requirements was "Outlines of Organic Chemistry," by H. F. Morley. He read this carefully over and over again, and in May, 1889, was the only one who obtained a First Class. He attributes his success entirely to this book.

Director R.R.L.

[72487.]—**Varnish for Tape Measure.**—You will only make matters worse with map varnish. Strain it out and go over it with the following:—Raw linseed oil a gill, and dissolve a piece of camphor in it about the size of a crack-nut, and apply with a piece of old black cloth. Do not drown it, but put on as thin as you can; give it a second coat, and it is done. Jack of All Trades.

[72488.]—**Dynamo Governors.**—To Mr. Allsop.—I do not know how many cells you have, but if the voltmeter shows an E.M.F. in excess of that given off by the accumulators (reckoning two volts for each cell) then the cut-out can be closed by hand. My experience of these cut-outs is that they generally require to be closed by hand, though they will always break the circuit if E.M.F. of the dynamo falls below that of the accumulators. The voltmeter is no good as a *resistance* for this purpose. You want one made of iron wire (stretched on a slate or in the air) which will allow as much current to pass as what the accumulators will take. This should be connected up to a two-way switch, which will allow the dynamo being transferred in one turn of the handle from resistance to accumulators. The amount of wire required you can soon determine by experiment. F. C. Allsop.

[72490.]—**Decorating Wax Candles.**—The designs are put on from "transfers." Then they are fixed by dipping the candles dexterously into a bath of melted wax. R. McLaren.

[72491.]—**Blowpipe.**—Write to Mr. T. Fletcher, of Warrington. Sm.

[72491.]—**Blow Lamp for Brazing Cycles.**—You had better write Fletcher, Warrington. He supplies blowers and generators for petrole[illegible] blast; the others are dangerous. In a large way, you can see some American hand lamps at Hi[illegible]man's, Whitechapel-road, for light petroleum spi[illegible], acting as you say. Jack of All Trades.

[72494.]—**Electro-Motor, Best Type.**—A motor of the Immisch type, with Siemens-Alteneck wound drum-armature, will give the best resul[illegible] with a given number of watts. As the result of [illegible] years' experience, I believe the drum armature w[illegible] eventually disperse all other forms, both for dyna[illegible] and motor. S. Bottone.

[72496.]—**Winter Health Resorts.**—Mu[illegible] may be said in favour both of Madeira and of t[illegible] West Indies. Madeira is of easy access, wit[illegible] four days' sail of Southampton, and mail steam[illegible] to and from, call there every week or oft[illegible] The climate is mild and delightful, the sce[illegible] grand, and the cost of living moderate. The to[illegible] of Funchal is beautifully situated. The [illegible] streets paved with small water-worn cobbl[illegible] gentle steps, are tiresome to walk upon, but [illegible] sleighs, drawn by bullocks, glide along them [illegible] over ice. Some of the steepest streets are descend[illegible] as in tobogganing,—a man at each side hold[illegible] back and guiding the sleigh by a rope. There [illegible] no wheeled conveyances in Funchal. The off[illegible] language is Portuguese, but English is univers[illegible] understood. The West Indian islands have [illegible] advantage, or disadvantage as the case may be, [illegible] entailing a longer sea voyage, the run fr[illegible] Southampton to Barbadoes occupying fourt[illegible] days. The numerous islands afford a very great [illegible] pleasing variety, which in these days of Afric[illegible] and Australasian booms does not receive attent[illegible] nor attract visitors as it deserves to do. [illegible] notorious that Lord John Russell referred, in [illegible] House of Commons, to "the island of Demera[illegible] the West Indies," and even our generally accu[illegible] correspondent, "F. R. A. S." recently (letter 31[illegible] page 511, Vol. LI.) relates how Miss E. Bro[illegible] describes her "journey from Barbadoes to Tri[illegible]dad, *and from Trinidad to Port of Spain.*" As [illegible] matter of fact, the Royal Mail steamers which [illegible] from Southampton, call first at Barbadoes, wh[illegible] steamers are awaiting the mail for St. L[illegible] Antigua, St. Kitt's, and other Leeward islands to [illegible] north; Tobago, Trinidad, and Demerara to [illegible] south; and to the Windward islands, St. Vinc[illegible] Grenada, and Trinidad to the south-west; [illegible] larger steamer continuing its way to Jamaica [illegible] thence to Panama. The variety and choice [illegible] abode is evident from the facilities thus provid[illegible] The climate of all the islands is healthy, and [illegible] temperature during the winter months is plea[illegible] It is generally warmer than Madeira, and [illegible] be found at times ennervating. Yet a ch[illegible] awaits the visitor in the truly trop[illegible] scenery, the magnificent trees, the new flora, [illegible] humming birds quivering over the flowering sh[illegible] by the wayside, within a few feet of the passer-[illegible] Bridgetown, Barbadoes, is an extremely gay [illegible] town; but the sugar-cane, with which almost ev[illegible] acre of the island is covered, makes the coun[illegible] landscape monotonous. The island of St. Vinc[illegible] very much resembles Madeira; but much of [illegible] land remains in its original uncultivated state, [illegible] the town does not possess the accommodation [illegible] casual visitors which Funchal has. Trinidad i[illegible] many considered the finest of the Windward g[illegible] It is richly cultivated, yet has many extensive [illegible] of virgin tropical forest. Its capital, Port of S[illegible] is the only port at which mail steamers call, so "Port of Spain" and "Trinidad" have be[illegible] nearly synonomous terms. Mulattoes of ev[illegible] shade, from the fair European to the ebony ne[illegible] tawny Caribs, indigenous to the soil, and impo[illegible] coolies, each dressed in characteristic style, pre[illegible] an ethnographic study. Hundreds of vultures [illegible] carrion crows, circle through the air overh[illegible] appearing as mere dots in the cloudless sky, [illegible] rged with food, are perched on the house- :owd the streets, like barndoor fowls, dis- .ly by the buggies and coaches that are r being driven past them. Port of Spain ır railway communication with the interior and, where endless subjects of interest :emselves; and if "S. A. B." can afford er cost of the trip, I am sure he will enjoy ) our somewhat neglected West Indian ven more than he would a stay in the island of Madeira. He will find ›rmation in *Whitaker's Almanack*, under Possessions in the West Indies"; and s "At Last" gives many true and vivid f the scenery. H. B. F.

|—**Dynamo.** — A drum armature 3in. ;in. long, wound with about 2lb. No. 18, 6 ampères at 55 volts if driven at about ;. The field magnet should be of the type, poles upwards, nearly as wide as ı of armature, shunt-wound, with about 20. For full details of mode of winding mode of connecting armature coils to or, and of mode of coupling brushes agnet coils and terminals, I must refer book, "The Dynamo, How made, &c.," ı, where you will find full explanation and ıs. S. BOTTONE.

—**Substitute for Putty and Red** ·ry white lead. Gilder's whiting two ed with japanners' gold size or boiled. work a coat of priming before stopping. JACK OF ALL TRADES.

—**Galvanic Current generated by** : **Action.**—You are quite right in attri- :se experiments to Du Bois Reymond. performed by connecting different por- the muscles (by means of probes, or ) to a very delicate galvanometer, and ıg or relaxing the muscles. You will interesting account of experiments made he existence of currents set up by the ion, in the *Electrical Review*, Vol. XXIII. S. BOTTONE.

—**Double Bichromate Batteries.**— cf failure is two-fold—(1) the acid is ) the connection between carbons and lefective, owing to corrosion. S. BOTTONE.

— **Bending Wood Hoops.**—Steam and break them upon a horse. The best ash, beech, white elm, rock elm, hickory, ık; but none of the articles must be JACK OF ALL TRADES.

—**Spectroscopic.**—Perhaps your slit is Perhaps it is not in focus. Perhaps you ıd the prisms out of parallelism with the ›e's or Schellen's "Spectrum Analysis.") SM.

— **Spectroscope.**— Ordinary artificial ıot show any absorption lines: daylight ›d. If it has an adjustable slit it should losed, and do not forget to focus. There book by R. A. Proctor, published by for Promoting Christian Knowledge. W. H. S.

## NSWERED QUERIES.

*rs and titles of queries which remain unan- ve weeks are inserted in this list, and if still re repeated four weeks afterwards. We trust ill look over the list, and send what information ıe benefit of their fellow contributors.*

: Northern Railway, 473.
ograph, 473.
ng Cardboard Boxes, 474.
r-Colour, 474.
›scope Amateur, 474.
Iotor for Lathe, 474.
ıetism, 474.
ram, 474.
ring-down Tinned Provisions, 474.
rie's Telephone, 474.
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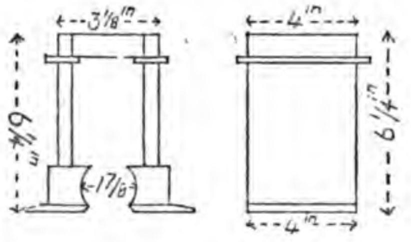
aulic Ram, 562.
m Colouring, 562.
ing Brass Beading, 562.
ılum, 562.
l Pumps and Injectors, 562.
Wanted, 562.
gth of Materials, 562.
ı-objective Screw Threads, 562.
›n B.Sc. Examination, p. 563.
Curves, 563.

uction of coal in British India last year ›o 1,750,000 tons, as compared with 1888, 1,564,000 in 1887, and 1,389,000 The number of collieries which have out is 117, but of these only 67 were year.

# QUERIES.

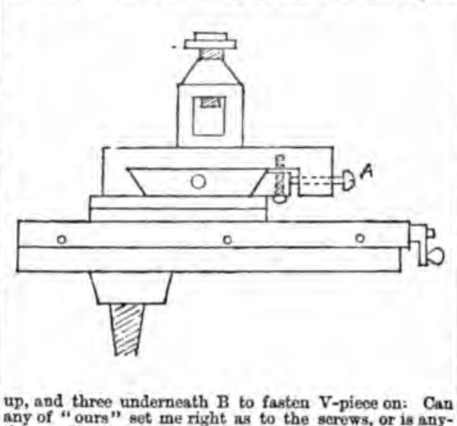
[72507.]—**Dynamo.**—To MR. BOTTONE.—I have wound the above with about 6oz. of No 18 cotton-covered wire on the armature, and 5lb. 10oz. of No. 22 cotton-covered on the field-magnets. Would you please tell me what volts and ampères it would give, and also how many 8 or 16c.p. lamps it would light, and oblige?—D. W. CAUMANDA.



[72508.]—**Thin Enamel on Glass.**—Will some reader kindly tell me how to put upon glass a very thin opaque enamel or film (colour unimportant), sufficiently thin to be cut through by the ruling diamond of my dividing engine?—M. D. EWELL, M.D., 97, Clark-street, Chicago, Ill., U.S.A.

[72509.]—**Explosive Liquid.**—Is there an explosive compound, not a liquid, which will explode immediately it is touched by water? If so, what are its ingredients, and their proportionate quantities?—JAS. G. TIBBITS.

[72510.]—**Slide-Rest.**—The top slide of my slide-rest does not seem to have been fitted truly. At one end it fits tight, and at the other it is quite loose. There are six screws to tighten with—three on side A to set V-piece up, and three underneath B to fasten V-piece on: Can any of "ours" set me right as to the screws, or is anything radically wrong with the tool itself? I have tested it for paralellism, and it seems all right.—TOAD IN A HOLE.



[72511.]—**Carpenter's Brace.**—I am about buying one of these, and think the American pattern very handy for odd bits; but should like to know if these hold the square taper shank of the ordinary centre-bit satisfactorily. I rather doubt it, and should be glad of information about this. I have used the English pattern before.—NEMO.

[72512.]—**Heating Shop.**—I am thinking of heating a shop 75ft. long by about 15ft., with hot water. Boiler to be in an underground cellar at one end of the shop. The water has to travel along the floor, and at the further end from the boiler is a doorway. I thought of using 2in. piping. Will this be large enough to insure circulation? Should the pipe be carried over or under the doorway? Will a saddle boiler answer, or should it be a vertical coil boiler with central flue? Will it be necessary to carry up a feed pipe to a cistern at some height, so as to get a pressure, or will it work at low-pressure? Any suggestion will be gladly received.—W. S. P.

[72513.]—**Noise in Telephone.**—Will some kind friend tell me the cause of the noise? I think it is in the battery. I connect it without microphone, and still get the noise. I have five Leclanché cells at each end, and keep them on the floor. The zincs are in good condition and good current. The noise is night and day, but not incessant. I have reduced the number of cells; but if I stop the noise, I must reduce the power until it will not ring the bell. This is the greatest difficulty I have found.—BRISTOL.

[72514.]—**Brazing Copper and Brass.**—I am in need of a kind of spelter (for brazing copper and brass) that will melt quickly, and with little heat. I have three equal quantities of copper and zinc, but find that it requires too great a heat. Should I get the desired effect by adding a little block tin. I require spelter that is pretty soft.—APPRENTICE COPPERSMITH.

[72515.]—**Umbrellas.**—Would someone kindly oblige by giving a few hints relating to covering umbrellas, how to cut the silk, kind of silk used, &c.?—H. E.

[72516.]—**Testing Hardness of Water.**—Wanted, a simple method of ascertaining the hardness of water. Also what quantity of lime-water should be added to, say, 50 gallons of water, of which the hardness has been thus ascertained, to reduce such hardness? A reference to any books on the subject would be useful.—E. A. FRY.

[72517.]—**Coil Winder.**—Can any reader kindly tell me how to make a coil winder, to wind on the secondary wire, No. 38, on an induction coil? I tried to wind on the secondary wire by fixing the coil on a spindle, while I fixed the bobbin on a spindle below it, supported between two uprights, but could not succeed in winding it on even. The length of the coil is 8in.—J. LAWSON.

[72518.]—**Dynamo.**—To MR. BOTTONE.—I have tried the dynamo joined up in shunt, as you suggested. It does light the lamps better, but not what they should be. I have got a high enough speed for it. If it will require smaller wire, would you kindly state what size and quantity?—J. CHRISTIE.

[72519.]—**Master Taps for Re-cutting Dies.**—Having some dies to re-cut, I want to know how to get the size of master taps for same, say, from 1in. downwards to 5-16in.?—MASTER TAP.

[72520.]—**Case-Hardening Oven.**—Could any reader give me a sketch of a cheap but efficient oven, preferably firebrick (to be heated by coal or coke), suitable for case-hardening small iron and mild-steel articles? The furnace also to be available when not used for case-hardening for annealing malleable iron castings. Can anyone also kindly say what is the probable reason that I sometimes find that mild-steel articles, which I have heated in a Fletcher's gas muffle furnace (inside an earthenware muffle, nearly filled with bone-dust or burnt leather, and properly luted with clay), often fail to harden at all on being plunged in absolutely cold water?—C. H. BINGHAM.

[72521.]—**Leverage.**—Let a bar be suspended at the point A; let a 12lb. weight C be hung at B, say, a distance of 6in. from A. If we hang another 12lb. weight E at D, also 6in. from A, it will balance weight C; and a weight of 24lb. plus bar will be on A. If we put a 6lb. weight F (Fig. 2) at G, a distance of 12in. from A, will it balance the weight C? Also what weight is on A now, and how is it calculated?—R. E. D.

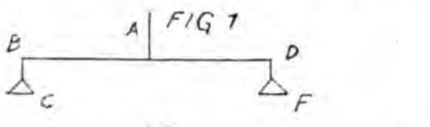


FIG 1

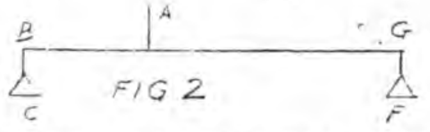


FIG 2

[72522.]—**Dynamo.**—I have some dynamo castings, open field vertical type. The armature is wound with 1lb. 13oz. No. 20 d.c.c. wire, and is 4⅝in. in diameter by 3in. long. The field cores are 1½in. by 5½in. wrought-iron. The machine stands 12½in. high. Kindly let me know how magnets should be wound to get the best results as a shunt machine. The armature is a wire ring, and is wound in 18 sections. What will be the probable output.—SCUD.

[72523.]—**Watch Gilding.**—Will anyone kindly tell me what process watch movements undergo for gilding after stoning, to produce the corn or frost? Have tried nitric acid, but this nor scratch-brushing will remove stoning marks. No mention in "Watt's Electro-Metallurgy" and the last four volumes of the "E. M."—COUNTRY WATCHMAKER.

[72524.]—**Limelight for Lanterns.**—Would some reader kindly say whether they consider the arrangement of two gas cylinders each with an automatic regulator and mixed gas-jets, dissolver, &c., a perfectly safe arrangement? Is it quite as safe as two bags? Could the gases possibly get mixed by the cylinders having an unequal amount of gas in them? Is it an arrangement used much at present? Of course I understand some care must be used with limelight. Having used bags, I now propose to use cylinders and valves. Will some users give their opinions?—SAPIENTIÆ.

[72525.]—**Exhaust Pipe.**—In instructions for fixing an Otto gas-engine, it is stated that the exhaust pipe must not be turned into a flue or a drain. Would some reader kindly state the reason, and also if there would be any objection to turn it into a flue that is never used?—CÆSAREA.

[72526.]—**Gas-Engine Governor.**—I should like to ask "Yarg" if he has a good and reliable governor for gas-engine? I have a gas-engine without governor, and should like to fit something that will govern well, simple, cheap, and good—if so, sketch would oblige.—GOVERNOR.

[72527.]—**Running Postmen in India.**—To "Eos."—Will "Eos" give a few hints about the running postmen in India? I have been told that they run with their mouths closed, and that they are better runners than our officers and other athletes who are out in India. I am a member of a harriers' club, and if I can gain a little knowledge which will be useful to myself and others, I shall be much obliged to "Eos." All the members in my own and other clubs that I have noticed run with open mouths, and it seems to be very difficult to keep them shut when racing hard.—HARRIER.

[72528.]—**Benzoline Gas.**—I want to make a gas blowpipe, to be used in connection with forge fire for brazing. Will any reader kindly oblige with sketch and particulars of an effective and safe apparatus for generating the gas from benzoline?—LEON.

[72529.]—**Lathe Matters.**—In common, no doubt, with others, I should be greatly pleased to have some details from "F. A. M." regarding the manipulation of the straight-line chuck, as referred to in his letter. I possess a straight-line chuck (not of latest pattern perhaps), an excellent one by Holtzapffel; but up till now I have not been able to use it, although I have both Vol. V. and Evans's book. Will "F. A. M." kindly explain how he uses it in conjunction with the rose-engine apparatus (which I also possess, but do not know very much about), and where I am puzzled is this—how, seeing that the straight-line chuck does not make continuous revolution, or rather the mandrel with worm-wheel has to be worked backwards and forwards, is the continuous motion necessary for rose-engine work applied? Any hints will oblige.—PHEDRICK.

[72530.]—**Zoology.**—What are the white maggots which sometimes appear in cheese, and which have the power of drawing themselves up into an arch, the sudden straightening of the body from this arch-like form throwing the animal forward? They appear to breed very rapidly under favourable circumstances.—H. S. R. E.

[72531.]—**Small Boiler.**—I am about to make one of ⅜in. iron, 1ft. diam., 2ft. high, to work at 45lb. per inch. Will any reader kindly tell me what size rivets to use, and at what distance apart? Should salammoniac be used in joints? Is there any better plan of fixing tubes instead of from top of firebox to top of boiler? Any hints will oblige.—Leon.

[72532.]—**Photographic Camera.**—Will any reader kindly give me directions for making above, with full sketches and dimensions?—H. Cooper.

[72533.]—**Alternating Current.**—What are the particular advantages of alternating current? No information is given in any of the books. Is it simply to get equal consumption of carbons, or is it absolutely necessary for high potential machines on account of sparking at commutators? Which is more dangerous to human life, continuous or alternating? Any other information will be esteemed a favour.—H. J.

[72534.]—**Battery Cells.**—In any single-liquid battery are separate cells absolutely necessary? Taking a Smee or bichromate element, will not one long undivided trough give just as good results as separate cells, provided the positive of one couple is at least 1in. distant from the negative of the next? Could they be coupled parallel or series?—H. J.

[72535.]—**Polariscope Construction.**—I have a crystal of Iceland spar, 1¼ by 1¼ by ⅜in. thick, and wish to make a polariscope for Beck's Star microscope. Will some kind reader inform me how to proceed? I can easily manage the brasswork and fitting.—H. J.

[72536.]—**Williams' High-speed Engine.**—How is the valve arranged in these engines, especially in the compound form? Sectional sketch would oblige.—T. H. S.

[72537.]—**L.B. and S.C.Ry. Singles.**—Could "Locomotive" tell me the use of that small copper wheel which is fitted to some of the L.B.S.C.Ry. singles? It is driven by a band passing around the axle of the driving wheel. Its own axle seems to pass into the firebox. Looking from the tender towards the funnel, it is on the right-hand side.—Stranger.

[72538.]—**The New L. and Y. Engines.**—Will any reader kindly give particulars of the Lancashire and Yorkshire 900 class of passenger engines? Also of the new engines being built for running the "45 minutes expresses," between Liverpool Exchange and Manchester Victoria?—Loco. No. 1.

[72539.]—**Railway Returns.**—The Board of Trade has just published a return showing the times of arrival of trains in London, from which it seems the Great Eastern is the best and Midland worst. Perhaps Mr. Stretton as a Midland advocate will explain how this occurs.—Traveller.

[72540.]—**M.S. and L. Engine, 560 Class.**—Wanted, a diagram or details of the new M.S. and L. express engine 564, and some idea of the gradients it works over.—Loco.

[72541.]—**Centre of Gravity of Loco. Engine.**—Should the centre of gravity of a 6-wheeled engine be in front of or behind the driving axle? And what is the rule to find the position of the centre of gravity? An engine I work has 14 tons 6cwt. on bogie, 14 tons 11cwt. 2lb. on driving wheels, and 12 tons 16cwt. on trailing wheels. From bogie to driving axle is 10ft., from driving to trailing 8ft., 6in. Where is her centre of gravity?—Driver.

[72542.]—**Weight of Engine.**—Locomotives seem to be gradually getting heavier. Will any reader say how the 40 tons weight is made up? Is the weight chiefly in the frame, the boiler, or the wheels?—Loco.

[72543.]—**Silvering Plate-glass Mirrors.**—Will any brother correspondent be good enough to inform me of the process commercially used in the silvering of large sheets of glass? From the prices quoted per superficial feet, it must be something cheaper and simpler than that employed for telescope specula, with which I have some practical acquaintance.—W. S. F.

[72544.]—**Xylonite.—Cellulite.**—To Mr. C. C. Ellison.—I have been trying for the past three or four months to find out some manufacturer of mock tortoiseshell, but have not succeeded. I see Mr. Ellison in answer to some query mentions xylonite, which, I believe, is a kindred substance in composition to this mock tortoiseshell, which seems to be made in Paris in quantity, judging from the combs, ladies' hair-fasteners, &c., of French make which are seen in the shops in all towns. Can Mr. Ellison give the method of preparing this substance, or any reference thereto? If he could, I should be obliged to him or any other reader. I believe the name for this material has at various times been called Parkesine (after its inventor), Cellulite, and several other names which I fail just now to remember. Am I correct?—Shoot-bang.

[72545.]—**Armature.**—To Mr. Bottone.—Many thanks for reply to query as to fixed H armature. I had thought that as the armature could be wound and magnetised by current that it would have compensated for extra space. If it is not troubling you too much, kindly say if the following is correct as to H armature of motor: To keep the magnetism of armature as it approaches field-magnets at same strength by transfer of current to field-magnets, and so diminish induced current that results from strengthening or weaking magnetism either of armature or field-magnets.—H. A.

[72546.]—**Reflecting Telescopes, Adjustment of.**—In letter No. 31561 of your issue of Sept. 12, Mr. T. Westlake states that "there is, I believe, nothing comparable to the spot and pinhole method, which I described in the English Mechanic of July 3, 1882." On inquiry at the "E. M." office, I find that that number is out of print. I should, therefore, be much obliged if he would kindly repeat the instructions, which, I believe would be very acceptable to many besides myself.—G. G. B.

[72547.]—**Available Sulphur in Spent Burnt Oxide.**—Will any reader who has had experience in the assay of available sulphur in burnt spent oxide give a quick method sufficiently accurate for technical purposes? I have recently tried one which promised to give fair results, but so far they have been very discordant. This was the oxide of copper and carbonate of soda method, which is doubtless well known to many of your readers, and which is reported, according to several textboooks, to be a good method for the assay of remaining sulphur in burnt cinders (burnt pyrites). From my trials I cannot say I have confidence in it; but it is right to add my experiments have not exceeded four or five trials upon one sample of oxide. Even if the results had been good, the expense of copper oxide would have debarred me from its use, for there is no means of recovering it and reusing. Where three or four estimations have to be made daily, it will be seen how costly they would prove. Should the sulphates of iron (ferrous and ferric) be decomposed at the temperature of the kilns used for the combustion of spent oxide?—Spent Oxide.

[72548.]—**Continuous Indicator.**—I wish to construct one similar to No. 109 in Mr. Allsop's "Practical Electric Bell-Fitting," only with this difference: when a continuous contact is made, as by a door being left open, the current is left circulating the coils of indicator, and is divided so that half is only left to ring the bell. Can this be so constructed to shut the indicator out of circuit without using two batteries?—F. G.

[72549.]—**Analysis of Caustic Potash.**—Will some of "ours" give a method of the above, not forgetting the separation of water and organic matter?—I mean the German or French article. What is the organic matter, and is the green colour seen in the centre of the drum owing to manganese?—J. H. Bootle.

[72550.]—**Making Batteries.**—Have bought a job-lot of chemicals, among which are the following:—Caustic potash, caustic soda, and their carbonates, sulphuric acid, manganese dioxide, and red lead. Would like to make some batteries if the above are available. Kindly advise form, and refer to source of minute details of construction?—J. H. Bootle.

[72551.]—**Ink for Lantern Slides.**—Please give a recipe for a brown ink for above to be used with a pen.—J. H. Bootle.

[72552.]—**Air-Pump.**—My double-barrelled air-pump will not exhaust receiver. The cylinders and valves seem clogged. I have removed pistons. There appear to be valves at the bottom of the cylinders. How should these be removed? Any hints on cleaning and setting up this apparatus would be valued by—Perseverance.

[72553.]—**Crystoleum Painting.**—Can any reader, who may be proficient in the above process, prescribe a cure for the spots that appear on these pictures when they are done through the transparentising medium drying? I use castor-oil one part, turps half a part, and also the crystal varnish supplied with the "sets" that Reeves and Sons sell for the process, and of the two I find that the varnish spots the soonest, presumably because it would dry the soonest. With pictures painted on two glasses, the spots appear first on those portions of the photograph which have received no paint, such as the dress and background if these have been put in on the second glass, and when only one glass has been employed, they naturally appear on the dark parts of the photo. Since they are due to little lumps in the paper produced by the thinning process, the cure, I take it, must be a medium which will render the photograph permanently transparent. Can such a medium be found? I doubt it, and on this account am inclined to think the process a delusion and a snare, and that this may account for its having died out. I shall be glad to hear to the contrary, for I have myself done (after great application) two or three charming pictures; but if they are doomed to "spot" after a few months it is pains wasted.—Rangoonite.

[72554.]—**Battery Power.**—Having fitted an hotel with about three miles of No. 18 i.r. c.c. wire, 1-30 Gent's indicator, three relays, four bells, how shall I find the battery power needed?—Cymro Bach.

[72555.]—**Loss of Power in Marine Engines.**—Will some friend tell me the amount of power absorbed (1) by the thrust block, (2) the slide-valve and the reversing gear? An answer will greatly oblige.—G. B. B.

[72556.]—**Starting Marine Engine.**—Will some friend tell me how this is accomplished when the piston is at half-stroke, the steam being cut-off at half-stroke? A diagram, with the Editor's permission, will greatly oblige.—G. B. B.

[72557.]—**Calculating Increase of Speed of Ships.**—Will some friend tell me in what proportion the power of engines must be increased to obtain an increase of speed? An answer will greatly oblige.—G. B. B.

[72558.]—**Air Surface Condenser.**—Can anyone inform me as to the relative surfaces of boiler heating to air surface condenser (with ordinary water surface it is about one half of that of the boiler)? The air surface condenser is supposed to be rotated to secure circulation of air as in Mr. Craddock's condenser, noted in "Rankine's Steam-Engine."—J. A. A.

[72559.]—**Sounds.**—Can anyone explain to me how it is that although several different sounds are issuing from different sources, yet all are heard distinctly together? I am under the impression that the one sound will strike the ear and cause vibrations of so many times per second, while the other sound, or sounds, strike the ear and cause it to vibrate at a greater or less number per second. Am I right in supposing the one membrane to be capable of several sets of vibrations each entirely different, and yet such membrane to be able to cause the effect of the several sounds to be recorded perfectly distinctly?—S. T. Andrews.

[72560.]—**Razor.**—To "Eos."—I, too, have a Swedish razor, which for some time was a wonder. It has now become dull and defies me, and has defied a cutler and a barber. Can you tell me how to get my razor sharpened as it was?—M.

[72561.]—**Auxiliary Power.**—Will any of "our" scientific readers help me to get over the following difficulty? I have a printing-office abroad, the machinery being worked by a 4 N.H.P. steam-engine. The engine is started at 7 o'clock a.m., and works intermittently until 6 o'clock p.m., when fire is drawn or "banked" until 2 a.m., when a demand is made on it of about 1 or 1½H.P. for two hours. During the day the engine is frequently doing no work for one or two hours at a stretch while "formes" are being got ready; and the full demands made on it at any time is never more than one-half its power. What I want to do is to dispense with the engine during the two hours, from 2 a.m. by storing the lost and surplus energy during the day. Can I do this without going to great expense, and how? Am willing to spend a little money, but have none to throw away on experiments. It is of no use to recommend a gas-engine. I have tried it, but with gas at 14s. 7d. per foot, and pressure at 5-10ths, I soon abandoned it. I hesitate at storage batteries and an electro-motor, because of the expense and trouble they give. Besides, there is, I understand, a good deal of technical knowledge required in their management, and that I am not possessed of. Would compressed air do? Perhaps I am asking for something which everybody wants, but which has yet to be invented. I shall be thankful, however, for practical advice, even if it is to abandon the idea and work away as I am doing. My engine suffers more from a careless attendant (and I can't get a careful one) in the two hours of night-work than in any twelve hours during the day.—Colonial Printer.

[72562.]—**Musical Fish.**—Can any reader give any information concerning a certain musical fish, known to exist in muddy creeks and shoals around Bombay and Galsette, the sound of which is described in "The Natural History of Ceylon," as gentle thrills of a musical chord, or the faint vibrations of a wineglass when its rim is rubbed by a moistened finger? Not being one sustained note, but a multitude of tiny sounds—each clear and distinct in itself. The sweetest treble mingling with the lowest base. It is evident that at that time (1861) the means were not afforded of determining how the musical sounds were produced and emitted. I should be pleased, and probably other readers, with any recent particulars, if any, in regard to this phenomenon.—F. C. V.

[72563.]—**Gauss's Logarithms.**—Are tables for finding the logarithms of the sums and differences of numbers much used? I have read that they are very useful to astronomers and actuaries. Is that so? Perhaps "F.R.A.S." would kindly say whether he makes use of them, and if so, which he thinks best. One set of tables I have seen is extremely incorrect in one part, namely where the differences are less than ·001. I should also like to know whether the demand for such tables is great enough to justify the publication of a new set of tables on an improved method. Whilst I am writing, I should like to ask whether "F.R.A.S." is quite sure that there is an edition of "Sang's Logarithm Tables" to 10 places ("E. M." p. 80). I can find no mention of such in the "Encyclopædias," nor is there a copy in the British Museum. Sang published tables to 5 places in 1859, and to 7 places in 1871. "Parkhurst's Tables," I see, were published in New York.—T. S. B.

[72564.]—**Boat Motor.**—In replies to queries, No. 68632, Mr. Bottone says a Siemens armature, 4½in. diam., 6in. deep, will develop sufficient power to drive a boat 20ft. long by 3ft. 6in. beam, at six miles an hour with 18 or 20 chromic-acid batteries. Will he kindly tell me amount of wire and gauge for the armature and field-magnets? Also dimensions of field-magnets?—J. M. S.

[72565.]—**Steam Boiler.**—I have a steam boiler which is chiefly used for supplying steam to a number of coils of iron piping for drying purposes, all of which are above the boiler itself. At present each of these coils is fed with steam at the highest point, and is connected at the lowest point with a steam trap, the water issuing from the traps being put back into the boiler by a pump. Any form of steam trap which I have tried, however, is unsatisfactory, and in order to do away with them I think of feeding the coils with steam at the lowest point, and closing up the other end altogether, leaving a gradual slope all the way from the boiler to the extreme limit of the piping in each case, and so allowing the water to flow back of itself to the boiler. Can anyone experienced tell me if this plan would act?—Desiccator.

[72566.]—**Cement for Loose Artificial Teeth.**—What cement do dentists use to fasten loose false teeth?—Dent.

[72567.]—**Working Amber.**—I have a quantity of amber I wish to drill and tap, but it chips and breaks with the least pressure. Can any of your numerous correspondents inform me how to do this, and what kind of tools to use?—Engineer.

[72568.]—**Pocket Accumulator.**—Would Mr. Bottone or some other kind reader answer the following questions? I have made a pocket accumulator consisting of three cells, each 1½ by 1⅝ by 4½in. In each cell I have placed two strips of perforated lead (coated with red lead and sulphuric acid), each 4 by 1⅝ by ⅛in. When connected up and formed (*a*) how many bichromate cells will it need to charge it, and what time will it require to perform the operation? (*b*) What current ought it to give, and how long ought it to light a 6-volt fairy lamp (1) when freshly charged, and (2) after an interval of thirty hours?—Chlorochromatic.

[72569.]—**Assaying White Metal.**—Whilst assaying some silver-plated white metal by the cupellation process, a patch of some substance resembling iron scale is left on the cupel and interferes with the bead of silver. Can this be iron? If so, how may it be detected so make sure of its identity? Also will some pra assayer please suggest how such an alloy should be tr to give a clean bead of silver on the cupel?—Tyro.

[72570.]—**Colliery Working.**—At a colliery in wh I am employed all the underground machinery is dr by steam power direct, which comprises two cylinders fixed 300ft. below the surface, driving double-acting 8in. buckets direct, 3ft. stroke, pumping to surface; and in the bottom there are another 20in. cylinders, with double-acting 8in. buckets lifting the water 300ft. high to the above. There is 400 to 500 gallons of water per minute. There is one cylinder direct-acting pump, lifting 50 gallons of per minute 150ft. high. Also there is one 18in. cy geared 1 in 2½ hauling up an incline, the bottom of is 130ft. vertically below level, and dips at an an about 1 in 5 average. The quantity drawn per

uals 300 tons in journeys of 4½ tons each
ıms and coal). Also there is one 12in.
:d 1 in 6, hauling out of a dip incline
n 3 from a level 100ft. vertically below,
ons in eight hours. Also there is a pair of
geared 1 in 4 hauling along a main road,
m, a distance of one mile, the far-end of
nds 40ft. higher than the shaft end. This
400 tons in eight hours (trams included).
is one 10in. cylinder geared 1 in 4, hauling
half a mile along a main road, tail-rope
ng 150 tons in eight hours. The far-end of
is 2 ft. higher than shaft end. The steam
wn the shaft for 450ft. from the boilers in
ll coated with a non-conductor, and from
300ft. in 6in. pipes, and then variously dis-
om 200 to 360ft. through 3in. or 4in. pipes
ent hauling engines, &c. The steam-
ilers is 50lb. per square inch. What size
rs and air cylinders would it require to do
rk in compressing air on the surface, the
ndensed?—ONE INTERESTED.

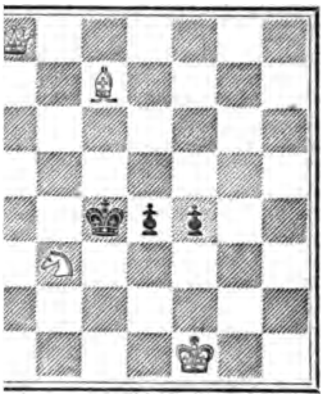
**ynamo.**—I have built a small dynamo,
e:—F.M. cores 4in. by 3¾in. by ⅝in., on
wound 3lb. No. 22 double cotton-covered
The armature which is of the Siemens H
. diameter, and is wound with 5oz. of No.
on-covered wire. After finishing it as care-
le, I coupled in shunt, and had it connected
ells (of a Leclanché battery) to try it as a
e armature set itself between the pole-pieces
would not move further till drawn out of
I then connected it to a small engine which
ture speed of 3,500 revolutions per minute,
sult I got was a slight spark when making
contact with wires from brush terminals.
sult is got when driven at 90 revolutions.
your numerous readers suggest what may
l oblige?—AMATEUR.

## CHESS.

unications for this department must be
'J. PIERCE, Knollside, Yawl, Lyme Regis,

PROBLEM MCCXXII.—No. 2.

*Black.*



*White.* [5 + 3

ite to play and mate in two moves.

SOLUTION TO 1220.

| *Vhite.* | *Black.* |
|---|---|
| . | 1. Any. |
| accordingly. | |

TICES TO CORRESPONDENTS.

lutions to 1220 by J. H. Eastwood, A. A.,
nstreet, Fr. Fernando (but K R 3 put for
istruck; to 1219 by A. A.

AND J. C. HEATHCOTE.—Names entered.
probably last nearly six months.

MER AND J. KISTRUCK.—Entrance fee re-
thanks.

Key move is enough for direct two-movers.

.—Get Green's "Chess," just published by
s, price one shilling. See page 5.

m of heating cars by steam from the
is proving so satisfactory in the States,
s likely to be generally adopted. The
existing concerned the economy of the
the possible effect upon the locomotive
cent tests, however, have settled that
d, indeed, the amount required, when
ith the pressure for drawing trains, is,
to the American *Journal of Railway*
so slight as to be scarcely appreciable.

STEEL is said to be coming into use for
e. It appears to be made by quenching
carbon steel in cold water from an
high temperature, such as would over-
for most purposes. This renders it not
but rather brittle, so that it is possible to
t. It is crushed in a stamp-mill, and
ly to size. It is said to be not only
t much more effective than emery, giving
and quicker polish, and lasting much

## ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

### HINTS TO CORRESPONDENTS.

**1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.**

***** Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

**The following are the initials, &c., of letters to hand up to Wednesday evening, Oct. 1, and unacknowledged elsewhere:—**

M. Glover and Co.—Randell Adams.—Foto File.—May.—St. Clair.—Arthur Hobday.—Dyfi.—Regulus.—E. W. —C. Goddard.—Invalid.—J. Brown, Belfast.—Pater.—Photo-Electrical.—Equi-potential.—Maud. — Worried. —Anxious Enquirer.—Astro-Star-gazer.—W. H. S.—J. G.—Jack of All Trades —Chas. J. Tahourdin.

JAMES ELLIS, Carnoustie. (You seem as much offended with us as with the authorities of the Dundee Free Library. We told you the volumes in which you will find Mr. Wassell's papers (XXXIII. to XLIV.), and we have no doubt the authorities having control of the library will allow you to see them if you conform to their rules. In Nos. 562, 564 you will find the paper of Mr. Lassell, revised by himself, or you can purchase Part I. Vol. 165 of the *Philosophical Transactions* of the Royal Society, which contains the paper complete. In many back volumes there are hints on the methods of working, but full directions necessarily occupy much space.)—YOUNG BOILER-MAKER. (Have you seen the articles published in the last three volumes? We do not know where you can obtain "working drawings," but some time ago a portfolio of working drawings was published at the office of the *Engineer*. There are no books specially devoted to locomotive boiler making, in the sense you mean.)—MACHANICAL ENGINEER (If you find spectacles necessary, it would be advisable to consult a specialist, and get him to examine the eyes. Works on the subject are obtainable at any booksellers, and you will find some mentioned in our advertising columns. "Eyesight, Good and Bad," by Brudenell Carter, F.R.C.S. (Macmillan), is the standard textbook.)—A. F. SHAKESPEAR. (Proctor's "Pocketbook for Marine Engineers" (Crosby Lockwood and Son) may be useful. Sennett's "Marine Steam Engine" (Longmans) is a well-known textbook, and there is Seaton's "Manual of Marine Engineering" (C. Griffin and Co.) You could see those and other works at the Patent Office Library.) — B. O. S. (The most accurate and elaborate map of the moon's surface is that by Schmidt, of Athens, published at the expense of the German Government. It is over 7½ft. in diameter. We do not know the price. Webb's was reduced from Beer and Mädler's, and is quite good enough for most observers. There are several maps in portions or charts. Mr. Wesley, Essex-street, Strand, W.C., could no doubt send you a list with prices.)—F. B. (You should procure the Programme of the Technological Examinations from the Secretary of the City and Guilds of London Institute, Gresham College, E.C.)—A. M. P. (So much depends on the "eye" at the end of the telescope that the question can be properly answered only by saying Try! Stars down to the 6th mag. may be seen by some eyes, especially in favoured climates; but as to what a 3in. refractor will show, the quality of the instrument comes in then in addition to the quality of the eye. Say, roughly, down to 11 mag.; but "it all depends"—one man can see better on some nights than on others.)—ELECTRICIAN. (Please see recent numbers and the indices to the back volumes. The questions have been answered over and over again.)—IGNORAMUS. (If you send the full "recipe" we may be able to guess what "hematis" means. Hematin is the colouring principle of logwood, and hæmatin is the colouring matter of blood; but it is useless to guess. Are you sure you have copied the word correctly?)—PESCATOR. (Apply to Sampson Low, Marston, and Co., Fetter-lane, E.C.)—LUX. Really we must refer you to our advertising columns, or to the catalogues of the lantern-makers. If the limelight is too costly, try paraffin-oil with a little camphor added. See the advertisements when the lantern season comes on.)—WOULD-BE ETCHER. (If you cannot manage it with soap and a saturated solution of sulphate of copper (bluestone), try Brunswick black or pitch softened with tallow. See indices to back volumes.)—G. W. VYSE. (If you cannot get the mercury to reunite by shaking the instrument, we are afraid there must be a crack or pinhole in the tube; but try shaking well and warming gently in an oven or over a spirit-lamp.)—F. HASSELL. (West's works on Moulding and Foundry Practice, published by Wiley and Son, New York, and by Trübner and Co. here, will no doubt suit; but there are many articles in back volumes.)—F. H. W. (Full information about organ building in back volumes; for a "book" procure Wicks's "Organ Building for Amateurs," Ward, Lock, and Co.)—EDITOR of KIBBIER. (The processes have been described; but the cost of "plant" would be so much that it would not pay; besides, if you have photos, you can get the blocks produced at, say, 6d. an inch.)—G. RYAN. (You will find full particulars in recent numbers. It would not pay except as an advertisement. Use accumulators if the shaft runs at an irregular speed. Have you calculated the cost of the dynamo and the power it will take off your shaft?)—GRANULE. (The materials, if in good condition, will do, of course; but we do not understand how we can tell the number of cells you will require without knowing the resistance of the lamp—probably three would suffice. Similar questions have been answered many times.)—LOCOMOTIVE. (Do you mean something that has not been illustrated? If so, please specify the class.)—BATTLE, NO NAME. (It would be a mere toy. See indices for hints on building miniature engines and boilers.)—A READER. (We do not know which set of articles you mean, but those on model locomotive run through the last three volumes.)—ISABEL BIRD. (Why not procure a map. Hevelius is at the top outside corner of the N.E. quadrant; in fact, just at the E. end of the equator in Beer and Mädler's chart.)

**Every Man and Woman wishing to be permanently strong and well should wear one of Harness' Electropathic Belts. They are delightfully comfortable to wear, and speedily invigorate and exhilarate the entire frame, completely exterminating disease from the system. Thousands of testimonials prove their remarkable curative value in nervous and rheumatic affections, liver, kidney, and other organic disorders, &c. Pamphlet and consultation free. Those who cannot call should write at once to the Medical Battery Co. (Ltd.), 52, Oxford-street, London, W. (the largest and only complete Electro-Medical Institute in the world).—[ADVT.]

## USEFUL AND SCIENTIFIC NOTES.

**Pearl Life Assurance Company.** — The annual report, presented at the twenty-sixth annual general meeting, held September 26th, states that 370,851 policies were issued during the past twelve months, representing a new annual premium income of £154,999 1s. 8½d. The total income for the past financial year amounted to £272,707 0s. 2d., and exceeded that of the previous year by £19,771 2s. 5½d., being an increase of more than 40 per cent. over that of the previous year. A dividend of 10 per cent. has been recommended and paid.

**Deepest Mine.**—The deepest mine in the world is said to be at St. Andre du Poirier, France. This mine yearly produces 300,000 tons of coal. The mine is worked with two shafts, one 2,952ft. deep, and the other 3,083ft. The latter shaft is now being deepened, and will soon touch the 4,000ft. level. A remarkable feature of this deep mine is the comparatively low temperature experienced, which seldom rises above 75° Fahr. The gold and silver mines of the Pacific Coast, at a depth of less than half that of the French coal mine, are often of so high a temperature that work becomes very difficult. In some levels of the Comstock lode the temperature rose as high as 120°

THE following paragraph is going the rounds:—In Arabia is a plant which has all the properties of laughing gas. It has bright yellow flowers, and seeds like black beans. These last are dried and crushed to powder, and when swallowed in small doses cause the person taking them to laugh and dance, and behave in a most ridiculous manner, until exhaustion and sleep supervene. The plant is known locally as "the laughing plant."

A NEW departure has been taken in the plans for the new building for the Congressional Library, in that the whole of that immense structure will contain no fire. The building will, of course be heated, but the heat will be located outside the building. Vaults will be constructed in the grounds where the fires and boilers will be placed, and the hot air will be carried into the library buildings by means of pipes. By this means complete protection against fire is secured. Where does the "new departure" come in?

THE Russian Geographical Society has received a further letter from Captain Grombtchevsky, dated July 20, and giving particulars of his survey of the Tibet plateau. On May 21 he and his companions began to go up the river Kouras, scaling the slope of the Tibet plateau. This march is exceedingly difficult. For fear of being pursued by the Chinese the travellers were obliged to proceed very quickly, marching as long as there was light and only resting in the dark. The weather was very cold. In the daytime the thermometer never rose above one degree centigrade, and at night it fell to 20° below zero, while the cold was much aggravated by several terrible snowstorms. Although in the middle of May there were no signs of the approach of spring. Snow and ice held undisputed possession of all the mountains. The route was everywhere suitable for wheeled traffic; but the want of forage and water makes it practicable for only 2½ months in the summer—viz., from July to mid-September. The expedition was consequently compelled to return to the neighbourhood of Lake Saghyl Kul. Captain Grombtchevsky then proposed to fix the position of several places, to explore the Kashgar mountains and the basin of the River Parnox. At Khoten the traveller visited the workshops of the jade and other stone quarriers, and photographed the workmen and their tools. He found the latter to be very simple; but also giving excellent results. Captain Grombtchevsky has also collected some interesting ethnographical information.

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Indexes for Vols. VI. and VII., 2d. each. Post free 2½d. each. Indexes to Vol. XL., and to subsequent vols., 3d. each, or post free 3½d. Cases for binding, 1s. 6d. each.

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Advertisements must reach the Office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

**Holloway's Pills.**—The balsamic nature of Holloway's Pills commends them to the favour of debilitated and nervous constitutions, which they soon resuscitate. They dislodge all obstructions, both in the bowels and elsewhere, and are, on that account, much sought after for promoting regularity of action in young females and delicate persons.

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**Astronomical Telescope**, 12½in. Equatorial, "With" Reflector, Wedge Photometer, Micrometer, Electric Illumination. Astronomical Books and Instruments. Opera Glasses, Plate Machine, Case Mathematical Instruments.—Below.

**Astronomical Observatory**, 12ft. dome, transit and computing rooms, two sets of Patterns for Equatorial stands, two Dynamos, Tricycle, Grindstone, Sugg's Cromartie Lamp.—Below.

**Astronomical Clock**, by Cooke, York; two Aneroid Barometers, three Bichromate Batteries, new Wimshurst Machine, 15in. ebonite cylinders; 15in. Terrestrial Globe, by Newton.—Below.

**Astronomical Transit**, 2½ O.G., silver circles, striding level, collimating eyepiece; 21 Lantern Photographs, Fletcher's Tubular Gas Stove, apparatus various. List, stamp.—Box 20, Liversedge.

**½H.P. Beam Engine**, fitted with governors, throttle vlave, slide valve, &c., cost £20 to make. Exchange for Gas Engine or offers.—John Pedley, 8, Stuart-street, Luton, Beds.

Wanted to exchange **Engine and Boiler Shell**, for ½H.P. Electric Motor. Good bargain.—For particulars apply A. S., 4, Bromley Villas, Wood Green, London, N.

**Shop Oil Lamps**, Vice, Lathe, Boy's Tricycle, Mail Cart, Perpetual Dater, A B C Copier. Fletcher's Blowpipe, Forge. Good exchange wanted.—9, Wellesley-terrace, Kilburn-lane.

Astronomical Telescope, Refractor, good, wanted in exchange for Microscope and Chronometer, value £25.—Bassett, 82, High-street, Stoke Newington.

Wanted, any Lathe Parts, finished or unfinished; also old brass or copper. Can offer first-class exchange. Offers invited.—T. Tipping, Painswick, Gloucestershire.

**Safety Bicycle**, ball bearings, in good order. Exchange anything useful.—R. Gornall, Damside, Pilling, viâ Garstang.

52in. **Bicycle**, ball bearings, good machine. Exchange.—R. Gornall, Damside, Pilling, viâ Garstang.

**Safety**, light rear-driver, value £10, good order (seen any time.) Exchange screw-cutting lathe, or offers.—Cyclist, 131, Scovell-road, Borough, S.E.

Wanted to exchange, ½-plate **Camera**, Lens, six double slides; and Watson's detective camera, six double slides, for 10 by 8 camera, lens, and six double slides in good condition. Can be seen.—D., 6, St. Germain's-road, Forest-hill.

Exchange **Vacuum Tube Rotator**, best make, under glass shade, fitted with adjustable tube-holder, and tube, for ½-plate apparatus or offers.—Below.

**A Brass Cylinder**, 1in. stroke, with crank and bearings, 6in. circular, suit lathe, exchange offers.—25, College-road, Kensal-green, W.

Exchange good **Rational Bicycle**, 53in., black rubbers, Bown's balls all over, almost new, for good drilling machine.—C. Bennett, Lesbourne-road, Reigate.

**Intensity Coil**, Electro-Motor, lot of Jars, Carbons, Clamps &c., for making bichromate batteries. Exchange lot only, prize pigeons, rabbits.—Hall, Pinfold-lane, Lancaster.

**50in. Bicycle**, Æolus bearings and new tyre to front wheel; new long distance saddle. Will exchange for good set of mathematical instruments.—F. D. Hunt, 32, Theobald-road, Croydon.

1 dozen new **Electric Bells**, best English make, warranted, polished hard-wood cases, iron frames, silk-covered wire; very highly finished. cost 60s. Exchange. Approval deposit.—M., 40, Woodberry Grove, Finsbury Park, N.

**Gas Engine**, 1H.P., by Crossley, in good condition. Exchange for 12in centre gap-bed Self-acting Lathe or Planing Machine.—Seage, Clifton-road, Exeter.

Cylinder **Printing Machine** (double crown), in splendid condition. Exchange for Iron Planing Machine or large Lathe.—Seage, Clifton-road, Exeter.

**Gas Engine**, horizontal, about ½H.P., experimental, Wither's patent, by Benyon and Cox, Torquay. Exchange for Iron Shaping Machine.—Seage, Clifton-road, Exeter.

Hand-power **Driving Wheel**, friction roller bearings, good condition. Exchange for small Shaping Machine.—Seage, Clifton-road, Exeter.

**Photo Burnishing Roller**, Phantom instantaneous shutter. Exchange anything useful to 15s., Lancaster's wide-angle view, or other ½ lens preferred.—Balmforth, Scout-hill, Dewsbury.

Pulvermacher's **Galvanic Chain Battery**, quite new, perfect; good Telescope 18½in. long, 1½ glass. Medical Coil and Battery (bisulphate mercury) with accessories in case.

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Will exchange 80 nos. "**Work**," also one volume "Amateur Gardening," for Electric Bells. Offers.—R. T., 15, Ruth-street, Bolton.

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Eighty numbers of "**Engineering**," with numerous plates. Will exchange for small Boiler and fittings.—H. Boulton, The Kennels, Cirencester.

**Revolver** and leather holster, flywheel, shaft and gear for mangle. Fan 9in., intermittent gear, and handwheel. Exchange for Model Engines and Boilers.—Gale, Seend, Melksham.

**Grindstone** and glazer, screwed spindle, and two sets of plates, two stones and one glazer; fast loose pulleys, all complete, ready for working. Exchange for strong Sewing Machine, Smith's Bellows, Musical Box, Telescope.—C. Metcalfe, Fishwick-street, Rochdale.

Strong beam **Scales** up to 10 cwt., wood ends and chains complete; eight 56lb. weights. Exchange offers.—C. Metcalfe, Fishwick-Street, Rochdale.

Fine **Horizontal Engine**, cylinder lagged, 2in. by 4in., with drain cocks. Slide-bars, gunmetal bearings throughout, drive lathe, worth 55s. Exchange.—Martin.

Splendid **Horizontal Engine**, cylinder 1½ by 3½, massive turned Iron Flywheel, quite new, value 60s., exchange. Either seen working.—W. Martin, East-road, West Ham, E.

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What offers for first class **Horizontal Bar**?—D., 29, Stock Orchard-crescent, Holloway.

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**Tandem Tricycle**, Sociable, single tricycles, safety bicycle, small engine. Either of above in exchange to value, for 1½ Shafting, Pulleys &c., to drive Lathes.—Tupper, Redhill.

¼-plate **Camera**, lens, tripod, lamp, developing trays, Printing Frames, &c. Exchange for six-chambered Revolver, by good maker.—Ernest Sladen, Ewell, Surrey.

½-plate **Camera**, 2 double backs, tripod, Lancaster landscape lens, for ½-plate Rectilinear. Will send on approval.—Trevett, 11, Southgate-road, Winchester.

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**Cornet**, B-flat, good maker, in box, cost £7. Exchange for Photographic Set or anything useful.—George, 1, Albert-terrace, Cloudesley-road, London, N.

**Euphonium**, in C, with slide to put into B-flat, cost £7. Exchange for Photographic Set or anything useful.—George, 1, Albert-terrace, Cloudesley-road.

What offers, 1½ **Cylinder**, brass, turned and bored, the set complete, with crank for same.—H. Byatt, 61, Oakfield-road, Stroud-green.

What offers for 3½ **Mandrel and Head**, 3 chucks, small driving.—H. Byatt, 61, Oakfield-road, Stroud-green, N.

"**English Mechanic**," Vols. VI. to XXXV., few bound, rest unbound, complete, with indexes; also Scientific Works, old and modern. Want Lantern Slides and ½-plate Portrait Lens.—77, Lavender-hill, Tonbridge, Kent.

**Dragoon Pigeons**.—High-class, prize-bred blue, and yellow Dragoons for exchange. Long focus 5 by 4 or ½ Camera wanted.—Smyth, Bury, Suffolk.

50c.p. **Dynamo** for exchange. Good Photo. apparatus or first-class ½-plate Lens only. Offers to—J. S., 18, Lowbaxter, Bury, Suffolk.

**Books**.—Wanted, "Thompson's Elementary Electricity," Monro or Kempe's Pocketbook, Salomon's Accumulator. Exchange Thompson's Dynamo, Badt's Dynamo Tender's Handbook, Culley's Telegraphy.—W., 70, Plumstead Common-road, S.E.

Small **Bench Lathe**, 1½in. centre, double-bar bed, and about 30 chucks, male and female, &c. Exchange 3in. compound slide, saloon rifle, or offers to—Draughtsman, Tramcar Works, Birkenhead.

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Will exchange the **Above** for a good Portable Forge and Anvil, or Shafting and Pulleys; engine flywheel, 3ft. 6in. dia.

Or will negotiate otherwise for the **Above** if cheap. No rubbish offered or accepted.—H. Rance, 102, Teviot-street, Bromley, E.

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English Mechanic
WORLD OF SCIENCE AND ART.
*FRIDAY, OCTOBER* 10, 1890.

# PHONES: THEIR CONSTRUC- ION AND FITTING.—VIII.

By F. C. Allsop.

of "Practical Electric Bell Fitting," lectric Bell Construction," "Practical Electric Light Fitting," &c.

### Fixing the Instruments.

telephone line having been got hrough between the two places and arth" wire run, the next thing is to instruments, which should previously been tested with a cell or two to see ey are in good condition. Having set battery so that the salammoniac can solving while the instruments are fixed, the first thing is to ascertain the sition in which to fix the telephone. iding on the position, care should be to see that the instrument is not on a partition or wall where there is vibration, such as is likely to be caused chinery or the opening and shutting of as this would cause noises in the tele- owing to the microphone being set in on. Noisy positions, such as near a or door opening into the street, also be avoided. The position being ined, we next ascertain the nature of ll, so that the fixing can be obtained ingly.

e are three different kinds of fixings lly met with in buildings—1, wood- 2, laths and plaster; and 3, brick, ith plaster. The construction of the n usually be found out by tapping on a hammer or the end of a screw-

If the wall is woodwork, it will lly give out a loud sound; if laths and , a hollow sound; and, if brick or a dull sound. In a laths and plaster n the upright posts to which the laths led can be found by probing with a l or similar instrument. If the wall d, the fixing will be comparatively s the instrument can be screwed to it rdinary wood-screws, but if laths and , lath screws must be used, the proper of which can be ascertained by g for the laths with a bradawl. one of the screws pass between two he position of the instrument should red until a lath is obtained for each

For a brick wall, the position for ews must first be marked by holding trument against the wall and passing wl through the screw-holes in the nent, and, the position being marked, ll must be plugged at these points. the wall an inch cold chisel will be d, with which a hole must be cut in l about 3in. deep and 1¼in. wide. The cut square, the back part being smaller in diameter than the . Wooden plugs must now be made, ut square like the hole, but slightly and shorter, and with a slight taper. tter also to so cut the plugs as to em a slight twist, as this form takes hold of a square hole. The plugs erwards driven into the plug holes ith the surface of the wall, and the ent fixed by means of wood-screws. ing the ends of the wires under the ls of the instrument, the ends of the ould be so placed under the terminal hen the terminal is screwed up it twist the wire round the body of ew, and not to unwind it, as this cause the wire to work out from ath the screwhead. In terminals he wire passes into a hole, and the ears directly on it, the end of the wire should be neatly doubled back on itself before being passed into the hole. In finishing off the ends of the wire where they join the instrument, a short length of the wire should be spiralled round a pencil, as this gives the instrument a more finished appearance.

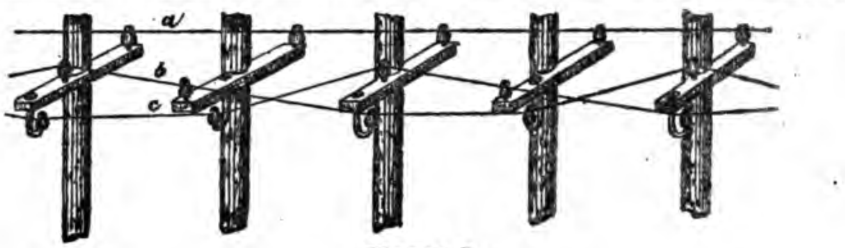

Fig. 45.

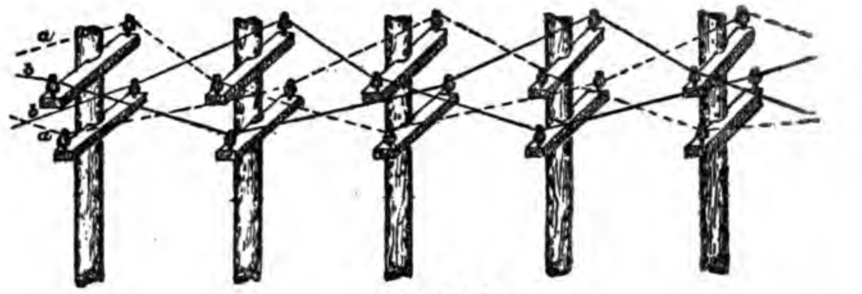

Fig. 46.

### Induction and Leakage.

Trouble will often arise in telephone lines that run side by side for any great distance from induction and leakage from wire to wire. The one can generally be remedied by a little attention to the insulation of the line, and the other by specially arranging the wires. The noises arising from induction are caused by the currents in a neighbouring wire inducing similar currents in the other wires. As we know from an ordinary induction coil, when we send a current in one direction in the primary, we get a current in the opposite direction in the secondary. In an induction coil, of course, the two circuits are coiled closely together, but the same result takes place in a less powerful manner when the circuits run straight side by side. Were the current in the primary of an induction coil perfectly continuous, there would be no result in the secondary; hence the necessity for a make-and-break or else an alternating current. Likewise, if the telephone currents were continuous, there would be no trouble from induction; but since the telephone depends for its action on undulating and varying currents, the current given out by the microphone or the magnetic receiver are necessarily of a rapidly alternating and undulating character. It seems almost incredible that a wire perfectly insulated can have any very inconveniencing effect on other wires, also well insulated, and some 3ft. or 4ft. away, but the currents required for working a telephone are of the most feeble strength. In a telephone exchange the inconveniences arising from induction are often very great: messages sent along one wire being heard distinctly in a neighbouring wire, and thus a message intended for a certain person might also reach the ears of persons from whom it was most desirable it should be kept.

Although the induction from wire to wire is bad, yet that arising from neighbouring electric-light wires is very much worse, the electric-light currents being so powerful that they make their effects felt from a great distance. Nearly everything depends on the arrangement of the electric-light circuits as to their effect on the neighbouring telephone wires. For instance, if the electric-light circuit consists of arc lamps in series, with the lead leaving the central station in one direction, and after making a whole circuit of the town returning in another, then the telephones in that town will have a merry time of it at night. Happily, however, though this method of working electric lamps was much in vogue three or four years ago, it is now rapidly giving way to the transformer systems, and as the transformers are in parallel, the return lead must necessarily be run in close proximity to the feed, thus the effect of the one wire is neutralised by that of the other.

When telephone wires run in close proximity to telegraph wires, we have noises in the telephones caused by the induction from the telegraph wires, the quick make-and-break of the circuit by the telegraph instruments being distinctly audible. With the telegraph wires an earth return is used; thus when towns are connected together for the purposes of telephonic communication, and the route along the railroad is taken, if an earth return were used for the telephones also, it would be well nigh impossible to detect what was being said, owing to the noise arising from induction. A return wire is, therefore, used for the telephones; though even this does not do away entirely with the induction, as one of the telephone wires is perhaps nearer to the telegraph wires than the other, and thus the neutralising effect of the two wires is lost. The telephone wires are therefore arranged so that they change position from pole to pole, first one wire and then the other being nearest the telegraph wires, as shown in Fig. 45. In the case of two telephone circuits the wires are arranged as in Fig. 46, the one circuit being represented by the continous, and the other by the dotted, lines. In Fig. 45, *a* is the telegraph wire, and *b* and *c* are the two wires of the telephone line, while in Fig. 46, *a a* are the two wires of the one telephone line, and *b b* those of the other.

Where telephone wires run for great distances together on the same poles or supports, another trouble that arises is that of leakage from one wire to another, causing noises in the telephone and "cross talk." This is caused by the current from one wire passing by means of the pathway formed at every insulator by the dust and moisture that collect on the surface to the neighbouring wires, all of which have a common return—viz., the earth. The greater the number of insulators on the lines, the more numerous the pathways from one wire to another, and the less the insulation resistance between the wires. Where trouble does arise from leakage and cross talk, it will generally be found that the insulation at some parts of the line has become defective. A film of dirt will often coat rapidly over the insulators, especially in smoky towns, and this when wet forms a path of leakage. It is best to expose the insulators of a line as much as possible, as then the heavy rains will from time to time wash them, and they will dry comparatively clean; but if sheltered in any way, the dirt quickly accumulates. In the case of telegraph circuits, where the currents are more powerful, the chief inconvenience caused by the leakage is that it reduces the strength of the current at the sending station; but, in telephony, where the currents are so feeble, the trouble is more, prevent these stray messages passing from one line to another, rather than to provide against the reduction of the current strength.

In towns where there are a number of telephones, there is another form of leakage that will sometimes take place from wire to wire—viz., that by way of earth. If two telephone lines coming from different parts of the town end at one station close together, and the earth connections of both have a high resistance, then the currents passing from the further end of No. 1 line might pass across to No. 2 line at the station where the earths are close together, and make its way to earth at the further end of No. 2 line, presuming this path was of lower resistance. Thus messages sent along one line would also be heard in the other. If care, however, is taken to secure a good earth connection at both ends of the line, such a trouble as this will be almost impossible.

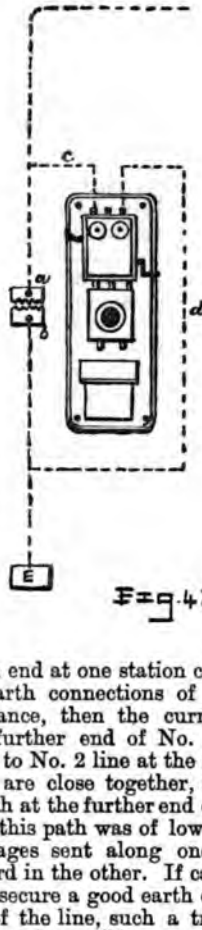

Fig. 47.

### Lightning Arresters.

The liability of overhead wires to be struck by lightning necessitates the employment of lightning arresters in a telephone line where the wires are overhead, though the necessity for lightning-arresters is not so great in this country as abroad. When a telephone line without an arrester is struck, the discharge passes to earth by means of one or both ends of the line, passing through and destroying the instrument, and might pass, if the conditions were favourable, to any person standing near the instrument, in all probability with unpleasant, if not fatal, results. The duty of a lightning-arrester is to intercept the discharge and pass it directly to earth, thus protecting the instrument and the person who might be using it. The manner in which this is done will readily be understood by referring to Fig. 47, which shows the connections at one end of a telephone line with the telephone and lightning arrester in circuit. The arrester consists of the two brass plates *a* and *b* fixed on an insulating base so as to be perfectly insulated from one another. The two sides of the brass plate, where they come close together, are cut to a saw-edge as shown in the figure, and the plates are so fixed that the projecting points of the one plate come opposite those of the other plate, and as close as possible without touching. The telephone currents entering at line pass to the wire *c*, through the telephone instrument, to wire *d*, and thence to earth, E. If the line, however, is struck by lightning, the discharge endeavours to pass to earth, and arriving at the plate *a*, jumps across to the plate *b*, from which plate there is a path of lower resistance to earth than through the telephone, and passes directly to earth, the jumping across the two plates being assisted by the serrated edges. As was pointed out when speaking of the earth wires, it is important that the earth wire does not pass too close to any pipes in connection with the earth, or it might jump across to these in preference. Six inches is the least distance that should be allowed.

The presence of thunder clouds will very often cause curious effects in the telephone, the inductive discharge setting the bells ringing, and being often powerful enough to fuse the coils of the bell or annunciator. When a thunderstorm is in progress in the neighbourhood of a telephone line, each flash can (though, by the way, it is not advisable to listen for them) distinctly be heard in the receiver, which manifests itself by a sharp click, and the writer has often been able to hear the flashes in the telephone some time after the storm has passed out of hearing.

(*To be continued.*)

## REVIEWS.

*A Handbook of Descriptive and Practical Astronomy.* By George F. Chambers, F.R.A.S. Oxford: The Clarendon Press.

THIS is the third and concluding volume of Mr. Chambers's new edition of his Handbook of Astronomy, which takes up the branch known as the "Starry Heavens." Each volume is now sold separately, and is complete in itself, dealing with one branch of the subject. The "Starry Heavens" is beautifully printed and freely illustrated, while its contents have been revised and brought up to date. The most important additions are the chapters containing a photometric catalogue of naked-eye stars, and on finding the constellations during the several months in the year. It is thus a working astronomer's handbook, and as such will be appreciated as much as the other volumes are by the student in the library. We need scarcely say that while the work will be useful to the practised astronomer, it will be of great value to the novice—the catalogues of stars being of especial worth to him when accompanied by so clear and readable a descriptive text. There is a separate index to the volume, and also a comprehensive index of the whole work, while the frontispiece is an "untouched" reproduction of a photograph of a portion of Cassiopeia, taken at the Paris Observatory in 1887. The three volumes may be said to form a "library" of astronomy, for Mr. Chambers has appended copious notes which render the work of the student comparatively easy, as they give the references which often take so much time to look up.

*Elementary Dynamics of Particles and Solids.* By W. M. Hicks, M.A., F.R.S. London: Macmillan and Co.

The contents of this volume are based on the lectures delivered by the author as Principal of Firth College, Sheffield, and looking through its pages we think it is admirably adapted for the object the author had in view, as it is intended for the use of students who, wishing to acquire some knowledge of the principles of dynamics, are without that acquaintance with the higher branches of mathematics which would enable them to tackle the more elaborate treatises. The student must, however, have some knowledge of algebra and geometry, and a little trigonometry; but the work contains many examples, so set out that the intelligent mechanic or engineer's apprentice will soon get such an insight into the business as will encourage him to go on. The treatise is also well adapted for a school book.

*Travels and Discoveries in North and Central Africa.* By Henry Barth, Ph.D., D.C.L. London, New York, and Melbourne: Ward, Lock, and Co.

This is one of the Minerva Library of Famous Books, edited by G. T. Bettany, M.A., B.Sc., and gives an account of the travels of the author, Dr. Barth, in North and Central Africa, including notes on Tripoli, the Sahara, the Kingdom of Bornu, and the countries around Lake Chad. The author's great work was published in English and German in 1857, and the volume now issued under the editorship of Mr. Bettany is the first half of probably the most important work ever written on the districts it describes. Dr. Barth was not a naturalist or a botanist, or a geologist in the sense that we think of Darwin or Wallace, but he was an energetic and observant traveller, and his works contain most interesting topographical, historical, and anthropological details, while they must have an interest for readers [in this country, inasmuch as Dr. Barth was supported by the British Government with ample funds, and obtained much valuable information about the prospects of trade in the localities he visited, as also (which was one of the chief objects) facts about the slave trade. The volume is illustrated with reproductions of the original plates, and with numerous woodcuts.

*The Story of the Heavens.* By Sir R. S. Ball, LL.D., F.R.S., Royal Astronomer of Ireland. Fifteenth Thousand. London: Cassell and Co., Limited.

We cannot say more in praise of this valuable book than we did in the exhaustive review which we devoted to it on its first publication just five years since. Certainly nothing has appeared since of equal merit—not merely as an astronomical textbook, but as a readable record for the man of ordinary intelligence and information, of the marvels of space and the mechanical and optical aids by which man has striven to familiarise himself with them. We may briefly remind readers not yet acquainted with the book that Sir Robert Ball conducts them first though the astronomer's observatory, explaining all his apparatus, and then deals in succession with the sun, the moon, and the planets; afterwards with the fixed stars, comets, the spectroscope, the astronomical significance of heat, and the nature of the tides. Each chapter is a model of judicious condensation, the illustrations are admirable, and the book, as a whole, is the best of its kind obtainable.

We have also received *The Electrical Engineer's Pocket-book*, by H. R. Kemp (London: Crosby Lockwood and Son), whic contains a great deal of information in th shape of *memoria technica* for electrica engineers, and will be found especially usefu by those who may be called upon to d electrical engineering work, for Mr. Kemp is the "technical officer" to the Postal Telegraphs. It is an excellent pocket-book for the practising electrician.——*Tables and Memoranda for Electrical Engineers*, by Frederick Walker (London: Iliffe and Son) will be found useful by the practical t is "interleaved" for the addition s, and is of small size.——*The a of Photography*, by JOHN WERGE : Piper and Carter), will interest ho practise photography for amuse- r as a profession. The author ' reminiscences" extending over ears, and some excellent auto- productions of portraits of the rs" in photography.——*A Treatise aw and Practice of Patents for In-* by JAMES JOHNSON and J. HENRY (Longmans), is the sixth edition nd enlarged of a well-known manual nt law, useful alike to intending s and those members of the legal n who may be engaged in patent —*The Elements of Machine Design*, AWTHORNE UNWIN (London: Long- the eleventh edition of a well-known hich, however, the author has found able to divide into two parts, and a third will appear. Part I. has ised and enlarged, and the fact that eleventh edition shows in what repute k is held.——*Electric Light Fitting*, W. URQUHART (London: Crosby d and Son) is a handbook for work- trical engineers—that is, for those thout being able to follow the authors tandard textbooks, desire to know can of the practical part of the work.

## 'S METHOD OF ELECTRIC WELDING.

E who have studied the question of tric welding most closely have little t in the future it will play an important e mechanic arts; therefore, we devote a description of the plan which has nted in this country on behalf of Mr. fin, of Detroit, Michigan, by Mr. W. P. n, the well-known patent agent. Mr. nvention relates to an improved process c welding, which differs from the known f electric welding in which the two to be welded are brought into contact d by the effect of an electric current through them, in that it utilises the heat of the voltaic arc, and therefore uch larger masses to be welded, and it ve with much less current. Fig. 1 of ings is a perspective view of one form tus which may be used to practise the . Fig. 2 shows a slight modification, the ends of the rods to be welded are y a light piece of metal which serves te the circuit, and is destroyed by the f the current, thus forming the voltaic g. 3 is a sectional elevation of the s, so constructed that the welding can be performed in a non-oxidising

Referring to Fig. 1, A represents a ne end of which is secured, but insu- refrom, a block, B, provided with a cap, olts, P, to form a clamp. C represents block to, but insulated from, the other e frame, and extended, as shown at C¹, bed for a movable clamp, D, having a ecured thereto by the bolts O. K repre- rew-rod passing through clamp C, and collar on its inner end (not shown), and rough clamp D, and terminating in a at its outer end. I represents a box to rew-rod, K, secured to bed C¹. W W two metal rods to be welded together, in the clamps B H and D G in line with r. Y and L indicate electric conductors rom the poles of an electrical generator, ectively connected to the resistance- and cut-out switch F. E represents a -switch for the purpose of regulating nt, and F represents a switch by which it may be opened or closed. M and N electrical conductors connecting the with the blocks C and B respectively. witches and electrical connections are wn, and form no part of the invention. eration of the invention is as follows:— ric current being turned into the piece e clamp D G is moved by turning the d K until the ends of the rods W W contact, closing the current. The d is then reversed, slightly separating the ends of the rods, and causing a voltaic arc to be formed between them, by which the ends of the rods are rapidly brought to welding heat. When this has been attained by means of the screw-rod K, the ends of the rods W W are pressed firmly together and held in contact until the weld is completed; or, instead of bringing the ends of the rods W W together and then separating them to form the arc, the space between them may be bridged by a light piece of metal, S (Fig. 2), which serves to complete the circuit, and is destroyed by the passage of the current, thus forming the voltaic arc.

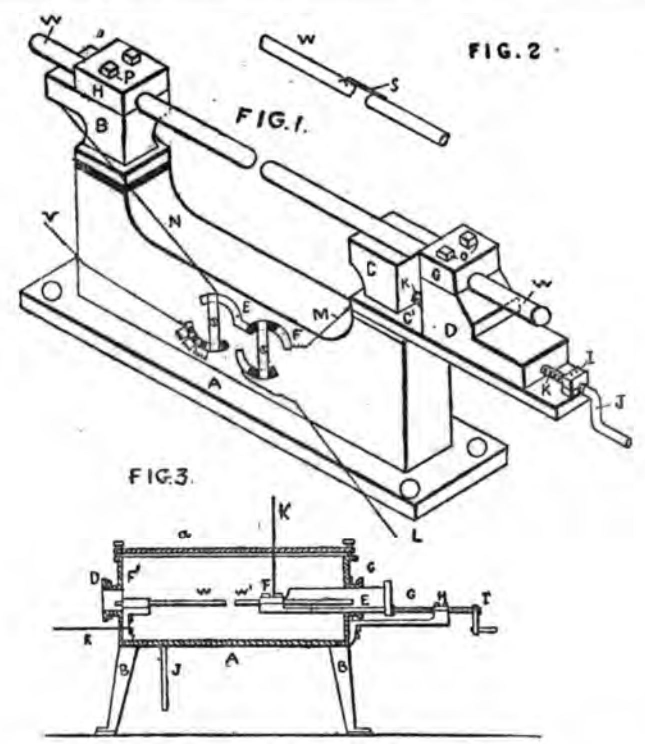

FIG. 1.

FIG. 2.

FIG. 3.

Fig. 3 shows the apparatus so constructed that the welding operation can be performed in a non-oxidising medium. In this Fig., A represents a box supported on legs, B, and having a tight-fitting cover, *a*, which may be bolted thereto. C represents a stuffing-box, through which slides a tight box, E, carrying on its end a clamp, F, insulated from the box E to hold one of the articles, W¹, to be welded. F¹ represents a clamp secured at one end of box, A, and insulated therefrom to hold the other article, W, to be welded. D represents a manhole provided with tight-fitting cover, through which the article W may be passed into the box A. K¹ and K represent electrical conductors, which connect the poles of an electrical generator with the clamps F and F¹. H represents a bracket secured to the end of box, A, having thereon a screw-nut, in which meshes a screw, G, provided with a crank, I, by which the box E may be moved in either direction. J represents a pipe connected with box A, by which said box may be exhausted of air and then filled with some non-oxidising medium. Any non-oxodising medium may be employed—such as hydrogen gas, nitrogen, hydrocarbon gas, solution of caustic alkaline, &c.—including any medium which retards the formation of oxides and scale upon and within the metal which is being welded. This medium may be used under pressure or under ordinary atmospheric pressure or rarefied. If a liquid medium be used, the cover *a* is, of course, unnecessary, the box A being filled with the liquid, so as to submerge the articles to be welded.

## MODEL LOCOMOTIVE-MAKING.—X.

THE fittings and mountings of the boiler described in the last article are the regulator, steam-pipe, safety-valve, gauge-cocks, whistle, fire and smoke-box doors, and fire bars.

Of regulators there are several kinds. In the last loco. we had one of the sliding form, Vol. L. p. 398, which gives rather more work than I want to introduce here. And placing a slide-valve in the smoke-box of a model is, I think, rather objectionable, because of the elasticity of the long slender rod, or rather wire, necessary to operate it. So I settle to have the regulator in the dome as before, and to bring the dome as close to the handle as possible. I show three forms, either of which will serve our purpose, and preferring, on the whole, Fig. 51, shall incorporate that in our design.

First, a common plug-cock, Fig. 49, will answer very well; but it should be specially made for the purpose. An ordinary cock is longer in the plug than the one drawn, and the diameter of the dome would have in consequence to be increased more than is desirable. Not that a large dome would in itself be an evil, but rather an advantage—to get good steam space; but it is objectionable on the ground of weakening the outer fire-box sheet by cutting out a disproportionately large hole. But by shortening the plug, and making its passage round, instead of slot-shaped, we might get a ⅜in. cock into a dome of 2¼in. internal diameter.

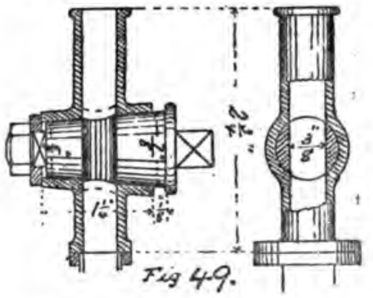

Fig 49.

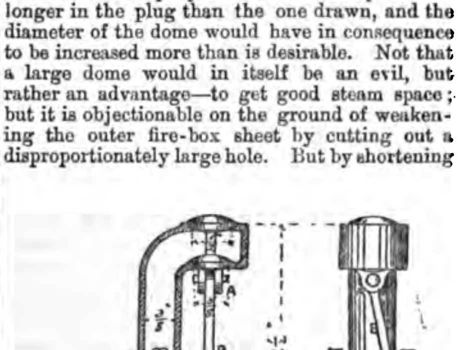

Fig. 50

Another suitable form is the double disc valve, Fig. 50. Of course, one disc—the upper one—would be sufficient; but having the lower one connected to it with a stem, the valve being double, is nearly in equilibrium, and can be opened and closed a trifle more easily than a single valve. Though the difference would be slight here, it is, nevertheless, worth considera-

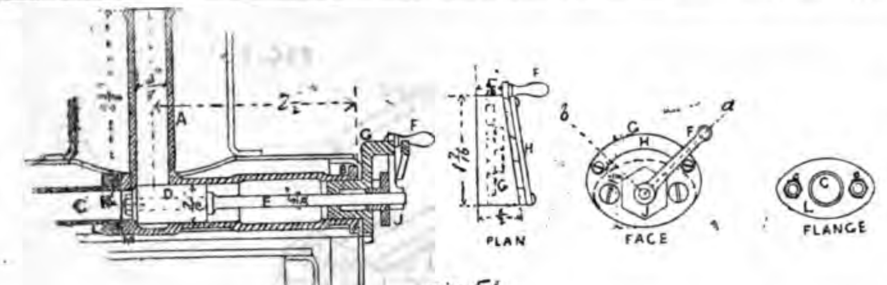

Fig 51.

tice in a model where the little levers are necessarily slight, and therefore apt to spring. A couple of lugs, A, are cast upon the valve, and receive the link B, which is operated by the levers C, C, whose extreme positions are shown at *a*, *a*. The lift of the valve need only be equivalent to the distance *b*, about $\frac{1}{8}$in. It would be easily made and fitted up.

But the valve in Fig. 51 is not only easily made, but it requires no attachment to the dome such as would be needed by the others. The casing A is held securely by means of the flange E bolted to the back fire-box plate at one end, and this, with the attachment of the regulator to the steam-pipe C at the other end, will keep it sufficiently rigid and steady in position.

The casing A consists of two tubes at right angles with each other. The valve D is a solid plug closing against an annular bevelled edge. To avoid drilling through the whole length of the horizontal tube, the metal is chambered out. The disc or plug valve D is opened and closed by means of the rod E and handle F. The regulator quadrant G, bolted to the back boiler-plate, has its face sloped to the same extent that the valve D is required to open; consequently, when the handle is moved from *a* to *b*, the valve D is drawn away from its bevelled seating to that extent. The valve may be tightly fixed on its rod, E, or the rod may be allowed to turn freely in the valve—it does not matter which. The handle F is made to slide inwards when turned from *b* to *a* for closing the valve by means of the bridge piece H screwed to the quadrant piece G. The quadrant has the usual stuffing-box and gland, J, the latter being in this instance only screwed in, and having an hexagonal flange.

The valve-casing A is attached to the steam-pipe C thus:—

At that end of the pipe C which abuts against the casing A, a small copper collar, K, is brazed on. This is embraced by a gland-shaped flange, L, which matches the flange M cast upon the end of the regulator pipe. These two flanges do not come into actual contact, but are separated by a little space, so that when the bolts *c*, or the hexagon-headed screws are tightened up, the end of the pipe C, with its bevelled collar K, and the flange L, will be pulled into steam-tight contact.

At the smoke-box end the steam-pipe is brazed or soldered into a casting having three branches, one for the main pipe, the other two branches receiving the smaller steam-pipes that conduct the steam to the cylinders. This branch pipe is attached by means of a circular flange to the tube plate, and will be shown in the next article. The boss, into which the main steam-pipe enters, is prolonged to pass just through the tube-plate.

The regulator is thrust into the boiler through the dome opening before the dome is finally steam-jointed. When the regulator is bolted to the back fire-box plate, then the long steam-pipe —brazed to its three-way casting—is thrust through the opening drilled for it in the front tube-plate, the flange L passed through the dome opening, slid over its end, and the copper collar K then brazed or soldered on with a blow-pipe inserted through the dome opening. The insertion of the screws will secure the whole in place.

At first I intended to screw a safety-valve into the fire-box sheet; but the crown of the dome offers a tempting seating for the safety-valve, and a spring balance has so good an appearance, that I show that arrangement in Fig. 52. A boss, A, is cast upon the crown of the dome and drilled to $\frac{3}{8}$in. or $\frac{7}{16}$in. to receive the valve. A lug, B, is cast upon the crown to take one end of the lever C freely pivoted upon it. The pin D is also freely pivoted to the lever, and is pressed down into the hollow of the valve by means of the spring balance E attached at one end to the lever and at the other to the crown sheet.

But though the safety-valve is thus shown fitted with spring balance in orthodox fashion, for some reasons I should prefer using a direct-acting spring like those sold in the model-maker's shops. The reasons are these: The pull on the spring balance is so slight that the least sticking anywhere would render the valve inoperative. This is in consequence of the small area of the valve itself—only a trifle over one tenth of a square inch, and the consequent small pressure upon it, with further diminution of pull at the spring balance. We will work it out.

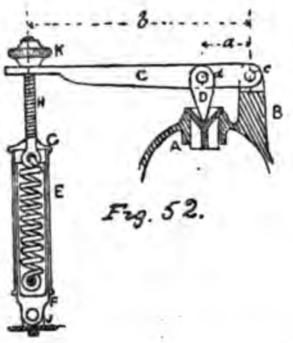

Fig. 52.

The diameter of the valve is, say, $\frac{3}{8}$in., and the proposed working pressure of the boiler is 70lb. The area of $\frac{3}{8}$in. is ·1104in., which, multiplied by 70, gives a pressure of 7·7280lb. on the valve. Neglecting the weight of the valve and lever, which is a mere trifle, we multiply 7·7280 by the distance *a* in Fig. = $\frac{9}{16}$in. = ·5625in., and divide the result by the distance $b$ = 2·6250in., and the result is 1·6lb. pull on the spring, in order that the valve shall blow off at 70lb.

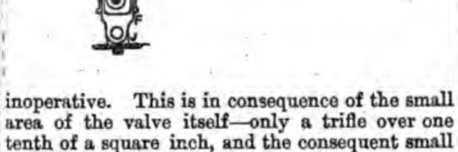

Fig. 53.

We cannot get much more pull on the spring because of limited space on the dome. The valve could be made $\frac{7}{16}$in. or $\frac{1}{2}$in. in diameter, and the short arm of the lever increased, and the long arm diminished in length—a little, but not much. For this reason I should, if a spring balance is fitted for the sake of good appearance, fit also a directing-acting spring safety-valve on the other side of the dome, away from the foot-plate.

Either form of valve can be bought of the model-makers, or made. The construction of the spring-balance form is as follows:—

The balance itself consists of an outer tube, E, and an inner, F, the latter sliding freely within the former. A cap, G, is fitted over E, and receives the end of the screw H, which is usually secured into the cap with a pin; in this case it had better be tapped in and there soldered. The lower end of the spring is attached to the bottom end of F by means of a pin passed through the eye of the spring. The cap G is then soldered on. A little anchoring block, J, is tapped into the boiler to take the lower end of F, to which it is secured with a pin. At the upper end of the balance the milled nut K is turned upon the screw above the lever C, and the tension of the spring is thus regulated. The lever C is pivoted at *c*, and the pin D, pivoted at *d* to the lever, is pressed upon the valve. The valve, being in unstable equilibrium, is less liable to stick than some other forms. The index pointer is attached to the inner tube in actual balances, and the graduations marked on the outer tube. All this is troublesome work, and, except desired for the sake of appearance, had better be left alone.

In a direct-acting spring valve, Fig. 53, the power of the spring would be exactly the same as the pressure on the valve—that is, 7·728lb. I should make the spring bear on the valve, encircle a valve-spindle prolonged upwards, and passing through a hole in the top of a casing made to encircle spring and spindle, and pierced at the sides to allow exit for the escaping steam. The casing might be cast in one with the seating, and so fitted and screwed down upon the boiler barrel. Both valves can be used on one boiler with advantage.

J. H.

## THE ELECTRO-MAGNET.—II.*

(*Continued from page* 118.)

At the date of Sturgeon's work the laws governing the flow of electric currents in wires were still obscure. Ohm's epoch-making enunciation of the law of the electric circuit appeared in "Poggendorff's Annalen" in the very year of Sturgeon's discovery, 1825, though his complete book appeared only in 1827, and his work, translated by Dr. Francis into English, only appeared (in Taylor's "Scientific Memoirs," vol. ii.) in 1841. Without the guidance of Ohm's law it was not strange that even the most able experimenters should not understand the relations between battery and circuit which would give them the best effects. These had to be found by the painful method of trial and failure. Pre-eminent amongst those who tried was Prof. Joseph Henry, then of the Albany Institute, in New York, later of Princeton, New Jersey, who succeeded in effecting an important improvement. In 1828, led on by a study of the "multiplier" (or galvanometer), he proposed to apply to electro-magnetic apparatus the device of winding them with a spiral coil of wire "closely turned on itself, the wire being of copper from $\frac{1}{40}$th to $\frac{1}{25}$th of an inch in diameter, covered with silk. In 1831 he thus describes the results of his experiments:—

"A round piece of iron, about $\frac{1}{4}$in. in diameter, was bent into the usual form of a horse-shoe, and instead of loosely coiling around it a few feet of wire, as is usually described, it was tightly wound with 35ft. of wire, covered with silk, so as to form about 400 turns; a pair of small galvanic plates, which could be dipped into a tumbler of diluted acid, was soldered to the ends of the wire, and the whole mounted on a stand. With these small plates the horse-shoe became much more powerfully magnetic than another of the same size, and wound in the same manner, by the application of a battery composed of 28 plates of copper and zinc, each 8in. square. Another convenient form of this apparatus was contrived by winding a straight bar of iron, 9in. long, with 35ft. of wire, and supporting it horizontally on a small cup of copper containing a cylinder of zinc—when this cup, which served the double purpose of a stand and the galvanic element, was filled with dilute acid, the bar became a portable electro-magnet. These articles were exhibited to the Institute in March, 1829. The idea afterwards occurred to me that a sufficient quantity of galvanism was furnished by the two small plates to develop, by means of the coil, a much greater magnetic power in a larger piece of iron. To test this, a cylindrical bar of iron, $\frac{1}{2}$in. in diameter, and about 10in. long, was bent into the shape of a horse-shoe, and wound with 30ft. of wire; with a pair of plates containing only $2\frac{1}{2}$ sq. inches of zinc, it lifted avoirdupois. At the same time, a very ial improvement in the formation of the coil sted itself to me on reading a more detailed nt of Prof. Schweigger's galvanometer, and was also tested with complete success upon me horse-shoe; it consisted in using several ls of wire, each covered with silk, instead of Agreeably to this construction, a second wire, same length as the first, was wound over it, e ends soldered to the zinc and copper in such r that the galvanic current might circulate same direction in both, or, in other words, he two wires might act as one; the effect by ldition was doubled, as the horse-shoe, with me plates before used, now supported 28lb. a pair of plates 4in. by 6in. it lifted 39lb., or than fifty times its own weight. These ex- ents conclusively proved that a great develop- f magnetism could be effected by a very small nic element, and also that the power of the as materially increased by multiplying the r of wires without increasing the number of ,

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* Extracted from the Cantor Lectures delivered by Prof. Silvanus P. Thompson, B.Sc., before the Society of Arts.

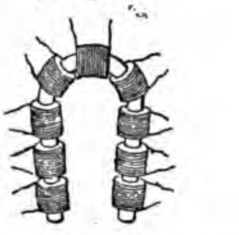
content with these results, Prof. Henry d forward on the line he had thus struck He was keenly desirous to ascertain how a magnetic force he could produce when using urrents of such a degree of smallness as could nsmitted through the comparatively thin wires, such as bell-hangers use. During ear 1830 he made great progress in this ion.

Silliman's Journal (April, 1831), Professor gave "an account of a large electro-magnet, for the laboratory of Yale College." The f the armature weighed 59½ lb., it was forged Henry's own direction, and wound by Dr. yck. This magnet, wound with 26 strands per bell-wire of total length of 728ft., and l by two cells which exposed nearly 4⅞ square surface, readily supported on its armature, weighed 23lb., a load of 2,063lb.

ting in 1867 of his earlier experiments, Henry thus of his ideas respecting the use of addi- coils on the magnet and the increase of y power:—

test these principles on a larger scale, the mental magnet was constructed, which is in Fig. 4. In this a number of compound

FIG. 4.



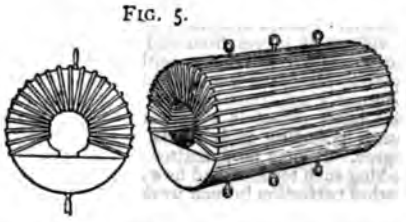
was placed on the same bar, their ends left ting, and so numbered that they could all be into one long helix, or variously combined in lesser length.

om a series of experiments with this and other ts, it was proved that in order to produce the st amount of magnetism from a battery of a cup a number of helices is required; but when pound battery is used then one long wire must ployed, making many turns around the iron, gth of wire and consequently the number of being commensurate with the projectile power battery."

ry sums up his own position as follows:— revious to my investigations the means of ping magnetism in soft iron were imperfectly tood, and the electro-magnet which then l was inapplicable to transmissions of power stance. 2. I was the first to prove by actual ment that in order to develop magnetic power stance, a galvanic battery of 'intensity' must ployed to project the current through the long tor, and that a magnet surrounded by many f one long wire must be used to receive this t. 3. I was the first to actually magnetise a f iron at a distance, and to call attention to t of the applicability of my experiments to egraph. 4. I was the first to actually sound t a distance by means of the electro-magnet. principles I had developed were applied by le to render Morse's machine effective at a e."

gh Henry's researches were published in hey were for some years almost unknown in s. Until April, 1837, when Henry himself Wheatstone at his laboratory at King's Col- he latter did not know how to construct an -magnet that could be worked through a long rcuit. Cooke, who became the coadjutor of stone, had originally come to him to consult n February, 1837, about his telegraph and , the electro-magnets of which, though they d well on short circuits, refused to work when placed in circuit with even a single mile of wire. Wheatstone's own account of the matter is extremely explicit:—"Relying on my former experience, I at once told Mr. Cooke that his plan would not and could not act as a telegraph, because sufficient attractive power could not be imparted to an electromagnet interposed in a long circuit; and to convince him of the truth of this assertion, I invited him to King's College to see the repetition of the experiments on which my conclusion was founded. He came, and after seeing a variety of voltaic magnets, which even with powerful batteries exhibited only slight adhesive attraction, he expressed his disappointment."

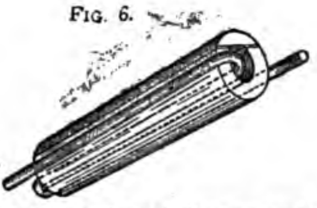
FIG. 5.



After Henry's visit to Wheatstone, the latter altered his tone. He had been using, *faute de mieux*, relay circuits to work the electro-magnets of his alarum in a short circuit with a local battery. "These short circuits," he writes, "have lost nearly all their importance and are scarcely worth contending about since *my discovery*" (the italics are our own) "that electro-magnets may be so constructed as to produce the required effects by means of the direct current, even in very long circuits."

We pass on to the researches of the distinguished physicist of Manchester, whose decease we have lately had to deplore, Mr. J. P. Joule, who, fired by the work of Sturgeon, made most valuable contributions to the subject. Most of these were published either in Sturgeon's "Annals of Electricity," or in the Proceedings of the Literary and Philosophical Society of Manchester, but their most accessible form is the republished volume issued five years ago by the Physical Society of London.

FIG. 6.

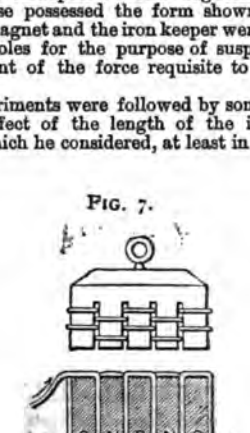


Henry's Experimental Electro-magnet.

In August, 1840, he wrote to the "Annals of Electricity," on electro-magnetic forces, dealing chiefly with some special electro-magnets for traction. One of these possessed the form shown in Fig. 5. Both the magnet and the iron keeper were furnished with eye-holes for the purpose of suspension and measurement of the force requisite to detach the keeper.

His experiments were followed by some to ascertain the effect of the length of the iron of the magnet, which he considered, at least in those cases where the degree of magnetisation is considerably below the point of saturation, to offer a decidedly proportional resistance to magnetisation; a view the justice of which is now, after fifty years, amply confirmed.

FIG. 7.



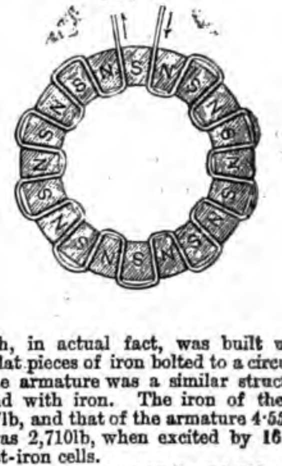
Joule's Electro-magnet.

In November of the same year further experiments in the same direction were published. A tube of iron, spirally made and welded, was prepared, planed down as in the preceding case, and fitted to a similarly prepared armature. The hollow cylinder thus formed, shown in Fig. 6, was 1ft. in length, in internal diameter was 1·42in., its internal being 0·5in. The least sectional area was 10½sq.in. The exciting coil consisted of a single copper rod, covered with tape, bent into a sort of S-shape. This was later replaced by a coil of twenty-one copper wires, each 1-25in. in diameter and 23ft. long, bound together by cotton tape. This magnet, excited by a battery of sixteen of Sturgeon's cast-iron cells, each 1ft. square and 3½in. in interior width, arranged in a series of four, gave a lifting power of 2,775lb.

Joule's work was well worthy of the master from whom he had learned his first lesson in electromagnetism. He showed his devotion not only by writing descriptions of them for Sturgeon's "Annals," but by exhibiting two of his electromagnets at the Victoria Gallery of Practical Science, of which Sturgeon was director. Others, stimulated into activity by Joule's example, proposed new forms, amongst them being two Manchester gentlemen, Mr. Radford and Mr. Richard Roberts, the latter being a well-known engineer and inventor. Mr. Radford's electro-magnet consisted of a flat iron disc, with deep spiral grooves cut in its face, in which were laid the insulated copper wires. The armature consisted of a plain iron disc of similar size. This form is described in Vol. IV. of Sturgeon's "Annals." Mr. Roberts's form of electromagnet consisted of a rectangular iron block, having straight parallel grooves cut across its face, as in Fig. 9. This was described in Vol. VI. of Sturgeon's "Annals," p. 166. Its face was 6in. square, and its thickness $2\frac{7}{16}$in. It weighed, with the conducting wire, 35lb.; and the armature, of the same size and 1½in. thick, weighed 23lb. The load sustained by this magnet was no less than 2,950lb. Roberts inferred that a magnet, if made of equal thickness, but 5ft. square, would sustain 100 tons weight. Some of Roberts's apparatus is still preserved in the Museum of Peel Park, Manchester.

On p. 431 of the same volume of the "Annals," Joule described yet another form of electro-magnet, the form of which resembled in general Fig. 10; but which, in actual fact, was built up of 12 separate flat pieces of iron bolted to a circular brass ring. The armature was a similar structure, but not wound with iron. The iron of the magnet weighed 7lb, and that of the armature 4·55lb. The weight was 2,710lb, when excited by 16 of Sturgeon's cast-iron cells.

FIG 8



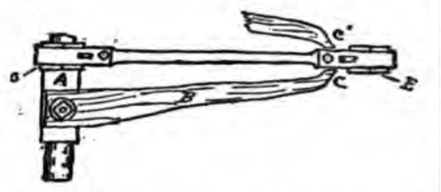
In a subsequent paper on the calorific effects of magneto-electricity, published in 1843, Joule described another form of electro-maguet of horse-shoe shape, made from a piece of boiler-plate. This was not intended to give great lifting power, and was used as the field-magnet of a motor. In 1852, another powerful electromaguet of horse-shoe form, sowewhat similar to the preceding, was constructed by Joule for experiment. He came to the conclusion that, owing to magnetic saturation setting in, it was improbable that any force of electric current could give a magnetic attraction greater than 200lb. per square inch. "That is, the greatest weight which could be lifted by an electro-magnet formed of a bar of iron one inch square, bent into a semicircular shape, would not exceed 400lb."

With the researches of Joule may be said to end the first stage of development. The notion of the magnetic circuit which had thus guided Joule's work did not commend itself at that time to the professors of physical theories: and the practical men, the telegraph engineers, were for the most part content to work by purely empirical methods. Between the practical man and the theoretical man there was, at least on this topic, a great gulf fixed. The theoretical man, arguing as though magnetism consisted in a surface distribution of polarity, and as though the laws of electro-magnets were like those of steel magnets, laid down rules not applicable to the cases which occur in practice, and which hindered rather than helped progress. The practical man, finding no help from theory, threw it on one side as misleading and useless. It is true that a few workers made careful observations and formulated into rules the results of their investigations. Amongst these, the principal were Ritchie, Robinson, Müller, Dub, Von Kolke, and Du Moncel; but their work was little known beyond the pages of the scientific journals wherein their results were described. Some of these results will be examined in my later lectures, but they cannot be discussed in this historical *résumé*, which is accordingly closed.

## ENGINE POUNDING.*

An engineer in charge of a smoothly running engine shows it with pride; but if, on the other hand, his engine pounds, he is humiliated and feels like apologising for the disorder, when, perhaps, it has pestered him from the start. That monotonous thud is always in his ears. He goes to the crank, and it is there; and when at the cylinder, it is there. It can only be silenced by making the boxes so tight that they become heated. The remedy is worse than the disease; so they are slackened again, the pounding goes on, and at times becomes almost unbearable. It is known that such imperfections are caused either by poor work in the shop or by imperfect alignment, and sometimes both; in which case the trouble may be regarded as chronic, and an overhauling in the shop is required. The work involved in dismantling and lining up is such as to discourage this undertaking. There are tests which do not require much time or labour, and serve well to detect imperfect alignment, as well as bad workmanship, and will show up imperfections that a line will not. A description of these may be of interest to some. The accuracy of the results will largely depend on the proper fitting of the connecting rod and correct boring of the boxes.

In the drawing is shown a simple device for proving this work. A square block of wood is turned at one end to fit the wrist pin boxes. The other end is made to fit the crosshead, as shown at A. The square shoulders are to rest against these boxes. A strip of wood, B, is made to reach the point, C, when bolted to the block as shown. The point at C is brought within the thickness of paper of the side of the rod. The block is then withdrawn and introduced into the opposite side of box, care being taken not to derange the strip, B. When the block is thrust to its shoulder, the point C' should be the same distance from the rod as at C, provided the flanges of box O are of equal thickness. Allowance must be made at C C' for any difference that may exist, as, for instance, if the point at C should stand off an eighth of an inch and the box flange at O be found as much thicker on this side, the boring of box O is evidently correct. The same process is employed to test the box E. It will be seen that any deviation from a true right angle in the boring of these will be increased at the point C in the ratio that the width of box bears to the length of rod. Assuming the rod to be correct, it is connected with the crosshead and keyed somewhat tighter than when in use. The engine being horizontal, the crank end of rod is brought to centre of the main shaft, and raised to the wrist pin at the upper half-stroke. It should here be in position to go on the wrist without forcing laterally in either direction, and the same when lowered to the lower half-stroke position. If it should bear off in one direction above and in the other below, it is evident that either the shaft or crosshead wrist is not level. This correction may be made without reference to a level, judgment dictating where the change can best be made. If the wrist box should require forcing toward the main shaft, both above and below, it is plain the wrist of crosshead is not square with the slides, or the hub of crank is too short. A subsequent test will indicate which is wrong. The rod may now be supported in a horizontal position, and the crosshead with rod attached moved from one extreme of slides to the other, noting if the wrist boxes bear the same relation to the wrist of crank at the two dead centres. Any discrepancy here will indicate that the main shaft is not square, or not at a right angle with the slides. By adjustment of the shaft and repeated trials, a good degree of accuracy may be secured in this way; but care must be taken to see that the rod has no lateral movement.



The next and last test is to disconnect the rod from the crosshead and connect it to the wrist pin, keying so as to prevent lateral movement and yet allow the wrist pin to turn. Support the rod above the crosshead so it may be free to move horizontally. Revolve the crank slowly, at the same time keeping the crosshead wrist exactly under the rod box. If all is right, the box should be in position to freely drop on the wrist at any point. This verifies the accuracy of the previous test. But if continually on the crank side of the crosshead, and requiring about the same amount of forcing to bring it to the wrist pin that it did at the other end of the former example, it is evident the hub of crank is too short, or in other words, the centre of wrist in crank is too near the main shaft, and the wrist in crosshead is not out of square, as the former test might indicate. Should the end of rod vibrate from side to side as it moves from end to end of slides, it shows one of two things—either the shaft is not squarely placed, or the wrist pin in crank has been improperly set, thus causing the rod to wobble. This latter defect is a serious one, and invariably causes pounding if it exists to any considerable degree. It may be a matter of surprise to those making such tests, to find how seldom the machinist reaches perfection in such work.

The above methods are doubtless open to criticism, but at the same time they possess merit in being able to detect defects that cannot be reached with a line or level.

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* By W. A. L. Kirk, in the *Scientific American.*

## HART'S SNAP SWITCH.

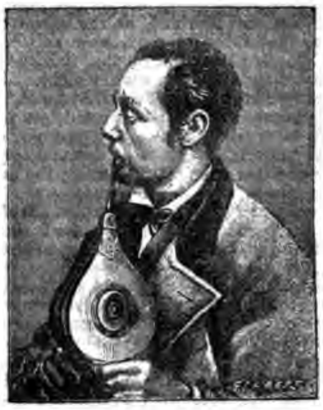
One of the neatest contributions to the line of snap switches which has appeared for a long time is that illustrated herewith. It is due to the ingenuity of Mr. G. W. Hart, of Kansas City, who was one of the old-timers in electric lighting, inasmuch as he entered the service of the Thomson-Houston Electric Company immediately after its organisation ten years ago. Since then his experience has been large in almost all departments of electric lighting, and like every other electrician, the need of a reliable switch impressed itself most vigorously upon him. The present switch has divers singular merits. In the first place it has no spiral spring, but a flat steel spring instead. The break and make is instantaneous, and the air gap very long. The motion of the switch is rotary, snapping forward a quarter of a revolution at a time. This is effected by a four-part hollow cam, in which is carried a stud attached to the switch handle, so that at each turn of the handle the arm carrying the contacts is shut through a quarter of a revolution by the flat spring that presses against it. The result is a very perfect rubbing contact, keeping the surfaces perfectly clean and bright. The 10-ampère switch is the one illustrated, and it is available for a current considerably greater, while the long air-gap made in the break—not less than 1in. and 1¼in.—allows of a 500-volt current being successfully used. The action of the switch is very smooth and certain, and the valuable property of a long, quick break is secured without complication of parts. There is very little about it that is likely to wear out, and the use of a flat instead of a spiral spring tends to increase its available life. The switch is neatly designed, and when put upon the market will be placed upon a porcelain base and covered with a close fitting cap shown by light lines in the cut. A double-pole switch of the same type is now in process of construction, and it will soon be ready.—*Electrical World*, N.Y.

## THE MUSICAL BELLOWS.

The instrument herewith illustrated is merely the ordinary hand-bellows that was met with a hundred and even a fewer years ago, not only in all the kitchens, but also in all the drawing-rooms of France and Navarre. At present, thanks to the discovery of coal and also to the improvement in heating apparatus, it has fallen into desuetude, and, before long, there will be generations to which it will be totally unknown.

If we wish to make use of one as a musical instrument, there is no need of having it made expressly for the purpose. No, the bellows, such as it is, can be very well utilised without previous preparation. Nevertheless, we add that if the bellows contains no holes or imperfections, and if it is provided with a well-adjusted nozzle, which is very smooth internally, it will be so much the better. The bellows, as we find it at the hardwareman's, is usually provided with a small collar at the end of the nozzle. As this is useless, and would in mode the player, it is better to remove it. may be done by grasping it with a pair of ni and giving it a slight twist; a little filing to re the roughness, and all is ready. The followi the mode of playing on this original instrumen

Hold the bellows straight before the breas end resting against the lower lip, the fixed h in the left hand, and the movable one in the The upper lip should be thrust slightly outwa



as to form an obstacle to the wind that es from the bellows. If we manœuvre it in this tion, we shall succeed, after a few tentatives, with a little patience, in producing a sound. haps this will not be harmonious for a begin but it will, at all events, be a sound, and w there is *sound*, there is music.

The wind, of course, must all be furnished b bellows, and all the player has to do is to wid contract the labial orifice, and to enlarge and re the buccal cavity. Do not despair if you d succeed at first. Neither did we succeed i beginning, and do you know how many note make? Nearly three octaves, and we play al airs that we care to, and that too without fatigue of the chest, since it is not we who blow

In order to produce grave notes, try to fo large cavity in the mouth, and, at the same tim round the lips. In order to give more intensi the notes, blow harder. When you have sufficient practice, you will be able to make this instrument what string instruments alone make, that is, the quarter tones. The sharp n as in all wind instruments, require more labour the bass ones, which also require more than intermediate notes.

It is unnecessary to say that in order to play instrument it is indispensable to have an ear, fo notes are not produced mechanically, as ma easily understood. It is also evident that a pe can play the bellows without being the least musician.

We have played bellows and flute duos with p accompaniment, and can assert that the effect very fine, and much appreciated by the audi We have sometimes played alone bellows and p duos. This is the way we did it: We attache bellows to our breast by a belt buckled tig behind the back, and while the right-hand duced the song, the left played upon the pia brief but sufficient accompaniment.—*La Natur*

The following recipe for perfuming a roo said to be good: Break off branches of the Nor spruce and arrange them in a large jug well f with water. In a few days tender, pale g branches feather out, soft and cool to the to and giving the delightful, health-giving odour.

**Sharpening Files.**—The method of "shar ing" files by pickling them in acid has been o mentioned in our columns and as often ridicu but we learn from *Le Génie Civil* that the prol —How shall we restore to the tooth of the too initial length, and at the same time sharpe without modifying the steel? has been solve M. A. Personne, of Senneroy, the inventor of new electric process which consists in formi carbon and acidulated water battery in which tool to be sharpened forms the anode, the ci being closed directly between the carbon and tool. Under the influence of the electric cur the water is rapidly decomposed into its elem each of which then performs a totally different While the oxygen proceeds to the bottom of furrows, which it gradually deepens, the hydr forms, in a nascent state, a covering of s bubbles over all the projecting parts, which thus protected against the attack of the liq Moreover, there results from the separation of two gases a sharpening of each tooth superio that given by hand.—We await the proof.

# SCIENTIFIC NEWS.

THAT a knowledge of the star maps may help a numismatist is shown by Dr. A. Vercoutre in *L'Astronomie*, as many of the coins and medals of the Roman Republic have the stars depicted in their proper positions relatively, and consequently enable the numismatist to decide the date (circa) of the coin, and also help the astronomer to form some idea of the proper motion of the stars.

If M. Janssen can persuade the French authorities, it is probable that before the century is ended we shall have an observatory as near the summit of Mont Blanc as it is possible to erect a habitable dwelling. That will put the observatory on Ben Nevis quite into the shade, and even the Lick Observatory will be in the second rank. M. Janssen has recently been up the mountain, and has made careful notes of the difficulties; but gives a decided opinion that it is possible to establish a station on what is practically the "summit" of Mont Blanc—or at least an elevation of 15,000ft. or more above the level of the sea.

A correspondent of the *Times* says that on Sept. 30 he and his party saw a rainbow which formed a complete circle, visible for nearly half an hour during their ascent of the Finsteraarhorn. "There were," he says, "heavy clouds lying some 4,000ft. below, on the Aar glacier, and it was on these that the beautiful, brilliantly coloured ring lay. A secondary circle was also visible. We were near the summit of the peak when we first observed it, and from that point the face of the mountain on the Grimsel side is almost perpendicular." Another correspondent says that at midday in sunshine the circular rainbow can be seen at the Cave of the Winds at Niagara. The only conditions necessary are a vertical sun and a horizontal body of mist. The second of these is always available at Niagara to those who will dress in oilskin and push through the driving, roaring spray.

Prof. Heinrich Scharwz died recently at Eberswalde, near Berlin, aged sixty-six. He was a distinguished chemist, one of his chief works being the introduction of volumetric analysis into Germany. He was a native of Eisleben, began his career as a private lecturer in Breslau University, and ended it as professor of chemical technology at Graz.

Dr. C. Handfield-Jones, F.R.S., died on September 30, aged seventy-two. The deceased had been consulting physician at St. Mary's Hospital for many years, and had contributed many valuable papers to medical literature.

Mr. Samuel Fry, a man whose name, at least, is known to all photographers, died last week at the age of fifty-six. Mr. Fry's name is indissolubly connected with the history of gelatine plates, and his many contributions to photographic literature will serve to keep his memory green.

Dr. Leopold Gruber, who was professor of anatomy at St. Petersburg for nearly forty years, died at Vienna last week at the age of 76. He published nearly 500 notes and papers on anatomical subjects, and had a European reputation. He was an Austrian by birth.

Dr. Andrew is to deliver the Harveian Oration before the Royal College of Physicians on Oct. 18.

The prize founded on the occasion of the seventieth birthday of the famous hygienist, Prof. Pettenkofer of Munich, has been for the first time awarded to Max Rubner, professor of hygiene at Marburg, well known for his investigations on the production of heat, and the bacteriologist Dr. Hans Buchner, private lecturer in the University of Munich, author of a book entitled "Naegeli's Theory of Infectious Diseases," and other writings on tuberculosis, anthrax, &c.

The annual fungus foray of the Essex Field Club will be held to-day and to-morrow in Hatfield Forest, near Great Hallingbury, the headquarters of the "meet" being at Bishop's Stortford.

The Lantern Society, having secured a suitable meeting room at 20, Hanover-square (the new premises of the Royal Medical and Chirurgical Society), invite all interested in work with the lantern to join. The paper on Monday, Oct. 13 (8.30 p.m.), will be by Mr. Andrew Pringle, on "The Modern Applications and Appliances of the Lantern." Mr. C. E. Gladstone, R.N., the hon. sec., 6, Bolton-street, Piccadilly, W., will forward the rules and programme.

A telegram from New York announces the discovery of a faint comet by Mr. E. E. Barnard, of the Lick Observatory. Its position at 8.46 p.m. on Monday (presumably local time) was R.A. 19h. 12m., S. Dec. 26°, motion easterly.

Under the auspices of the Fruiterers' Company a show of splendid fruit was held at the Guildhall this week; but the labels which most attracted our attention were on dishes of apples exhibited by Miss Grace Hardman, of the Hut, Harrow-on-the-Hill, which were stated to have been gathered from trees planted on March 23, 1889. That fact ought to encourage pomologists.

In the course of a lecture at Toynbee Hall last Saturday, the Rev. Dr. Abbott, whose subject was "Illusions," discriminated between illusion and delusion. The former was, he said, the necessary influence to which healthy human nature was subject, and through which we reached truth, whereas delusion was a sign of diseased nature. Bacon had said that God was playing a game of hide-and-seek with His children, and desired to be found out. Browning had spoken of the illusions with which he was concerned "as the midway help" to the attainment of truth. We were subject to a sort of atmospheric illusion in the attainment of even physical knowledge. There is the illusion of sound. We do not hear what is, but what was. So with sight, though light travels much more rapidly than sound. So it was with the setting of the sun and other natural phenomena. So the pole star was not where we think we see it now; we see it where it was 12 years ago. There were stars still more distant, and it might be that the inhabitants of some star were now looking at the Battle of Hastings, and wishing success to one side or the other. All these were illusions, or behindhand observations.

At the Royal Victoria Hall the Rev. Prof. Cheshire will deliver a lecture on "Bees as Florists and Fruit Producers" on Oct. 14, and on Oct. 21. Dr. W. D. Halliburton will lecture on "The Colours of Animals and their Uses."

The telephone cable to be laid across the Channel will, it is stated, contain four copper conductors, each a strand of seven wires insulated with guttapercha, and the group will be protected by layers of tanned hemp and an outer sheathing of galvanised iron wires laid on spirally, after the manner of an ordinary submarine telegraph cable. The conductors have been calculated to give good speaking, and the armour to guard the wires from ships' anchors or bottom friction. Four conductors have been chosen, because there are to be two separate lines, and each line will consist of a going and returning wire. That is to say, the circuit between the terminal stations will be a "loop" one, formed of wire throughout, the earth itself not being used as the return wire.

To find out the amount of slack given to cables as deposited in the ocean at the time of paying out, Messrs. Siemens Brothers are using a steel piano wire, payed out simultaneously, with a tension sufficient to make it taut over sea-bottom. By mechanism on board, which measures the rate of paying out cable and wire, the necessary slackness in the cable can be determined and constantly verified, thus avoiding all unnecessary slackness, and saving large sums of money.

The Board of Agriculture are advised that the season is approaching when the winter moth and other dangerous moths will commence laying their eggs. It has been deemed expedient to warn fruit-growers on this subject. There has, therefore, been issued by the intelligence department of the board an illustrated leaflet giving suggestions as to the best methods of diminishing the danger.

The Royal Microscopical Society will hold the first meeting of the session at 20, Hanover-square, W., on Wednesday, the 15th instant, when papers will be read by Mr. H. B. Brady, F.R.S., on a New Type of Foraminifer; by Mr. P. C. Waite, on a New Method of Demonstrating Intercellular Protoplasmic Continuity; and by Mr. Dowdeswell, on a Simple Warm Stage for the Microscope.

# LETTERS TO THE EDITOR.

*[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]*

*All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

*All Cheques and Post-office Orders to be made payable to* J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

## THE BRITISH ASTRONOMICAL SOCIETY.

[31683.]—THE letter of a "Yorkshireman" (31655) in your last issue gives expression to a criticism on the method adopted in the formation of this society which has already been made to me privately, almost in the same words, by two well known astronomers, so that, although it is practically the only criticism which I have yet received —unqualified commendation having been the rule— a similar objection may possibly have been entertained by others. It may, therefore, be well worth while, if you will accord me the space, to try to answer it.

First of all it must be borne in mind that the preliminary action of any society must have some features of irregularity. Such action is no precedent for the course to be followed when the society has been properly constituted, and, *per contra*, the course followed by old-established societies is no precedent for such preliminary action of a new body. For example, I am at present a self-appointed secretary, the provisional committee is my own choice, the treasurer my own nomination; an assumption of responsibility absolutely indefensible if it had occurred in the regular action of an old society, but not less absolutely essential if the new society was to come into existence. And it is perfectly clear that the members at large have realised the fact. They have sent in their subscriptions to the nominated treasurer, and their names to the self-nominated secretary without hesitation. We are neither of us elected to our office as yet; but it seems to me that this practical recognition of us on the part of the members is more emphatic than any amount of mere voting could be.

"Yorkshireman's" difficulty seems to be that we have decided on several points which ought to have been subjected to the decision of a general meeting. We have fixed the number of the council and arranged the election of the council in a given manner; but "Yorkshireman" forgets that the general meeting will have full power to say that the present council shall terminate its period of office at any given time it chooses. The meeting *must* do so in fact, for one thing it must fix is the time of the year when the annual election shall take place. No one has intimated that that will be October 1 another year. Further, the mode of election of the present council and its numbers are not necessarily precedents for future councils, these points will all be laid down in the by-laws which the general meeting will frame. The present council therefore, though fully constituted, for it is elected by the entire society, is in these particulars, and to this extent, a provisional one—that is, as to size, length of office, and mode of election, it is not necessarily a precedent for future councils.

But why have a council in any way provisionally? Why not hold a general meeting, fix all these details, and then elect a council formally? Because it is absolutely necessary that when the general meeting comes together it should find (1) officers to conduct it, (2) a clear and definite plan of procedure, (3) a well-considered scheme of proposed by-laws for it to discuss. The airy suggestion that I should "call a general meeting and settle all these details," *without* such preliminary preparation, is not a practical one. It would have landed us in a *fiasco*, and I should have been very unworthy of the confidence which I have found has been so generally placed in me if I had been weak enough to entertain any such absurdity. The mass of business the general meeting will have to transact will be heavy enough to tax its utmost powers, even if everything is prepared for it with the utmost skill and forethought possible; and I can assure you, Sir, I feel the weight of responsibility resting on me with regard to it most heavily. My only reliance is on the consideration and courtesy which I have received from every quarter so far, and which has smoothed, and I am sure will smooth, every difficulty.

But if these preparations are to be made, who is to make them?—the Provisional Committee? That is impossible, for the committee is too scattered to meet for conference, and the details are too complicated to be settled by correspondence. Myself personally? But I could not hope to draw up by myself so good a scheme of by-laws as a committee or council would, comprising many men of far greater knowledge and experience. Besides, what authority should I have to nominate officers and fix procedure? And, further, I should have placed myself in a false position. When the general meeting was held, and I laid my by-laws before it, they would of course be criticised and amended, and I should have been, one man by myself, on the defensive the whole time. It is quite possible that when the meeting saw the position I was driven to occupy, many would, merely from courtesy, have refrained from the full criticism my actual proposals deserved.

I do not think either that it would have been received without objection if I had appointed a few personal friends to act with me in fixing the preliminaries for the meeting. There, therefore, remains but one sole resource—a council elected by the society. Such a council has been elected: it will arrange for the meeting, and draft a scheme of by-laws; a scheme I feel sure which will stand in much less need of amendment or discussion than one I might have prepared by myself.

If a council was to be elected, it is obvious that the provisional committee must fix its numbers and the mode of its election. I am not concerned to defend the method adopted on theoretical grounds; practically it was the fairest and best possible. To have issued a house-list would have been, under present circumstances, simply to have nominated the council. To have issued a complete list of all the members would have been an impracticable course; the best known members, irrespective of their ability or willingness actually to work on the council would have been elected, whilst the inevitable scattering of votes would have necessitated a second, or perhaps a third, ballot. There are yet other and stronger objections to which I need not allude. The mode adopted of a redundant list remains the only possible one, and I think the voting in the two elections—for there was necessarily a previous earlier election within the provisional committee—conclusively shows that the men elected do really represent the actual choice of the society. It is perfectly possible that, had a complete list been issued, some of the elected would not have had that character, for in such random voting a man with a compact knot of friends, and perhaps no other claim, could always manage to get himself in.

The election could not have been conducted at the general meeting, as "Yorkshireman" suggests, for the number of the council and the mode of election could not have been settled until the meeting had decided upon them. These decided, the meeting could not have proceeded then and there to elect a council, as that would have been a flagrant breach of faith with regard to the absent members, since "voting by post" is a fundamental principle of the society. The election would, therefore, have had to be postponed, and an unnecessary delay occasioned. Probably, in consequence, we should have had to hold *two* general meetings—one before and one after the election—instead of making one suffice. And, after all, when all had been done, we should have simply arrived by a rougher and more circuitous path to the point where the proposed general meeting will no doubt lead us.

One other point—the nomination of the directors of the observing sections. This may be considered as constituting a "house list" for the approval of the society. Clearly, it was necessary to first of all ascertain whether a man was willing to serve before submitting his name to the society. It would have been impossible to have subjected these departments to a free election, as we could do in the case of the ordinary members of council. Theoretically, therefore, I may have acted *ultra vires* in nominating them. Practically, I expect that the general opinion will be that I took the only possible course, and that I deserve more praise for enlisting the services of these gentlemen than censure for acting irregularly, where, from the nature of the case, regularity and red tape were not possible. Still, if the general meeting thinks otherwise, it will be full competent to say so; to alter, reverse, or sanction these appointments, or any of them, as it chooses. Should it sanction them, any irregularity which may at present attach to them will be effectually removed.

May I also point out that the provisional committee, though not an elected body, may fairly be considered a representative one? It is insignificant neither in numbers nor in character. It numbers fifty members, one-fifth of the society to-day; one-fourth of it at the time of the election. At one time, not many weeks ago, it *was* the society. Surely it is hyper-criticism—it is to mistake verbiage for reality, to dispute a decision of such a body on a merely temporary matter, and to be willing to accept the decision of a general meeting which probably would not contain more members, for all the permanent regulations of the society.

**E. Walter Maunder.**

Hyde House, Ulundi-road, Blackheath.
October 4.

## THE CLUSTER 5 MESSIER AND MR. PACKER

[31684.]—Mr. Packer, in your issue of Sept. 19, insinuates that an observation of his of a star in the cluster 5 Messier was wilfully kept out of a note that appeared in *Nature* on Sept. 4. It would have been unnecessary to have answered this letter but for the fact that your correspondent, "F.R.A.S.," points out that since Mr. Common is a friend of the editor of *Nature*, fair play was impossible.

I wrote the note which has furnished Mr. Packer with his grievance whilst enjoying a holiday more than a hundred miles from London. It was published without alteration and without any juggling of the facts. I was at the Royal Astronomical Society when Mr. Common exhibited his five photographs, but did not particularly observe the stars in which he had detected variability. When Prof. Pickering's note appeared in *Astronomische Nachrichten*, I recorded his observations, with those of Mr. Common, in separate paragraphs, and without at all attempting to mislead. My note, with little alteration, appeared in the English Mechanic a week after it had been published in *Nature*. It is evident, therefore, that Mr. Packer's prior observation is not widely known, and, in my opinion, he should have written directly to the editor of *Nature* and have stated his case, before making assertions that have not the shadow of foundation in fact. That "F.R.A.S." should have supported the assertions is not surprising to one who is acquainted with his prejudices. **Another F.R.A.S.**

## TRANSIT OF JUPITER'S SATELLITE—REFLECTORS.

[31685.]—On Sept. 14th the transit of Sat. II. was well seen here. I was too late for the ingress, but saw it about twenty minutes after. The sat. presented a dusky appearance, which deepened as it advanced to the centre of the disc, after which it gradually grew brighter, passing off the limb of the planet brighter than its primary as a tiny, well-defined disc on to the dark sky. The instrument used was a speculum of 8⅝in. aperture, which I finished off a few weeks ago; power about 150.

"Tenebris" asks in one of his letters, Will a reflector define Jupiter fairly well? Considering the great south declination of the planet, is this performance good enough? I have had many opportunities of observing him during his late apparition, and have often used power of 380 with good definition. With this speculum stopped to 3½in., ε Boötis is well divided; δ Cygni is well shown with 6½in.; 90 Herculis, η Coronæ present no difficulty with full aperture on good nights, and on the same night as the transit mentioned it elongated $\nu^2$ Andromedæ: power used 380. Will refractors perform better than this? I use a skeleton mounting, a perfect plane, and see that the adjustments are correct, which, with a little practice, is a very easy matter. If the reflector did not answer, its inefficiency would have been demonstrated long ago.

Hadleigh, Suffolk. **May.**

## METEOR RADIANTS.

[31686.]—Some time ago I intimated in your columns my belief that all meteor radiants were of the stationary or long-enduring character—that is, that they continued without change for a longer period than the current theory accounts for. To show the evidence in favour of the view afforded by Mr. Denning's late Catalogue, I now send a complete list of the positions noted by him from R.A. 0° to R.A. 10°. I believe that any other 10° would afford similar (if not more conclusive) evidence.

R.A. 0°. One position at + 53° on Aug. 14 (probably connected with others afterwards noticed).

R.A. 1°. Two positions. One at − 5° on Sept. 15, and the other at + 63° on Aug. 28. The last is probably connected with a position at 358° + 60°, in which case the duration exceeds three weeks.

R.A. 2°. No position.

R.A. 3°. Three positions. One at + 27° on Aug. 7, another at + 35° on July 25, and a third at + 49° on July 8. The last of these Mr. Denning treats as an early Perseid. It seems rather connected with the position at 0° + 63°, and others to be noted hereafter.

R.A. 4°. Three positions. One at − 2° (probably connected with that at 1° − 5°) on Sept. 3; another at + 20° on Aug. 7; and the third at + 35° on July 7.

R.A. 5°. Thirteen positions. Three of these are at + 10°, dates July 31, Aug. 25, and Sept. 19, respectively. Three more are situated one at + 11½, and the other two at + 12°, the dates being Aug. 20, Aug. 24, and Sept. 15 respectively; one position occurs at + 17°, but Mr. Denning suspects an error of about 5°; then occur three positions at + 35° (connected with those at 3° + 35° and 4° + 35° already given), dates July 11, July 16, and Aug. 21; lastly, there are three positions, two at + 52°, and one at + 54°, dates July 16, Aug. 21, and Nov. 12.

R.A. 6°. Five positions. One at + 11° on July 13: three at + 34° + 35° and + 37° on July 27, July 30, and Aug. 10 respectively; and one at + 53° on July 12.

R.A. 7°. Nine positions. One at + 10°, and two at + 11°, dates July 31, Aug. 4, and Sept. 22; one at + 35°, one at + 36°, and two at + 37°, dates July 12, July 28, July 29, and Oct. 5; one at + 44° on Sept. 21; and two at + 51° and + 53° respectively on July 17 and Oct. 15.

R.A. 8°. Seven positions. One at 33°, one at 35°, and two at + 38 on Aug. 7, Aug. 11, Aug. 14, and Oct. 8 respectively; one at + 45° on Aug. 24 (connected with the previous position at 7° + 44°, and perhaps with subsequent ones at 11° + 47° and 11° + 48°), and two at + 52° and 53° on July 27 and Aug. 10.

R.A. 9°. One position at + 34° on Aug. 4.

Of the forty-four positions thus examined, not one can be set down as isolated, and with much the greater number the connection appears unmistakable.

Ilfracombe, Oct. 4. **W. H. S. Monck.**

## BRILLIANT METEOR.

[31687.]—Last evening when observing Jupiter for the transit of satellite I., I witnessed the apparition of a very brilliant meteor about nine o'clock. It first appeared from a point about 5° north of the planet, near β Capricorni, and fell slowly towards the west at an angle of 45° with the horizon. It was sensibly larger than Jupiter, and whiter than he in colour. The path was not long, but very luminous—altogether it was an exceptional class of meteor.

In letter 31605, page 82 of present volume, 7.15 should be 7.45.

Southampton, Oct. 4. **S. S.**

## LUNAR GLACIATION AND METEORIC DUSTFALL.

[31688.]—I have to thank "F.R.A.S." for remarks in 31412, and as the question of meteoric dustfall I find interests others also, beg to point out that in answer to the former query (29511 in number 1240 page 356), I wrote in number 1250, "I do not think that meteoric dust would fall in patches, but equally all over the surface. It would tend to accumulate on the levels, whence gravitation could not remove it, and hence their relative darkness. But on the mountains and all inclines and cliffs that I assume are composed of snow, I see no reason why avalanches should not remove it occasionally, and hence give us the whiteness, or even brilliancy, at all such places."

I cannot see how or why it should fall in patterns. The fall would, I presume, be very slow, yet sufficient after some thousands of years to darken the surface and reduce the albedo from 0·783 to ·1736.

I notice that in Huxley's "Lay Sermons," page 215, Sir W. Thomson is referred to as endorsing a fall of 12in. of meteoric dust on our earth in 4,000 years. This I should consider obviously far too much for my purpose on the moon, and should say 6in. in 10,000 years would be ample.

With regard to the brightness of Censorinus, Euclides, Parry, and other portions of the surface which are level, and where the brilliancy could not be due to gravitation, we generally find a crater or quasi-volcanic orifice associated. The explanation here offered for such cases is, that the dust stain has been overlaid by a snowfall. The phenomena of haze or cloud is well known, and it is here contended that occasionally aqueous vapour is given off through the crater, and at rare intervals, may be accompanied by some gas which, on entering the outer void, would explosively scatter the snow particles, and thus form a cloud, which on subsidance is the "nimbus" or brilliantly white patch. At page 372, "Neison's Moon," he says: "At Q is a great 9° bright spot, seen at low illumination to be a level plain, surrounded by low hills and valleys. Near here appeared the celebrated white cloud of Cassini, which soon after disappeared."

I take it that the meteoric dustfall is not heavy enough to obliterate the rays. Once formed, they would remain, though slowly becoming less brilliant, and it is well known that they are not all of equal brightness.

With regard to *prolonged* electrical tension, I cannot see why it should be assumed. The electrical disturbance which would cause the formation of a ray would, I presume, be exceedingly rare, and due to internal faulting on a large scale. That faulting on a gigantic scale must take place at rare intervals, there seems ample and admitted evidence. I must admit that it looks a "large order" to assume that the vast littoral mountain ranges on the moon, such as the Apennines, are formed wholly of snow deposit; yet the arguments in favour of such a view are many and cumulative. Imprimis, most of the large ranges, named and unnamed, actually border *maria*, and are counterparts on a large scale of the vast ramparts around the walled plains. Look at Mare Crisium and the Sinus Iridium highlands, and those around Mare Smythii. I cannot see where they practically differ from the ranges round, say, Bailly, Schickard, Plato, Bessel, and Messier. They are truly ramparts.

Nor can I see why we should be surprised at snowfall accumulating around the sea margins under the assumed conditions of low maximum temperature and absence of atmosphere. The aqueous vapour inevitably given off from the water surfaces could not travel far inland, but would fall as snow, and the snowed borders to the Martial seas are thought quite natural under *nearly* similar conditions.

So far as to position. Then as regards tint, they are bright, and in the cliff faces even brilliant, and there is a total absence of colour in large masses, such as we see in terrestrial ranges. If the great lunar ranges were occasionally dark, or distinctly coloured here and there, this would at once alter the case; but the absence of colour and also darkness, when added to the peculiar positions, seems an argument of some weight on my side.

A celebrated astronomer (not English), who as yet does not accept the theory, writes me that "there may very possibly be something in your idea of the formation of ring plains and flat-floored craters by a process of lagooning"; and in a later letter says, "I have thought it over a good deal, and am disposed to admit a good deal of your lagoon theory. I think we must have recourse to something of the kind in order to explain the great circular forms like the Mare Crisium and the Sinus Iridium, not to mention any others. The old volcanic theory seems to me insufficient."

I cannot expect such a revolutionary theory as this is to be accepted, or even understood, right off, especially in presence of the very divergent views at present held by astronomers *in re* lunar surface temperature, &c. This latter I find varies from about the freezing point of mercury to the *melting point of iron*, which as late as 1875 was the published belief of our Astronomer Royal, Mr. W. H. M. Christie (Manual Elementary Science, "Astronomy," S.P.C.K., page 55). But from what reaches me, the theory seems to be gaining ground as it becomes better understood.

A notable feature in the case is the divergence of views: what one considers a fatal objection, another equally eminent thinks in my favour. In most cases I find the theory is not understood from end to end—partly my fault, I fear—in not laying it out more clearly. One "F.R.A.S.," however, does, I see, grasp it as a whole, and he *accepts* it.

Sibsagar, Asam, India. **S. E. Peal.**

P.S.—I hope Mr. E. W. Maunder will enrol me as a member of the British Astronomical Society.

### ICE ON THE MOON—NEW KIND OF LENSES—THE B.A.S.

[31689.]—With reference to the theory that the moon's surface is covered with ice and snow, I have always noticed that when I observe the moon at or nearly full, with a low-power eyepiece, the impression produced is that of having a thin stream of some ice-cold substance injected right into the back of the eye. Is this likely to be caused by the "cold rays" emitted by the moon, or by the (probable) paralysis of the retinal nerve twigs in the strong concentrated moonlight?

Can my fellow-readers tell me anything about the wonderful discovery in lenses, said to have been made by an American, who died lately? He claimed to have been able to use all the direct rays, and none of the convergent (whatever that may mean). There is said to be at Greenwich, and at the Lick Observatory, telescopes made by him. This story has been going the rounds of the daily papers, headed "A Great Loss to Science."

I really wonder at "Yorkshireman's" grumble (letter 31655) about the election of the B.A.S. council. Does he think he could suggest a more representative board? For my part, I felt sorry to put my pen through any names.

Glasgow. **J. W.**

### THE REFLECTING TELESCOPE.

[31690.]—I venture to think that "Tenebris" tries to make too much of the fact that the late Mr. Nasmyth is supposed to have "never made any appointment with any friend" to use his reflectors. I know the late Mr. N. was a clever engineer; but this talent does not necessarily give the aptitude to make a good or properly-corrected optical surface. I know that he was of great assistance to the late Mr. Lassell in designing and making specula-grinding machinery, and that a good deal of thought was brought to bear upon this important matter. I have studied very many books and articles on the subject of specula-making, from Mudge's process downwards; but if anyone can point out to me where I can find any description of the late Mr. Nasmyth's method of working (if different from Lassell's), I shall feel obliged.

Now, most of the old workers were content with a certain method of working which, in the process of polishing, would tend to roll back the edge zone, and a prolongation of the process results always in a "crowding together" of the more central facets of the polishing tool compared with those nearer the margin. This is due to the concavity of the surface acted upon, and has in time the effect of producing a certain amount of "correction" towards the parabola: but it does not follow from this that the curve is regular in its proportions—in fact, the result is generally to unduly deepen the centre. I have seen this often in specula I have tested, and it is in avoiding this and keeping a true balance that the skill of the optician is severely taxed.

Now, we have no evidence, that I am aware of, that Mr. N.'s 13in. and 20in. mirrors were as perfect as they could be made now under the more scientific and searching methods of testing we now adopt, for the old system of testing by diaphragms in the telescope is based on an altogether faulty principle compared with the Wassell method of testing by zonal measurement at the centre of curvature.

As regards the letter by my respected patron "Bramley," I may perhaps be allowed to say that he is quite satisfied with the performance in good air of his With 12¼ and the two 12¼ mirrors I have worked for him, but that he frequently fails to obtain good definition owing to his unfortunate position, which though in the country is in a valley at the base of the slope of the "Hog's Back," a hilly range in an adjoining county. I suppose under such circumstances one must frequently expect atmospheric disturbance, for the cold air must often descend into the valley and mix with the warmer air to be found there. Of course, a refractor of equal size would suffer as much as a reflector.

Ramsgate. **J. C. Linscott.**

### HOW TO DRAW PENTAGONS.

[31691.]—I am not aware that the following curious approximation of all the five main lines of a pentagon to some small integral numbers has ever been published, except in a note to my "Guide to St. Alban's Cathedral" as explaining the diaper-work round the pulpit. It is much more remarkable than the single coincidence between the side of a heptagon and the height of the constituent triangle of a hexagon, which De Morgan said differ only by a 480th, or at the rate of half-penny in the pound; but that is only one coincidence, and here are four or five. Moreover, heptagons are never used, while pentagons and their constituent triangles often are, in architectural ornaments, and windows, and roofs, and in many natural flowers, too, which proves its beauty.

Taking the base of that triangle for datum, divide it into 13 by the well-known easy method for any number. Then 11 of these parts will be the radius of the pentagon, i.e., of the circumscribed circle, and nine of the inscribed one, or the height of the roof of which 13 is the base, 20 the height of the pentagon, and 21 its width across the shoulders, as we may call it—very nearly. Therefore, whichever dimensions happens from circumstances to be the datum, it is easy to divide the space into pentagons, or to build one up. Thus, suppose you have a fixed height to divide into horizontal bands of pentagons touching at their shoulders, divide the height of the band into 20, and draw a horizontal line all along at the distance of nine from the bottom: that is the line of centres, and the radius of each pentagon is the upper part of the 20 line. Then divide the band by verticals 10½ apart, which will pass alternately through the centres and the shoulders, and circles struck with the 13 radius from the tops of the central verticals will cut the others at the shoulders, and the lower corners are 6½ from the bottom of each central vertical. None of the errors in a drawing of any probable size exceed the thickness of a pencil mark. Taking 13 exactly for the datum, the errors of the other four lines run from ·0025 of it to ·0046, which are quite imperceptible.

For those who do not know how to divide a straight line A B into *n* parts, I add it. Draw an indefinite line making any moderate angle with A B at A, and stride out with compasses on it *n* divisions as near the required ones as you can guess, and mark them 1, 2, 3. . . . . N; join N B, and draw lines parallel to it through all the other divisions. They will evidently divide A B into *n* equal parts.

St. Alban's, Oct. 5. **Grimthorpe.**

### PIANO PLAYED BY ELECTRICITY.

[31692.]—Referring to letter (or rather query) No. 72461, and Mr. F. C. Allsop's reply, I may perhaps help "A. J." if he is thinking of constructing such an apparatus. Very many years ago (before even Bishop took out his patent), I devoted some attention to the same thing; but the difficulty and expense of getting my ideas carried into effect (the usual fate of amateurs) caused me to abandon the project. Mine, however, was for an organ, and not for a piano.

The simplest idea would be to use an arrangement like a "single-stroke" electric bell, letting the hammer strike the key instead of the bell. The movement of the armature is, however, so small, that in order to get sufficient "stroke" the hammer stem must be proportionately long, and thus the force of the blow would be too weak unless the electro-magnet were large and cumbersome, and the battery a powerful one.

Another arrangement would be to use a "solenoid" with a bar magnet sliding up and down inside it. This magnet has a brass rod screwed into the lower end, which rod carries at bottom a leather button to depress the key. The magnet and its rod are kept up by a spiral spring just balancing their weight. On making contact with battery wires, the magnet would be drawn down into the coil, and the key would of course be instantly forced down. The solenoids are unfortunately, even more bulky than the electro-magnets, and would have to be arranged in tiers to get room for them. The battery, too, would have to be a large one for such work.

Other arrangements will readily suggest themselves, but the difficulty is always the same, either too little power or too little motion, and the only way is to use the magnetic part to regulate the action, and not to perform the action itself. In Bishop's organ, the electro-magnets merely open and close small valves which admit air to the "puffs" (a kind of small bellows), and these in their turn open the actual pallets in the wind-chest. In Thibouville-Lamy's Pianista, the "puffs" work stickers and hammers that strike the piano-keys, a supply of wind (at, I believe, considerable pressure) being maintained by a foot-blower. In this instrument the perforated paper regulates the admission of the wind to the "puffs." It is necessarily complicated and expensive.

My suggestion would be this: Let there be a revolving barrel, as usual in a mechanical piano, but let it be studded with pins all over, so that it would strike every note at once, and as repeatedly as if the whole tune consisted of demisemiquavers. Ordinarily, however, the pins would just miss (laterally) the hammer tails, so *no* notes would be sounded. Then, by means of the electro-magnets, any required tail or tails is slightly drawn aside, so that the pins catch in and lift it—a spring returning it to it place, and striking the blow on the wire or key. Or, if preferred, instead of a revolving barrel, a reciprocating bar on Mr. Wenham's plan could be employed, as described some time since in the English Mechanic.

In working out the details of the "make-and-break" action for the electro-magnets, it will require care to avoid cutting off the currents from, say, a bass note when making the connection for a note nearer the battery, assuming that to be led in at the treble end.

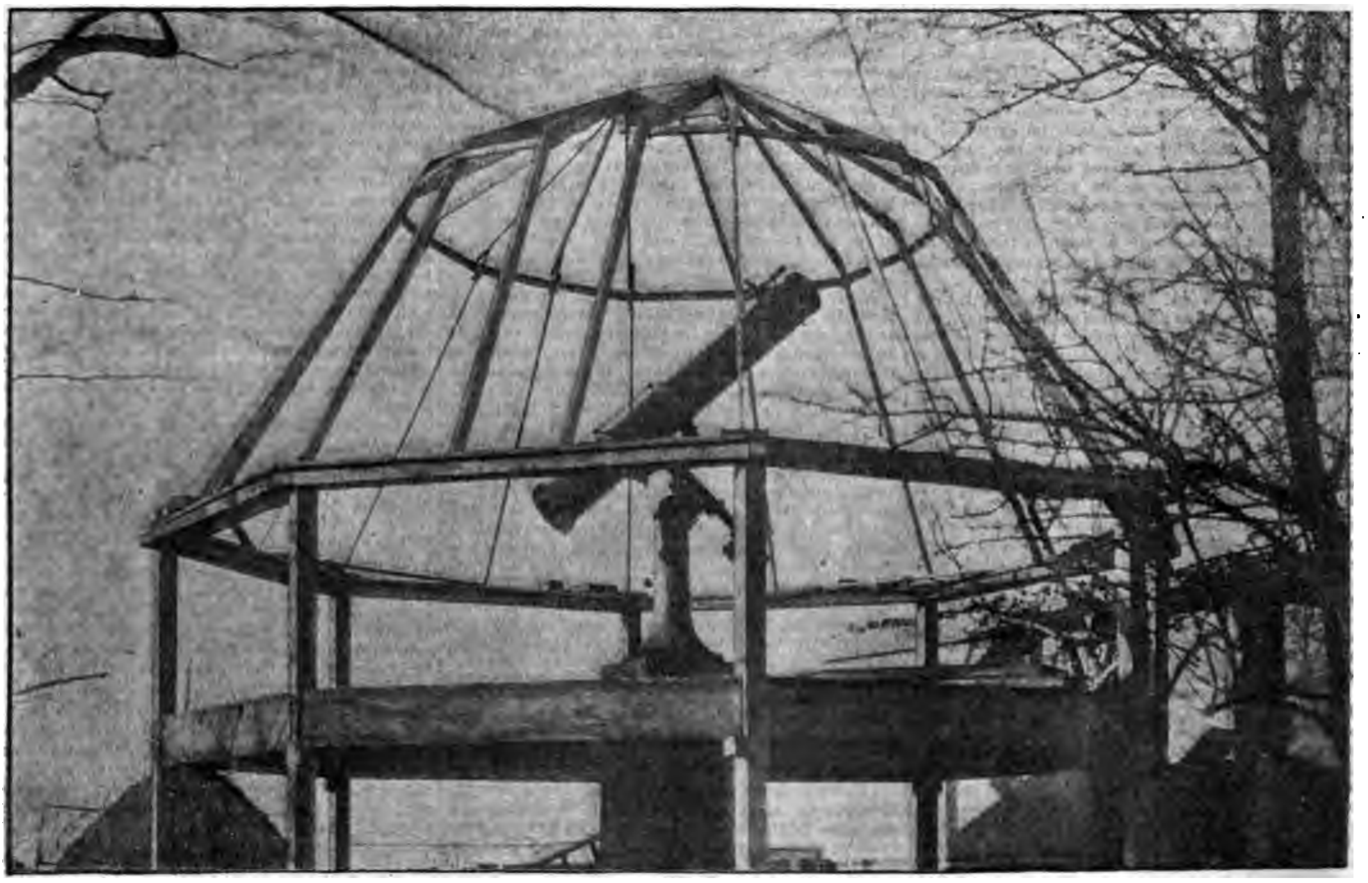
I think the best way is to have a bent lever whose "nose" enters the holes in the "tune band," and whose "tail" is made to push apart two light springs previously in contact with each other. The tail of the lever is of ebonite, and carries a stud on each side, which studs are in connection with the two ends of the coil of the electro-magnet, to which it belongs. When, therefore, the tail pushes apart the two springs, its studs form connections with them, and divert the current to the electro-magnet, the current being supposed to be constantly flowing through all the pairs of springs belonging to the (say) 54 notes. In this arrangement the electro-magnets that are in action are arranged "in series"; but I suppose they could be arranged "in parallel," though I am not clear how this would answer when several notes had to be sounded simultaneously. I fear the E.M.'s which provided the shortest route would get more than their share of the current. Perhaps Mr. Allsop would clear up this point. If it would answer it would be better than the former plan in saving the battery from supplying a continuous current, and so running down quickly.

In conclusion, let me advise "A. J." not to attempt the job unless he can do the work himself, or he will involve himself in endless worry and difficulty, *with a frightful bill at the end of it!*

**A. S. L.**

### THE BOYNTON BICYCLE RAILWAY.

[31693.]—People over here are much interested in what is known as the Rapid Transit Bicycle Railway. For the past year or two there has been considerable speculation as to the success of the Boynton Bicycle Railway. Experiments seemed to warrant the inventor in developing his plan and giving it a practical test. Lately a trial trip was made with a new machine at Brighton Beach, which proved a very successful one, and the speed attained was far ahead of anything thus far brought into practical operation. The patent consists of a locomotive propelled by steam, run on a single rail. The locomotive has but one wheel for driving and two others to support the tender. The locomotive and cars are balanced by wheels overhead, which run along a beam erected for the purpose. It weighs five tons, has one driver, and is said to be capable of a traction of five



tons, which could be increased to nine tons. The carriage was a double-decker weighing five tons, and capable of carrying 180 passengers. The road used for the trial belongs to the company, and is 1¾ mile in length. The start was made without mishap, and the distance to Coney Island traversed in 1¾ minute, including a slowing up over the curve, which covers three-quarters of a mile. The first mile, from Coney Island Creek to the Boulevard, was made in 42 seconds, the time being taken by four of the gentlemen in the party, all of whom were sceptical as to the result of the experiment. A return trip was made to Gravesend, and on the second journey to Coney Island the straight mile of the distance was completed in 32 seconds. The engine and car ran smoothly enough over the single track. Gen. Wingate, one of the party present at the test, was of the opinion that the bicycle engine and cars can be used on the elevated roads with perfect safety, and the others in the party were pleased as well as surprised at the result of the experiments. Boynton has consulted with Jay Gould and other railroad magnates interested in our elevated systems, and the inventor is confident that ere long the present system of transportation will give way to his patent.

New York, Sept. 20. **J. Younger.**

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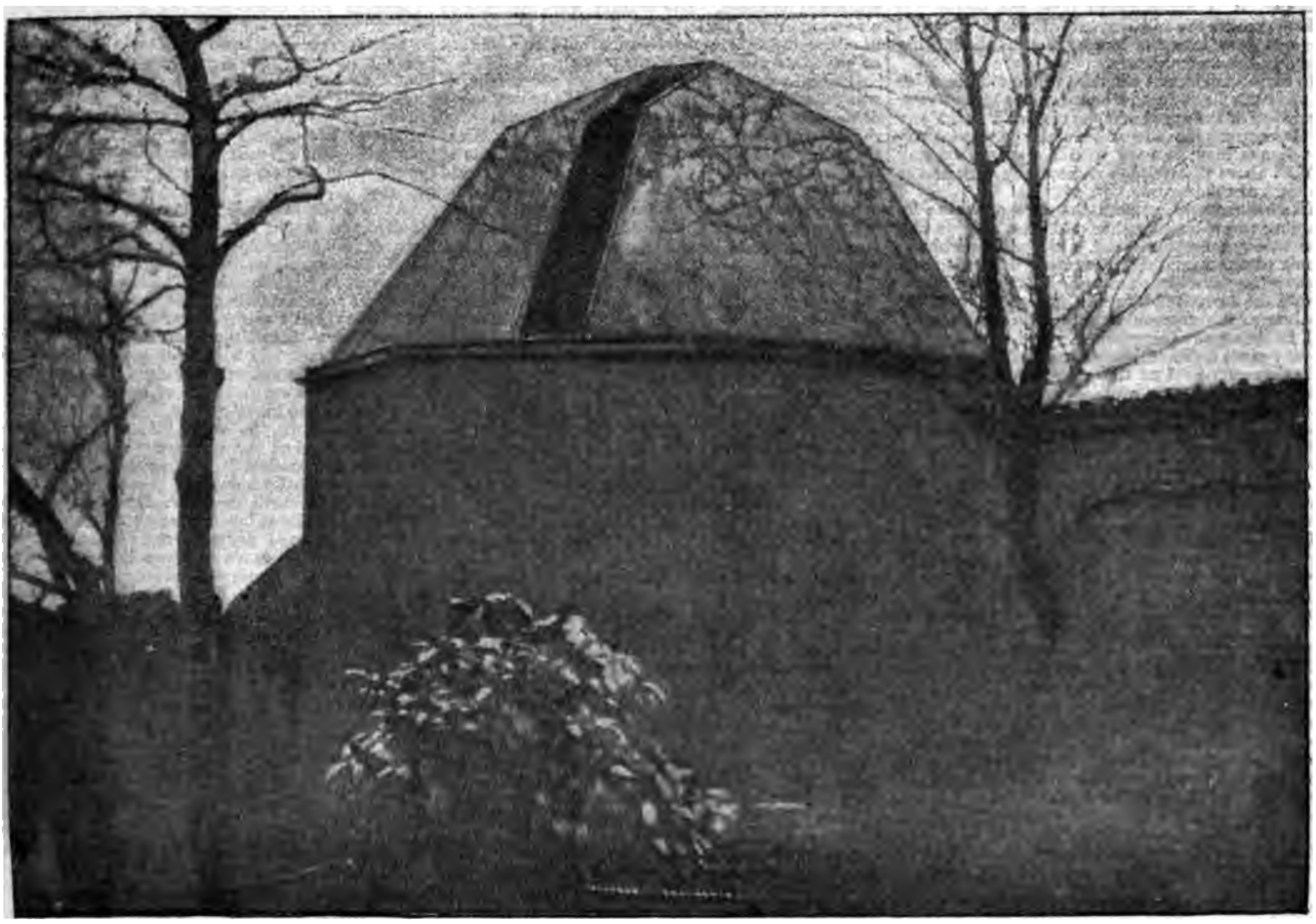
## ASTRONOMICAL OBSERVATORY.

[31694.]—Your correspondent, "W. S. P." (31572), and a previous correspondent, invite suggestions as to an efficient and economical observatory for an 8¼in. reflector, and as I have recently myself constructed such a house, I offer the few following remarks in case you might think them useful:—

My horizon was obstructed upon the ground level, and, consequently, I had to raise the floor of the observatory 6ft. The house is an octagon-shaped one, 16ft. in diameter. I obtained eight 4in. × 4in. pieces of yellow pine 10ft. long each. I set out upon the ground a regular octagon, and at each of the corners I dug a trench 18in. square and 18in. deep, which I filled with good concrete, and upon this built a dwarf 9in. square pillar, three bricks high, in cement. In the centre of the octagon I dug out a trench 4ft. × 4ft. and 3ft. deep, and filled this with good concrete. Upon this a column of brickwork 23in. square and 8ft. high was built in cement, and was capped by a 2in. stone paving slab, set as truly level as considerable pains could make it. I cut mortises in each of the eight 4in. × 4in. posts 6ft. from their bottoms, and mortised them in pairs with 2in. × 9in. joists at such distances apart as would enable them to stand upon their 9in. square brick pillars. The two pairs of middle ones would be, of course, 16ft. apart from outside to outside, and the two outside ones 94in. apart. The joists were then cross-mortised and recross-mortised in such a manner as to form a proper bearing upon which to nail the floor-boards, but at the same time so as to leave a space of 2in. clear all round the central telescope column. The 4in. × 4in. posts were then cross-stayed diagonally, and horizontal bars of 3in. × 4in. stuff fixed to them, to which eventually galvanised iron sheeting was to be nailed. Floor boards were then laid, still leaving a space all round the centre column, and a short flight of stairs was run up at the north side of the telescope. In passing, I would mention that with a refractor the least inconvenient side for the staircase would probably be the south side. The tops of the eight posts were then planed off level with each other, and lengths of the 2in. × 9in. joists were mitred from one to the other and fixed upon them, forming a level octagon 9in. wide. My 8¼in. Calver has a cast-iron round column, which I now placed in the centre of the house upon the stone paving slab. I then took a length of slate batten, 1in. by 2½in., which I had at hand, and using the round iron column of the telescope as a centre, I ascertained by experiment what point in this radius bar would describe a circle upon the 9in. wide octagon, which would as nearly as possible fall entirely upon it. I found a point at which a circle could be described, which left the octagon only for a very trifling extent at the inner angles. I then bored a hole in the radius bar of the size of an ordinary lead pencil, and carefully scribed the circle upon the octagon. I then bent rods of ½in. round iron to the scribed circle, and drilled countersunk holes at every 2ft. of their lengths of a size to suit the inch screws I had, and then screwed the iron rods in their places. I next cut lengths of floor boards, which I mitred so as to form an octagon identical with that fixed to the top of the posts. The mitred joints I united by simply screwing over each joint a 15in. length of floor board and using ten screws to each joint. This formed a fairly rigid octagon. Having laid it upon the other with exactitude, I described upon it a circle similar to that described upon the other, and at a point about 18in. to the right of each joint, cut slots 4in. long by 1in. wide, in the centre of which was then visible the iron rod which had been fixed to the other octagon. On each side of every slot, and parallel to its length, was then firmly screwed a block of wood 2in. thick, 3in. deep, and 4in. long. In a line with the centre of each slot, and 2¾in. from the bottom of the upper octagon, I bored a ⅝in. hole through the two blocks parallel with the octagon and in a line with a radius of the circle. I then cut 5¼in. lengths of ⅝in. iron gas barrel, and having procured eight cast-iron grooved ¾in. wide wheels of 6in. diameter and with a ⅝in. hole in the centre of each, I placed them between the blocks and through the slots in the upper octagon, and inserted the iron barrel lengths to form their axles. My upper octagon was therefore raised by the wheels ½in. above the lower one and revolved with the greatest ease upon the round iron ring. I then proceeded to construct the roof. For this purpose I procured a quantity of slate battens 1in. × 2½in. deal. Having decided to build the roof after the figure of what I think they call a hipped roof, when applied to a green-house, I arbitrarily fixed upon an angle at which the two portions of the roof should meet, by moving one length of the batten upon the other until my eye was satisfied with the appearance of the angle. Having once decided upon one, I firmly screwed one piece upon the other without halving either, and sawed off the projecting corners. I then screwed up 14 other bars, which were 7ft. 6in. long from the bottom to the hip, and about 4ft. from the hip to the ridge. In order to provide for the shutter I decided not to allow the roof bars to meet at a central pinnacle, but to form a ridge bar 2ft. long, consisting of a piece of floor board with a 3in. square pinnacle mortised at each end of it. Seven of the roof bars met, therefore, at each of these pinnacles, which, for a purpose presently appearing, were kept 1½in. below the top of the ridge bar itself. The odd roof bar, viz., the 15th one, was fixed on one side of the ridge bar to its centre, and 1½in. below its upper edge. On the opposite side to the 15th roof bar just referred to, and screwed to the inner sides of the two 3in. square pinnacles, and on a level with the upper edge of the ridge bar, were two strong roof bars, 1in. × 4in., mitred to the angles of the other roof bars, but having the upper and lower portions all in the same line. These were fixed parallel with one another, and, of course, 2ft. apart. Having been fixed level with the upper surface of the ridge bar, they would, of course, project 1½in. beyond the general surface of the roof, and form a suitable opening, over which a shutter could be fitted. The roof bars were fixed to the ridge pinnacles by a single screw each, and to the upper octagon by another single screw. I then fitted horizontal pieces between each roof bar, just at the hip, which served the purpose of regulating their distances apart, and of forming a hip ridge, over which to stretch the Willesden canvas, which I eventually used. I, of course, did not continue this regulating horizontal bar through the observing space, but I supported the two 1in. × 4in. roof bars on each side by a diagonal strut. I next bought a roll of wire netting 30in. high and 1¼in. mesh. I wound a length of this round the bottom of the roof, commencing at one side of the observing aperture, and strained it to each successive roof bar, and then pinning it, cut off the length when I came back to the shutter. I then pinned the wire netting by its lower edge firmly all round the upper octagon, to which all the roof bars were screwed, and without attempting



to take in the fulness which existed at the upper edge of the wire netting, owing to the decreasing octagonal section of the roof, I strained the netting upwards at each roof bar and pinned it there. This left a considerable fulness in each section, and I was surprised at the success I attained in taking this fulness up. I simply put the handle of a bradawl in each successive loop and strained it upwards. The result was magical. All the meshes regulated themselves, and a taut flat surface was produced for the canvas to lie upon. Leaving 3in. between the first layer of netting I pinned on a second layer and proceeded in precisely the same manner. The netting adjusted itself with perfect ease to the angle at the hip. When the second row was done I laced the top of the first row to the bottom of the second, and by having allowed a 3in. space between them I was able to strain the two together in a very satisfactory manner. The roof bars at the top falling so close together, a third row of netting was not necessary. When the netting was fixed, the roof, though composed of such slight materials, was incredibly strong, so much so, that the ridge would support my whole weight. I then procured a quantity of Willesden canvas, and proceeded to nail it to the roof bars in the following manner. I forget its exact width, but it was something like 54in. This was about 12in. over the width necessary to cover the widest part between the roof bars. I therefore took the left-hand corner of the canvas and nailed it to the first shutter roof bar with ¾in. copper nails, and strained it by its selvage edge down the roof bar, and cut off the length of canvas 8in. below the upper octagon. I then strained the canvas on to the next roof bar, so that it was free from wrinkles, tacked it down, and leaving a 1in. margin, cut it off. The piece cut off, upon being reversed, was tacked along its selvage to the second roof bar and strained to the third. Then a fresh length was taken from the roll, and the same course pursued. By this means the whole roof was covered, leaving the observing aperture projecting 1¼in. beyond the surface of the roof. To cover this aperture, I made two light frames of the slate battens. One covered the portion of the opening up to the hip and the other the remainder. The top one overlapped the lower one. The roof when finished is easily revolved with one hand. To avoid the possibility of it being blown off, two ropes fall from the ridge bar, and, being furnished with loops, are attached to hooks driven into the telescope brick column. These, on proceeding to use the telescope, are hooked to one of the roof bars. The outside of the house was covered with corrugated galvanised iron sheeting in 10ft. lengths, and the inside of the upstairs part is match-boarded round the sides. This house has now stood twelve months, and has answered my purpose entirely. Owing to the aperture between the two octagon plates the ventilation is good, and the temperature about that of the outside air. But the telescope is preserved from wet, and the observer from wind. I am very much alive to the deficiencies of this description, and do not suggest that the house could not be improved upon. But it has been built and designed, except as regards the brickwork, in every detail by the unaided hands of an amateur, and these remarks are only sent as a contribution to the discussion of a question interesting to so many. I inclose two photographs—one of the house with the roof-bars fixed, and the other the house canvas covered.

Norwood, S.E. **John Bell.**

## THE ELECTRIC LIGHTING OF TRAINS.

[31695.]—What progress is being made for using electricity in the lighting of trains in England? The Great Northern have made some experiments, and it is used, I believe, on all the Brighton expresses; but over here it is dropped in some places quite as fast as it is taken up in others. Thus, for instance, Mr. Leonard, the superintendent of the telegraphs on the Chesapeake and Ohio Railway (one of the most important here), says, in a paper on "Electric Lighting in Train Service," that the Boston and Albany Railroad Company, after two-and a half years' trial, recently abandoned electricity on the two trains that were so lighted, and substituted the Pintsch gas system. The Pennsylvania Company, however, still continues to light cars from storage batteries, using a low voltage lamp. The Intercolonial Railway Company of Canada has adopted the accumulator system alone on the trains between Halifax and Quebec, and now has more than forty cars fitted up with electric lamps, which are of 10c.p., and vary from 11 to 22 to a car. The accumulators are charged at four different points on the line, running about 500 miles with the one charge, and the results thus far obtained are very satisfactory, but to provide for emergencies oil lamps have been retained in each car. The combination of dynamo and storage battery first adopted by the Pullman Company is gradually being extended in this country, and is giving great satisfaction in the East and West, but, it appears, at a large expense for maintenance. The Chesapeake and Ohio vestibule train, "Fast Flying Virginian," running between New York and Cincinnati with six cars, is supplied with 118 lamps divided up thus: two Pullman coaches with 30 lamps each, dining car with 26, day coach 16, combination car 13, and the baggage car 3. Up to May 1, 1890, the average cost per lamp for maintenance and renewals was 1·10dol. per month; yet where the exhaust steam is utilised for heating the train, the cost can be very materially decreased.

With this object in view, the Chicago, Milwaukee, and St. Paul Railway Company has recently added to its equipment two independent light and heat tenders, which carry their own boilers for steam heating and for running a Westinghouse automatic engine attached to a No. 4 Edison compound-wound dynamo, supplying the current direct for lighting all the cars in the train, thus doing away with the dynamo on the baggage car and storage battery combination.

The results have been very favourable, and during more than six months of constant service there has not been a single failure. This company has four trains covering about 45 cars lighted by electricity, and expects to adopt this system of illumination on all of its through trains. It is stated that the expense of building and equipping these tenders is not much greater than the cost of the storage battery-dynamo combination, with the expensive wiring required in that system.

It is confidentially believed that the cost of lighting trains by electricity in the United States can be greatly reduced by adopting the method so largely used abroad of getting power from the axle. Mr. Houghton, the telegraph superintendent of the London, Brighton and South Coast Railway Company, one of the patentees of the system, advises me that there are 16 trains running on that road which are so lighted—13 of them local trains and 3 expresses. The speed of the express train reaches 70 miles an hour, while that of local trains run from 20 to 60 miles per hour. The express trains are wired for an average of 70 lamps, and the others 40. The candle powers of these lamps varies from 8 to 16, according to the speed of the train. The dynamo furnishing current for these lamps is placed in the baggage car, and has a pulley at each end connected by belts direct to the axle of the car, no intermediate shafting being used. The slack is taken up by loose pulleys that can be pressed upon the belts. In the same car with the dynamo, 22 accumulators weighing about 4,000lb. are placed in parallel with the dynamo, for use whenever the train stops. Connected by a belt from the dynamo is a centrifugal governor which joins up the circuit at any desired speed, causing the dynamo to charge the accumulators. When the lamps are not lighted, the governor introduces resistance into the dynamo field, reducing the output to about 40 ampères, in order not to damage the accumulator plates. When, however, it is necessary to light the lamps, the dynamo makes the full current, of which about 35 ampères pass into the lamps, the balance being stored in the accumulators.

In each lamp circuit a regulator is placed in order to keep the light in the lamps at the same power regardless of the speed of the train, and shunt any surplus current into the accumulators; so that 42-volt lamps may be used with a dynamo of any E.M.F. above that voltage without any variation in the light of the lamps.

The connections between the cars are made by coupling two cables together, and when the dynamo runs below a certain speed, a cut-out breaks the circuit of the armature, preventing the cells from discharging themselves through and burning it out. Should the current not furnish enough current for the lamps, the accumulators supply the balance, and in doing so strengthen the field magnets, and thereby cause an increase of current in the dynamos.

One arrangement of the circuits of these trains has the field magnets of the dynamo wound with two wires in opposite directions, one of which is shunt to the armature as if the dynamo was an ordinary shunt machine; the other is wound in the reverse direction as if the dynamo were a compound machine, and the accumulators are in series with the wire. The lamps are also in shunt with the armature.

The trains on which this system is used consist mostly of ten cars which run solid, that is, are not broken up, and average 40 12-candle power lamps to a train. By using accumulators in each car, however, no difficulty would be found in splitting up the train at various points.

The figures given by Mr. Houghton are as follows:—Total weight of the plant on each train, three tons; cost of plant on each train, £400 sterling; cost of maintenance per annum, £65 sterling. The only attention given trains is at each terminus, where one man inspects the apparatus, oils the pulley bearings, &c., before the train pulls out. One of these trains has been running since December 19, 1883, without a single failure being reported. During the first eleven months of its use, it made 2,352 trips, and ran 27,322 miles.

The Midland Railway Company of England is running three trains lighted by electricity, and has recently fitted up two others. Two of these are short trains, always run solid, and the others main line trains made up at various points. The dynamo is placed in the baggage-car, and is also driven from the axle with about the same electrical arrangements as are used on the London and Brighton road. The short trains have 85 lamps run from one set of storage batteries, in the baggage-car. On one train the batteries are in series, but on the other in parallel. This seems to be the most satisfactory. Eight candle-power lamps are used on this road, two to each compartment, which can be turned down, and this feature is found to be very convenient to through passengers.

This system of illuminating passenger trains is becoming very popular in England, and it is believed that all such trains on the important roads of the kingdom will shortly be equipped in this way. The expense, as shown by seven years' experience on the London and Brighton road, is certainly not greater than where common oil is used, and seems to corroborate the report made by Sartiaux and Weissenbruch to the International Railroad Congress at Paris a year or two ago, in which it was stated that for lights of the same candle-power, gas supplied by the Pintsch system would cost about 11·3 centimes, and coal oil about 16·9 centimes per lamp-hour as against 5·6 centimes for the electric light.

Compared with the practice on American roads, the economy of this method of generating the current is remarkable. It has been stated, however, by various authorities that it is impossible to secure even fair results in train lighting in this country, where the power is supplied by the car axle, owing to the numerous curves on American roads, around which the wheels will often slide without turning the axle a single revolution, thus seriously damaging belts and armature, and the constant changes in speed; while English roads are almost always tangents, and a high and constant rate of speed is maintained. The experiments made here some years ago seem to corroborate these statements.

In 1886 or 1887, Mr. Barrett, of Springfield, Mass., fitted up a train on the Connecticut River Railroad to be lighted with electric lamps run from a dynamo obtaining its power from the car-axle. A countershaft was used, and a peculiar arrangement of a friction clamp transmitted the power to a pulley on the shaft. This clamp was governed by centrifugal weights balanced by stiff springs. When the dynamo ran at its normal speed, these springs just balanced the friction of the clamp, and there was no slip: any increase of speed then caused the friction to diminish, and the pulley slipped upon the shaft until the equilibrium was restored; 24 accumulators were connected with the circuit as a regulator, keeping the lamps lighted when the train stopped, and a centrifugal governor broke the accumulator circuit when the train slackened its speed. The brushes were attached to a rocking arm or lever, which was tilted by magnets in either direction in accordance with the forward or backward movement of the train.

Owing to the arrangement of the car-trucks, it was found very difficult to obtain the proper speed of the dynamo, and after successive trials with belts, ropes, and chains, it was finally abandoned. Since that time there have been no further experiments of this character in the United States; but it is said that such improvements are now being made in the driving gear as will obviate the difficulties heretofore encountered, and that further trials in this direction may be looked for within the next six months.

It would be interesting to learn whether there is any possibility of sufficient economy or advantage being obtained to induce railway companies to adopt the electric light for their coaches. There is no doubt as to its superiority over oil-lamps.

Cincinnati, Sept. 10. M. M.

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## ELECTRICITY AND ETHER.—II.

[31696.]—As I am now engaged in a systematic examination of the alleged function of the ether in electrical phenomena, and intend to examine a considerable range of facts and ideas, I do not propose to discuss any criticisms which may be offered unless they really call for attention and reply. But letters 31673 and 31674, p. 123, call for a few remarks which may render future ones less necessary.

Thus I will ask those moved to criticism to avoid a few things. 1. Please do not repeat over and over again statements or ideas already dealt with. I do not wish to be accused of saying the same thing repeatedly; but what can I do if I am expected to argue over the same ground? Mr. Bousfield does this as to what he calls my "assertion" that there is no evidence "of the transmission of electric or magnetic force through space." This leads me to 2. Please criticise exactly what I say, not something my words are altered into. I said there is no evidence that electric or magnetic action traverses space. I do say that energy traverses space from the sun; we do not know in what form, but certainly not in that of electricity or magnetism. This is not my assertion, Mr. Bousfield; I have asserted and will assert no single thing which I do not support by facts or reasons. This assertion I claim the right to say I have proved, because I have given reasons which no one has dared to question, often as I have challenged reply here and elsewhere. Now, Mr. Bousfield brings up and refers me to certain facts which he says prove that "magnetic phenomena are intimately associated with solar action." I never said they were not; I have often said they were. The facts and the relation are both treated of on pages 113 and 442-3 of my "Electricity." But I grow (as others do) flowers and cabbages in my garden; we all know that solar action is intimately associated with the phenomena of vegetation. Does Mr. B., therefore, purpose denying my assertion that cabbages and flowers do not traverse space? Solar action produces heat, yet space is cold. It is hypothesis (natural) that light and heat traverse space; but we do not know it; and as regards heat, it is very doubtful. What traverses space is energy, and when that energy is taken up by *matter*, it calls into action the manifold functions of that matter in the form of the various forces, heat, electricity, magnetism, vegetation, &c., and this, it should be clearly understood, is the central point of this discussion, my datum line, that we are to look for the causes of phenomena—that is to say, the forces in the properties of matter on which we can experiment, instead of inventing imaginary properties of an imaginary agent. As to the traversing space, is Mr. B. prepared to answer my argument, that the presence of electric and magnetic forces in space is absolutely inconsistent with the invariable attractions of gravitation? Till that is answered my "assertion" cannot be honestly disputed.

3. Please do not pelt me with big names. I do not care the proverbial brass farthing for any name whatever, and do not belong to any of the "mutual admiration" cliques. If people talk nonsense, I do not care to inquire who the people are. I freely give to everyone the pure, honest admiration for real work. In the opening quotation of the Church service, we are told, by the prophet Ezekiel, what shall happen when the wicked turn from their sins and do what is lawful and right; but he makes a correlative remark (not quoted) about what shall happen if the rightous man turns to wickedness, and says "all his righteousness that he has done shall not be mentioned." I hold that doctrine in this matter. Instead of meeting my definite arguments, every other letter in this discussion has pelted me with, "Sir Wm. Thomson, and Clerk-Maxwell, and 'W. C. E.' is at it again." He says: "One has heard *usque ad nauseam* about the mathematical mill." Possibly. We all know that mathematicians feel towards any one who doubts the universal value of formulæ, much as an Inquisitor regarded anyone who doubted the dogmas of the Church. But is it not possible we have heard enough about Sir W. Thomson and Clerk-Maxwell giving authority to any of their guesses?

Sir W. Thomson is an admirable worker, and I should not attempt to criticise his mathematics; but as to hypothesis—why, the most wildly absurd hypothesis ever offered to this generation was invented by Sir W. Thomson; I refer to his meteoric origin of life on this planet. Mr. Bousfield, as a biologist, will, of course, see how forcibly we are required to respect this, as it came from such a source.

As to Clerk-Maxwell, I am not at all sure that, if alive, he would not be on my side. That did happen in a discussion long ago, when I was objecting to the erroneous ideas resulting from the misuse of the word "potential." There was a long course of letters from a number of leading men, professors and others, and I was pelted with big names. Ultimately Clerk-Maxwell himself wrote and *said just what I had said*, and been well scolded for saying. I wonder how many who call upon his name think of the real, deep significance of those words of his in the preface to his last work. When referring to his former work, he says: "I have since become more convinced of the superiority of methods akin to those of Faraday." The methods of Faraday are those which I employ.

But what on earth does Mr. Bousfield mean by saying "If 'Sigma' can prove that the specific inductive capacity of dry air is not to that of mica as 1 to 5, he will do more to upset the ether theory than by whole volumes of academical arguments"? I am lost in wonder! Why should I disprove it? What is really needed is *proof* of the *assertion* that the real thing is not air nor mica, but ether, which is said to have a capacity something less than that of dry air. I want to know why, if ether is the real active agent, guttapercha should have five or six times the power of the nearest approach we can make to it—viz., vacuum? Academical arguments! I deal only with plain known facts, and object to their being obscured by academical arguments and obscure refinements of calculation.

As to Mr. B.'s remarks about opacity, they would reduce scientific definition to childishness. The mathematical theory is said to result in *inductors* being transparent and *conductors* opaque; and we are to be told, forsooth, that the real explanation of this is that "'Sigma' must first find an opaque body."

Both Mr. B. and "W. C. E." drop into prophecy. It appears that something *may* be discovered that will explain something. Also that a "grand generalisation is looming in the distance," which may do something or other some time or other. I remember some years ago the late Rev. Mr. Highton asked me how I should feel when in a short time the scientific principles I had been expounding as to the relations of energy to work were upset upon the completion of one of the American inventions, Keeley's motor—no, it was Pain's engine—and I replied that *then* I would reconsider my position; but in the mean time I should *wait*. Now, is it not somewhat in the *hanky-panky* style to talk about looming generalisations, and things which may be discovered, when evidence is called for in support of a debated hypothesis?

All old readers of these pages know that "W. C. E." is a man of clear thought and much knowledge; but it is evident that, whatever may be done or not done in four-conditioned space, he has managed (as most mathematicians do) to tie himself up in knots which he cannot escape from. Out of that bondage he would be the first to pour scorn upon anyone who offered such arguments as he applies to me. He is a logician, yet descends to the lowest form of bad logic—begging the question. The question is the properties of a supposed agent. I made what he calls the extraordinary statement "that the ether does not possess any of the properties of matter as known to us." I gave all this in detail some time ago, and I point out the absurdity of applying calculations based upon the known properties of matter, which I specified, to a substance which certainly, if existing, does not possess those properties. How can the laws of motion, the facts of momentum, be applied to a substance having no weight and resistance to motion? And then he goes on to say, it is "usually supposed to have all the properties of a perfectly gravitationless material." Just so; it is *supposed*—that is, asserted—to possess those properties, *merely because a material possessing those properties, but utterly out of our knowledge and experience*, is needed to enable mathematicians to work out a theory. That material exists, therefore, merely because it is desirable, and we must take it without proof, because Sir W. Thomson and Clerk-Maxwell found it would be useful. Well, I will call Sir W. Thomson himself in evidence by-and-by.

But I have had to say so much that is desultory, that I cannot in this letter resume my own argument. I will now only say that in my last letter I treated only of the "induction" side of the subject. Had the etherialists been satisfied with that field, I should not have troubled myself much. Comparatively little is yet known of it because it has not many practical complications and interests, and affords a happy hunting-ground for the ima-on. It is the attempt to make conduction a of the ether which stirred me up to protest; this that I applied the term "nonsense," hen I have worked the thing out I think I rove its justice. And I shall begin by giving atements of some of the leading apostles of her doctrine—their assertions on the one hand, n the other their admissions that they are elves utterly ignorant of what they speak so positively. **Sigma.**

## MOTORS FOR CYCLES.

97.]—I forward sketch of steam motor for for the benefit of those interested. Fig. 1 is

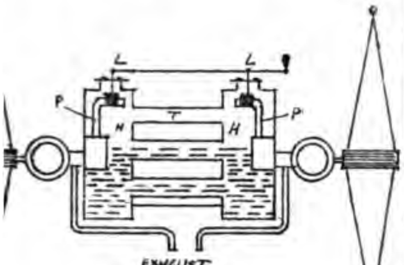
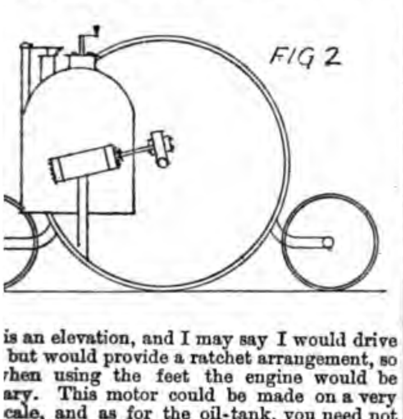


FIG 1 -

on of boiler showing cylinder ends. H H o hollow boxes, either cast or made of copper uld prefer copper), and the tubes T are l into these boxes, thus making a kind of r boiler. The engine is of the oscillating and is fed direct from the boiler, thus securing eam, and as the supply-pipe and stop-cocks inside the boiler, there would be nothing ut the cylinders and exhaust-pipes, which I discharge close to the ground. The boxes rould have to be put together with flanges, rise you could not fix the steam-pipes P P. the regulator connected with rod, as shown. oxes H H might also be provided with a on so as to form a pair of tanks for the oil; have not given a description of the lamps, as nds on the kind of oil intended to be used.

FIG 2

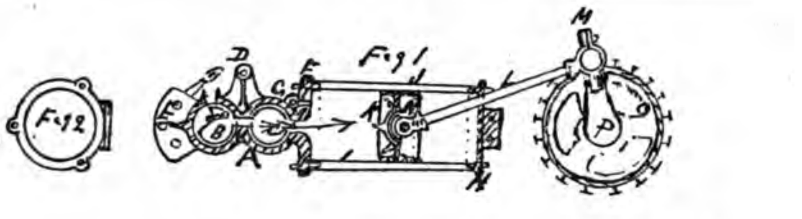


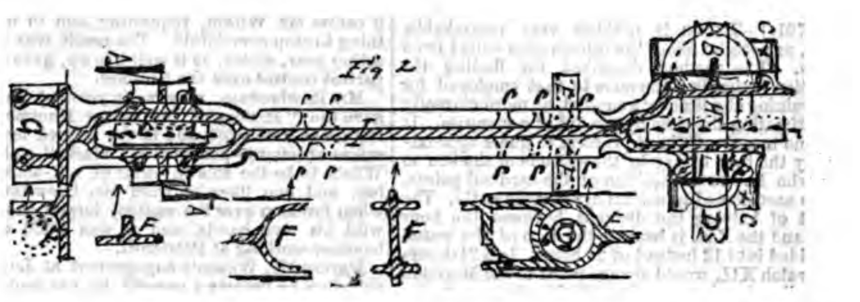
is an elevation, and I may say I would drive but would provide a ratchet arrangement, so when using the feet the engine would be ary. This motor could be made on a very cale, and as for the oil-tank, you need not bove a gallon at once, because you could supply at any small village. So much for motors; but I would like to ask, Are all the ical arrangements exhausted? I think For over two years I have been studying G. J.'s" arrangement—that of reducing when coming to a hill; but I would not use hains. I would do away with the chains her, and drive with toothed gearing (rather onable, I know, but we cannot help it), and g this arrangement to safeties, I should he rear wheel with a rod from pedal axle vel wheels, the rod being made to slide, thus g it in and out of gear to different speeds. I say rod, I mean a light shaft. This could e by the feet or a lever from the handles. return to tricycles. I think a flywheel ement, something like the Britannia Co.'s r saw. I think the extra weight of the fly- would be compensated for by the power it store up. But one objection would be that ld not stop so suddenly; but this could be ed by putting the brake on the flywheel.
ham. **C. Goddard.**

## LIARY POWER FOR TRICYCLES.

8.]—Having gone so far with the climbing p gradients, we will proceed next to the ration of the frame or carrier for motive

The machines that these are intended for uilt very light (and it is absolutely necessary ey should remain so), we must find some way to arrange this affair without throwing any extra strain upon the machine, if possible, and, at the same time, be a stay and as light as possible. Therefore, the section of the following sketch I have confined to $\frac{3}{16}$ths, and I think it will be perfectly rigid enough for anything that we shall require. According to the plan I have laid out upon my board, it runs into 21in. in length, $\frac{3}{4}$in. across I, and $1\frac{1}{2}$in. deep, and this length and breadth as arranged I reckon will run inside of 7lb. weight, $\frac{1}{4}$-plate iron being about 10lb. per square foot. This embraces two chain-wheels as well as chain, and is independent of the other chain-wheels driven by the pedals, and is furnished with a clutch to throw it out of gear when pedalling, or if an accident should occur, that you can use it as really an auxiliary power, or dispense with it as occasion offers. The cylinders will run into another 6lb., and if it can be carried out for petroleum, the pump arrangements with generator, with supply of material, will run into another 6lb. Now a petroleum engine will have to be single-acting, and therefore it will be an open cylinder, but of that more presently. Let us see what the frame sketch is like. Well, this is made of malleable cast iron or steel $\frac{3}{16}$ in section all through, as near as it is possible to get at it. This is not only necessary for lightness, but for the insurance of a good casting, as the cause of light castings being unsound is chiefly owing to the heavy parts dragging and breaking the light in contraction. In cooling, heavy casting in ordinary cast iron will rupture from the same cause, and in making of patterns this must always be taken into consideration. Where it is not taken into consideration, there is every likelihood of a failure. Description for petroleum engine: cranks, fore and aft, A A, that is forward, the bracket G embraces a ferrule upon the ordinary crank pedal shaft, with a washer and pin to keep it from running off; H is the main axle, a chain-wheel is fast on that, and a clutch is upon the boss, while another movable boss with teeth engage when required, B and D showing same shaft right through; C × C × are side views of carriage; E E is not required for the petroleum engine, but I put it there for future reference. It is a bush cast on the frame for the trunnions of the oscillating cylinders for steam-engine. F F F F F are sections, as shown at arrows, as there will be little or any strain upon any part of the machine besides the weight; $\frac{1}{4}$ bolts will be sufficient for all purposes; the pull coming direct end on the framing or carriage, and in lieu of boss and bush, E 2, ribs will be cast in the carriage J J J J J J for a bearing to affix the cylinders to.





Now, the next thing is, how are we going to construct the cylinders? A is the base or back-end, made of malleable cast iron or steel, phosphor bronze, or Mitis or Delta—you have plenty of choice now; but I should prefer the two first. The two chambers for igniting and charge (B and C) are cast in, and the tail-piece E for fixing to frame, and the web at E, central, can have a hole put into it for the lamp for permanent light. D is a bracket or pedestal to carry the arrangement to work the valves B, C, and G, which is the exhaust, though this would be best, perhaps, placed at the bottom; F is the base of the cylinder; the cylinder I is steel, solid drawn tube, 2in. diam.; thickness, No. 16 B.W.G. The base is bored out to fit the tube tightly, and recessed about $\frac{1}{16}$ or $\frac{3}{32}$ deep. The tube can be driven in or drawn in and sweated in with soft solder. The outside of F is turned and the outer tube (that tube is light brass) and fitted on between these two tubes packed with asbestos wool. H is a hoop over all, fitted to the two tubes as shown the other end, and the lot drawn together with three or five bolts, as shown at Fig. 2. K is a somewhat elongated piston, and I should prefer that malleable cast iron with brass rings $\frac{1}{16}$ sq.in. L, connecting rod, can be cast of iron or steel, and bushed, or the rod L steel, and M N phosphor bronze. O, chain wheel, and P, crank and pin, all cast in one of malleable iron or steel. This is the petroleum engine, and it has its disadvantages. First, an open cylinder; secondly, the cranks must be fore and aft. Engines only single-acting—wear and tear will be enormous from grit, &c., and no amount of lubrication will alter it. And last, but not least, I do not think in this case there will be any certainty of its action, and the power will be nominal. It is too early to ask for information emanating from the experimental plant put forth previous to this I expect. I hope someone will pull foot and report, and let us hope favourably, if not for this for something else I have in store. **Jack of All Trades.**

## SAP IN TREES.

[31699.]—Mr. Reeves (letter 31639) states that water will not rise 1ft. in either blotting-paper or calico. I have not tried blotting-paper, but find that it will rise 1ft. 6in. in well-washed calico, if left long enough. It is best to wet it first.

If he will refer to Stewart and Gee's "Lessons in Elementary Practical Physics," Vol. I. p. 198-201, he will find that when superficial tension of water = T grammes per centimètre.

$$\frac{\text{Radius} \times \text{height}}{2} = T$$

$$\text{Radius} = \frac{2\ T}{\text{height}}$$

or— $$\text{Diameter} = \frac{4\ T}{\text{height}}$$

taking T = ·073 and height = 50ft. = 600in.

diameter $= \frac{4 \times \cdot073}{600} = \frac{\cdot292}{600} = \frac{1}{2055}$ inch. Water will rise 50ft. in a tube having a diameter of $\frac{1}{2055}$ inch.

With regard to osmosis, I should like to know how he arranged his membranes; unless there was liquid between them, there could not be any action. If this was not the reason, he either did not observe with sufficient care or wait long enough. If the space between the membranes and in the tube above is filled with salt solution and then placed into a disc of water, there will be osmosis through the first membrane; this will decrease the strength of the solution, and cause osmosis through second membrane.

Water absorbed by earth is in the liquid state, and there is osmosis when mud is used instead of water.

I have heard that in the "Tropics, where the most succulent trees flourish," there is plenty of water at the depth of a few feet; if it were not so, they would dry up.

Capillary action and osmosis may not be the only causes of the sap rising; there may be some vital action. **W. H. S.**

## THE CARBON DIOXIDE GUN.

[31700.]—There is one fact in connection with propelling bullets by means of liquefied $CO_2$ or any other condensed gas which seems to have escaped notice—viz., the variation in the tension of the gas with changes of temperature. The pressure at 5° Centigrade is 30753· millimètres of mercury, at 15° it becomes 39646 millimètres, and 10° higher it rises to 50207· millimètres. This change of pressure would cause corresponding change in the velocity of the bullet, and would thus alter the "elevation" necessary to hit a given object. It is difficult enough to keep the elevation correct even with gunpowder, and what the problem would become if a variable propelling power like $CO_2$ were used, can only be imagined.

The discharge of the gun would cool it, and thus the elevation would rise after each shot.

**Wm. John Grey,**
Staff Sergeant 5th V.B. Durham Light Infantry, Secretary Durham County Rifle Association, Newcastle Rifle Association, and Derwent Rifle Club.

### THE "TRUTH" ABOUT THE COMPASS.

[31701.]—There is nothing very remarkable, novel, or peculiar about the information culled from *Truth*. The method described for finding the Meridian is simply a converse to that employed for ascertaining the time by a sundial, or more correctly for estimating the time by the aid of a compass. It is by no means a difficult problem to guess approximately the time of day by the altitude of the sun to one who knows the position of the cardinal points, and is accustomed to use his eyes intelligently. The object of halving the distance between the hour hand and the XII. is because the face of the watch is divided into 12 instead of 24 hours. In a 24-hour-dial watch XII. would always point to the Meridian under the circumstances described. **Sm.**

[31702.]—Since reading the paragraph in *Truth* about finding the south point by the help of the watch and the sun (having a long garden nearly running N. and S.), I have tried the experiment several times, and find I can get an excellent approximate result. There is no necessity to blind one's eyes. Hold the watch with the hour hand pointed towards the sun, so that the hand "covers its own shadow," then the distance half-way between the *minute* to which it points and the XII. will be nearly S.—at all events, sufficiently so for ordinary purposes, such as taking a country walk, or finding one's bearings in the streets of a strange town, and avoiding the occasional necessity of pulling out a pocket compass before an admiring company of small boys.

Two things I have noticed—viz., that you must find your S. point by looking at the *minute* marks, not the *hours*, as the V.'s and X.'s in their thick strokes are not true to centre, and liable to throw one out. Secondly, that as there are 60 minutes on the face of the watch, and 32 points on the compass, a fair result may be obtained by taking the interval between two minutes as an "ordinary" point, calculating from a mark fixed on as representing the position of a "cardinal" one.

It also strikes me that in our long summer days, before 6 a.m. and after 6 p.m., the half-distance between the hour-hand and XII. will show N., not S.

I have not the slightest acquaintance with science in any way; but it seems to me that the original discoverer must have indulged in a species of "contemplative retrogressive progression" in connection with the sundial. **V.**

### WAVE APPARATUS.

[31703.]—I am sorry to see that in the "improved form of wave apparatus," described by Mr. J. T. Stoddart in the *American Journal of Science*, and copied into the last number of the English Mechanic, no credit is given to the originator of this form of apparatus. The arrangement is well known as "Young's Harmonic Sliders," and is described in the *Journal* of the Royal Institution of Great Britain for 1802, Vol. I. p. 261. See also "Miscellaneous Works of the late Thomas Young," Murray, 1885, Vol. I. p. 216.

**C. J. Woodward.**
Birmingham and Midland Institute,
Birmingham, Oct. 6, 1890.

### NASMYTH HAMMER.

[31704.]—Probably a few facts relative to above may prove interesting. Sketch dated Nov. 24, 1839, was brought about in the following manner: The *Great Britain* was intended to have paddles; but no firm had machinery capable of forging the heavy shaft as required, so Mr. Humphries visited Patricroft to consult with Mr. Nasmyth as to the getting over this difficulty. During the interview Mr. Nasmyth made the sketch alluded to in letter 31635; but the manufacture was not proceeded with because the idea of paddles was given up, and the screw-propeller adopted.

Bad times had nothing to do in delaying the production of the steam hammer; the demand for heavier forgings than the existing machinery could produce not commencing for some years after the design was made.

In letter 31635 the writer is correct as to MM. Schneider and Bourdon visiting Patricroft; but Mr. Nasmyth was absent, and the visitors were received and shown, among other things, Mr. Nasmyth's sketch-book, by his partner, Mr. Gaskell.

Seeing the large forging at Creusot, Mr. Nasmyth asked how it had been made. Mr. Bourdon replied—"With your steam hammer."

Mr. Nasmyth had not sufficient means at his command to secure the patent, neither would his partner join him in so doing, and but for the assistance of friends (particularly, I believe, his brother-in-law), the patent could not have been secured. The hammer, as originally constructed in accordance with Mr. Nasmyth's design, was most unsatisfactory; the driver being unable to control it as to force of blow.

A letter of complaint being received during Mr. Nasmyth's absence, his partner, Mr. Gaskell, laid it before Mr. Wilson, requesting him to do something to stop complaints. The result was the self-acting gear, which, as is well known, gave the most perfect control over the hammer.

Mr. Rowlandson, very many years at Patricroft, gave the "History of the Steam Hammer" in a lecture at Patricroft, and in the printed lecture are copies of letters—one from Mr. Gaskell stating Mr. Wilson to be the sole inventor of self-acting gearing, and one likewise from Mr. Crewdson, who, when foreman over the smiths, forged the gearing with his own hands, and it was fitted upon the hammer working at Patricroft.

During Mr. Wilson's engagement at Low Moor, and since he became a partner, he has continued to improve the hammer in many ways. The great success of Nasmyth's steam hammer is certainly due to the self-acting gear of Mr. Wilson. I also understand that great credit is given to Mr. Wilson with reference to the screw propeller. At the time the lecture was given the local press—the *Engineer and Colliery Guardian*—alluded to it, and it will well repay anyone to read the lecture and comments upon it. **R. Pilkington.**

## USEFUL AND SCIENTIFIC NOTES.

A paragraphist says that the first velocipede was invented by Mr. Philipp Trexler, in Gratz, in Germany, in 1784. A long article in a newspaper of that time describes the invention, and names the sum of 20 ducats as given for the first machine. Why is not the name of the paper given?

As is well known, certain chemical reactions are accelerated by sunlight; but Herr Bruhl, a German chemist, has recently intensified the effect by placing the retort in the focus of a concave mirror. The vessel contained zinc filings and ethyl iodide, and the mirror, which was about a foot in diameter, concentrated the sun's rays upon it. The reaction soon began and continued briskly till, at the expiry of a quarter of an hour, the ethyl iodide was all consumed and a good supply of zinc ethyl ultimately obtained. Herr Bruhl considers the concave mirror preferable to a glass lens, which would be less powerful, owing to the athermancy of the glass, so at least it is reported.

**The Coal Supply.**—It is estimated that the coal under the magnesian limestone, in the fields which it is now proposed to test in the division of Lower Osgoldcross, will be no less than 58,000 acres, and in Lower Barkstoneash 35,000 acres. Taking the workable seams of coal at fifteen, with a total thickness of 45ft. of coal, the acreage given would be about 145 square miles, the yield averaging 1,300 tons for each foot, the actual quantity being 1,600 tons, but the difference of 300 tons will allow of loss in working and in other ways. There would consequently be 58,500 tons of coal to each acre worked, or a total for the 155 square miles of 5,783,200,000 tons, which at the present production of the whole of Yorkshire would last for 250 years. At the present time deep coal is being worked at Ashton Moss, near Manchester, at a vertical depth of 1,000 yards from the surface; Rosebridge, near Wigan, 815 yards deep; Dukinfield, Cheshire, 717 yards; whilst at the nearest colliery to the measures on the Hull and Barnsley route, that of South Kirby, is 634 yards deep.

The Cardiff Town Council propose to make grants, under the powers conferred upon them by the Technical Instruction Act, 1889, for the promotion of technical instruction; that instruction will be given in the following subjects which are not included in the branches of science and art with respect to which grants are at present made by the Department of Science and Art, viz.:—(1) Plumbing, (2) carpentry and joinery, (3) masonry and stonework, (4) mechanical engineering, (5) French, (6) German, (7) Spanish, (8) book-keeping, (9) commercial arithmetic, (10) commercial correspondence, (11) commercial geography, (12) shorthand, (13) domestic economy, (14) scientific dressmaking, and that, in the opinion of the Town Council, such a form of instruction is required by the circumstances of its district. In accordance with the request of the Town Council, the Education Committee are pleased to sanction this form of instruction under Clause 8 of the Technical Instruction Act, 1889, for the borough of Cardiff, and a minute will be laid before Parliament in accordance therewith.

## REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[71874.]—**Colours of Compounds.**—I remember receiving the letter to which M. Ch. Rabache refers on page 126. It was exceedingly lengthy. I judged from the high-flown stye of the commencement that it was from a paradoxist, and probably did not read all of it. Very likely I never replied, and this is, I suppose, the unbecoming conduct of which he accuses me. Très fâché, monsieur, mais je n'ai pas le temps de raisonner avec un paradoxist. M. Rabache says I am wrong in stating that nothing is known as to the connection between the formula of a compound and its colour, and refers me to a passage in a work published twenty-three years ago. He does not give the name of the work or of the author, two rather curious omissions, and he gives the passage in French, though he is well able to translate it. Lest any of our readers, who do not know French, should imagine that there is any real knowledge veiled in this passage, I give a tolerably literal translation: "Combined colours of atoms and harmonic ratios.—Colours are a constant property of terrestrial bodies. They are in direct ratio with their chemical elements. Coloured bodies are distinguished from colourless bodies by the harmonic ratios in which the quantities of chemical atoms enter to form the compounds of which the bodies are composed. (1) Production of colours from the combination of colourless atoms. (2) Bodies composed of two or more chemical compounds. (3) Tints produced by the mixture of colours. Knowing the seven harmonic ratios 2 : 1, 15 : 8, 5 : 3, 3 : 2, 4 : 3, 5 : 4, 9 : 8, and their agreement with the lengths of the atoms of the seven colours—red, orange, yellow, green, blue, indigo, violet—if we know the number of atoms or of chemical elements of each kind which enter into a compound, we can determine the colour. (2) If we know the colour of a compound we can determine the ratio in which the chemical elements enter into the combination. If we know at the same time the colour and the chemical elements, we can prove that the analyses are exact. (3) Lastly, in the case where there is any disagreement between the arrangement of the elements, we know which is true. M. Rabache gives us an illustration of his law in the case of crystallised copper sulphate. He says: "The number 5 is the *sine quâ non* cause of the green by its arrangement 3 : 2, and another arrangement 4 : 3 causes the blue; hence the bluish-green, &c." Very clear indeed. It is curious that this valuable and interesting law, which would be a most important addition to chemical philosophy, has escaped notice; it is not in any English book, so far as I know, and I fear it will not get in until Mr. John Hampden's views on the Solar System find a place in standard treatises on astronomy. William John Grey, F.C.S.
Analytical Chemist, Newcastle-on-Tyne.

[71929.]—**Oil-Engines, &c.**—"Glatton" and others have kindly explained all about consumption and duty of oil-engines; but what I want is how to construct such an engine on a small scale, able to drive a 6in. lathe; or can castings be had to enable one to erect such an engine? Where are Messrs. Brown and May's engines made, and can, or will, they supply castings? Full particulars and sketch, if necessary, will much oblige. Carius.

[71967.]—**Logarithm.**—"Self-Taught" asks to be shown how the logarithm of 2 can be calculated from that of 5. Easily enough. Deduct the log. of 5 from unity, and the difference is the log. of 2. But if he replies that unity is the log. of 10, and he does not want any other logarithm used, even then it is easily done. Multiply the log. of 5 by 2, and we get the log. of 25; strike off the characteristic, and we get ·39794, which is the log. of 2·5. Subtract this from the log. of 5, and we get ·69897 − ·39794 = ·30103, the log. of 2. With regard to the other question, the log. of 1593 to the base 12 is the ordinary log. 3·20222 divided by the log. of 12, 1·07918. The quotient 2·96727 is the log. to base 12. T. S. B.

[71985.]—**Clock Wheels (U.Q.)**—For an 8-day clock with seconds pendulum and gravity escapement, make the wheels with 40 teeth for every inch in diameter. The four-legged escapement is the best for a clock of above size, and easier to make than a six-legged one. Do not be persuaded to have solid pinions: the lanterns beat them hollow in running. Use hard knitting-needle steel 58 Stubb's gauge for the leaves. The division-plate on the lathe will divide the holes—they are easy to make; put pinions on arbors tight—no solder.

Tubbor.

[72045.]—**Cutting Tissue-Paper.**—It should "shear on to it in the downward movement."

G. A. Battes.

[72065.]—**Limits.**—It does not appear to me that the differential calculus fails in this case, for e is scarcely one applicable thereto. The ex- n required to be evaluated is not a proper ing fraction, nor can it be reduced to any of her indeterminate forms. It is, however, o see, as remarked by "M.I.C.E.," that $m = n$, the value of the expression is infinity. hen $n$ approaches to infinity, the value of the sion then rightly becomes zero. There is no istency in this, for there is no such thing as olute infinity; and if $n = \infty$, it ceases to be a nt, and we then have *two* variables instead of The question is then altered, and instead of $n$ a fixed finite number, and $m$ a variable ap- ing to it in value, we have $n$ a variable ap- ing infinity, and $m$ another variable also ching infinity, but at same time always g nearer in value to $n$.

T. S. Barrett, F.S.S.

55.]—**Limits** (U.Q.)—Since writing my eply, I find that my statement that—

$$\frac{m}{n\,(n^2 - m^2)}$$

$n = n$, is not an expression to be evaluated calculus, is only true when $n$ is finite. But $n = \infty$, the expression $n^2 - m^2 = \infty - \infty$, m indeterminate form, which can be evaluated usual way by considering $n$ a constant and variable. Thus—

$$\frac{m}{n\,(n^2 - m^2)} = \frac{m}{n} \times \frac{1}{n^2 - m^2}$$

when $m = n$, $\frac{m}{n} = 1$, and may be eliminated.

$$\frac{1}{n^2 - m^2} = \frac{\frac{1}{n^2\,m^2}}{\frac{1}{m^2} - \frac{1}{n^2}}$$

when $n$ and $m$ are both infinite, becomes proper vanishing fraction. Accordingly, tiating both numerator and denominator, spect to $m$, we obtain—

$$\frac{-\frac{2}{m^3\,n^2}}{-\frac{2}{m^3}}$$

is equal to $\frac{1}{n^4}$; and the value of this is 0, is made infinite.

T. S. Barrett.

55.]—**Earwigs** (U.Q.)—Place some empty pots about the house upside down. Can hem that way, as they avoid light.

G. A. Battes.

4.]—**Music for the Deaf.**—If "Afflicted can procure "Memoirs of Life and Work, J. B. Williams, M.D., F.R.S." (Smith, and Co.), he will find a very interesting tructive chapter on deafness, and the doctor's nents to remedy this affliction, from which self suffered. Messrs. Creswick and Co., 12, Portland-street, W., manufacture ear tubes principle, and will on application forward their illustrated lists of same. They are f pasteboard, which the doctor states to be superior to metal ones "in conveying the vibrations through their light material by tion as well as by reflection, and in their more free from the echoes and ringing sounds ed by metals.

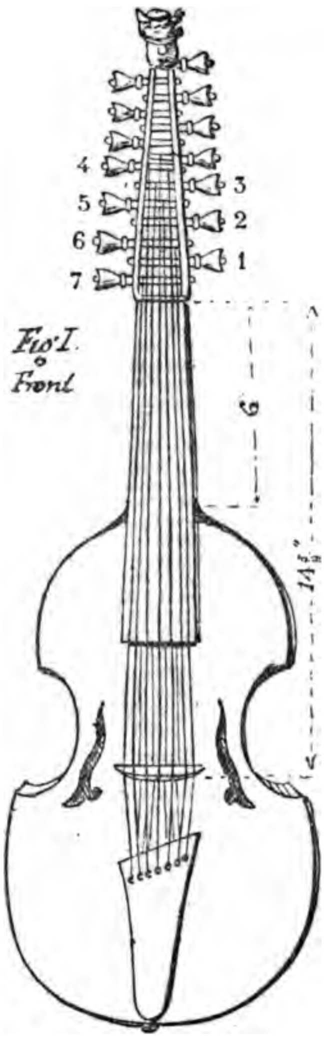
eld. J. H.

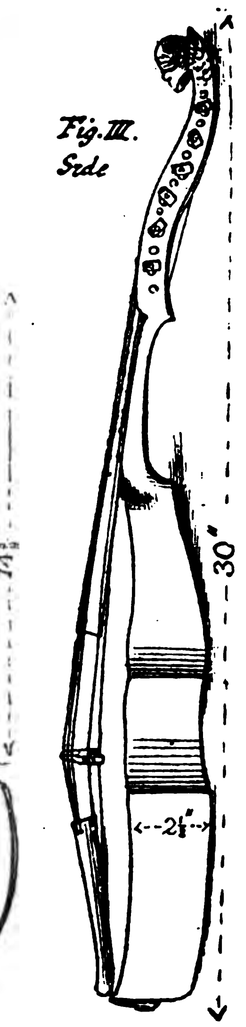
2.]—**Tallow Bleaching.**—If the querist mmunicate direct with me, I shall be very to give him any information in my power.

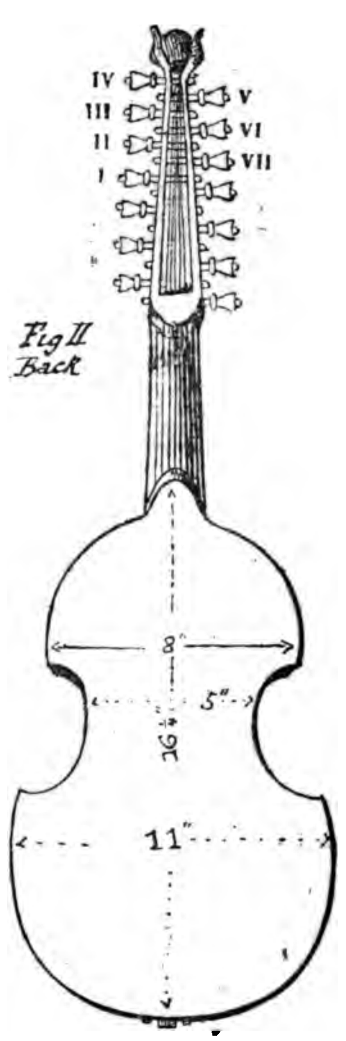
pool. Geo. G. Blackwell.

3.]—**Electric Bell and Battery.**—I have rfectly aware ever since the appearance of seley's article on electric-bells in the *Elec-* of 1879, of his great hallucination with o the necessity of the carbon of the battery onnected to push. It is clearly evident, I to anyone who is capable to judge in the that, provided the insulation is good, it is y immaterial to which pole of the battery e from the pushes is connected. A very case will show this:—Suppose we have a to the positive pole of which is connected of an insulated wire, the other end of the ing insulated, and the wire resting on the Any leakage now that arises must take place e wire to the earth on which it is resting, ugh the insulation of the wire. If we turn ery about, putting the negative pole to the e leakage will now take place from the earth ire; but there is just the same thickness and insulation as before, and it cannot possibly which way through the insulation the ten- flow is. Does Mr. Moseley mean to say e will be a greater strain on the insulation ire when the negative pole is connected to when the positive is, or that it matters the strain is from the outside or inside of ? Provided one pole of an insulated bat- erfectly insulated, there can be no leakage (since the current must pass from one pole to the other) and with both poles insulated the tendency to leak must be less, and this irrespective of which way through the insulation the tendency to flow is. On page 113 of "Practical Electric-bell Fitting" I have pointed out in connection with a diagram of the wiring of an hotel a case where it might be preferable to put zinc to push, but this is to save a rupture of the main wire to the pushes, and consequently a breakdown in the communication throughout the entire building. F. C. Allsop.

165, Queen Victoria-street, E.C.







[72198.]—**Weymersch Battery.**—This querist can refer to the index of the last volume for references to notes on the subject, and if the battery is patented he can, of course, find full details in the specification; but many of these batteries are, so to speak, "secret." However, let him read up what has been printed in your columns, and then he can guess, and go on guessing. T. L.

[72199.]—**Solder for Indian Silver Jewelry.** —Here is an "easy" solder, as it is termed, which will do for most work of the kind: Fine silver, 1oz.; tinsel, 10dwt., and arsenic, 5dwt. Or, which is perhaps easier, fine silver, 1oz.; shot copper, 12dwt.; spelter (pure), 3dwt. By varying the proportions you have all the useful solders for silver work in these two recipes. Nun. Dor.

[72206.]—**Drawing and Making Boilers.**—Perhaps the querist had better procure Nicholls's work, which he publishes, I think, at Blackpool. Mr. Nicholls used to contribute to these columns, in which much useful information on boiler-making can be found; but he may be dead for all I know. At any rate, his book seems to meet the wants of the querist, so far as they can be estimated by his query. Nun. Dor.

[72215.]—**Coloured Gold.**—I suppose this querist can polish his gold with rouge and the ordinary leather. Is he sure that it is 22-carat—because that is nearly pure gold, and very little "polishing" should be required. S.

[72259.]—**Viol d'Amour.**—I am glad now to be able to furnish further details as to this instrument. The diagrams will give a general idea of the form of the viol, and I have upon them indicated the measurements as nearly as may be. It appears that the number of strings is not invariably the same; but the general number may be taken as fourteen—viz., seven gut strings and seven wire strings. The former pass from tail-piece over bridge to the lower pegs (Nos. 1 to 7, Fig. 1). The latter are eyed and attached to hitch-pins or studs in an ebony or ivory plate fixed either to the belly underneath the tail-piece, or to the bottom ribs just above the button. They then pass through a slot or through separate holes in the bridge, and are carried beneath the finger-plate through a channel in the neck and below the pegs Nos. 1 to 7 to the pegs I. to VII., shown on Fig. 2. Pegs 1 to 7 are turned away from, and pegs I. to VII. towards, the performer, and the instrument is, I am told, played from the chin. Its least compass is from tenor D to F³ in altissimo, and it is tuned in thirds and fourths, so as to give the common chord in two octaves. There are several fine specimens of this instrument in the South Kensington Museum, two being of remarkable and somewhat fantastic design. M. Chanot, of 157, Wardour-street, has two or three good ones, and Mr. Morley, of 6, Sussex-place, South Kensington, was good enough to show me one he had recently purchased in a collection. This he was offering for sale at £7 7s.; M. Chanot asks £8 and £20 respectively for two of his instruments. There is, at least, one professor in England, Mr. F. Louis Schneider, of 87, Shaftesbury-road, Hammersmith, and Messrs. Lafleur, of Green-street, Leicester-square, are the publishers of an instruction book (the only one extant here), which contains a history and description of the instrument; indeed, it is to the courtesy of these gentlemen that I am indebted for the diagrams I send. They represent a viol belonging to Prof. Zoeller, of Rome. It is labelled inside "Joannes Udalricus Eberle, Lautenmacher in Prag, 1730." It will, I think, be clear from the diagrams that the belly alone is arched, the back being flat.

Charles J. Tahourdin.

[72237.]—**Water Supply.**—The question is unanswerable. The supply can be increased only by going deeper, or by getting the "clerk" to turn on more rain. There are so many wells now drawing water from the London basin that even the great breweries have to be careful. R.

[72284.]—**Cement Kiln.**—Referring to "Jack of All Trades" reply (on page 86) to the query, the kiln he describes seems to be an ordinary dome kiln, such as is used for burning chalk, lime, or bricks. There are several points in his letter on which I should like further information. Firstly, have not the letters designating the different parts got rather mixed up, and what is meant by "can be made up with covers to double wall inside and out." Secondly, how is it proposed to draw the kiln when burnt off. Thirdly, is it "Portland cement" which it is proposed to burn? If so, why does "Jack of All Trades" propose making the fire arches of chalk or bricks, as that would only mean extra labour and expense in freeing the burnt material from foreign matter (i.e., lime or melted brick). Also what are the bricks to be put on the top of the charge for. If common bricks, they would be all melted up. Fourthly, would such a kiln burn Portland cement at all? If it would, why should the cement be very strong, as I do not see that any virtue would be obtained from the wood fuel used. "Jack of All Trades" also says, "In firing with wood, if it be green, you will have a pretty clinker." Does he mean a pretty cement clinker, or simply a mess on the firebars? I may say, for the information of those who don't know, that Portland cement material, when properly burnt, is changed to a very dark, hard, heavy, semi-vitreous mass, technically called "clinker," and a very intense heat is required to bring about this change. CEMENT CLINKER.

[72268.] — **Turning Spirals in Wood.** — "Batho" very kindly explains how to lay off the spirals; but that is not what is wanted (see my inquiry—"a description of the lathe and appliances used would oblige"). Now, I want to know how a lathe can be constructed to turn spirals, and to be driven by engine-power. Is there such a lathe made, or can be made? CARIUS.

[72348.]—**Chemical Analysis.**—I cannot understand "A.'s" difficulty yet; but here is a method of analysing a mixture of Al, Cr, and Fe. Add to your solution ammonium chloride in good quantity (this is to keep any Mg in solution if it happens to be present), then ammonia until your solution smells of it, and then boil until the solution has a faint acid reaction. Cr, Al, and Fe are then completely precipitated as hydrates. Filter and fuse the precipitate with pure caustic soda in an iron or silver dish. Boil the fused mass with water, and test for Cr (solution has a yellow colour) by adding excess of acetic acid, and then acetate of lead to get yellow $Pb, Cr, O_4$. Test another portion for Al by boiling with ammonium chloride. With regard to the bromide, this is the equation—

$$2KBr + MnO_2 + 2H_2SO_4 = Br_2 + K_2SO_4 + MnSO_4 + 2H_2O.$$

ST. CLAIR.

[72348.]—**Chemical Analysis.**—If to a solution containing $Am_2Ox$ and pot. chrom. is added AmOH and $Am_2S$, and it be then boiled, chromium hydrate will be precipitated. The filtrate may be evaporated and examined for potassium and oxalic acid. I presume you know where to look for the Am. To analyse a bromide, take a decinormal solution of silver, and prepare one of Am sulphocyanide the same strength. Run off 10c.c. silver, add a measured quantity of pure $HNO_3$, and a measured quantity of solution of ferric alum; add the sulphocyanide until one drop gives a faint permanent red tinge. This is to standardise the sulphocyanide, which must balance the silver. Next, take solution of bromide, add $HNO_3$ and ferric alum, add slight excess of silver, shake well, and titrate back with sulphocyanide. Deduct quantity used from silver and calculate into Br. Thus:—*Typical Analysis.*—The silver solution = ·00825 Br in 1c.c.; ·2075grm. dibromonaphthalene was burnt with lime. To the cold solution in nitric acid was added 14·35c.c. silver, well shaken, iron added, and ·35 sulphocyanide required for production of a red colour. This corrected for final drop becomes ·3, and the silver used = 14·05. Thus:—

| | | | |
|---|---|---|---|
| Silver: finish = | 18·60 | Sulpho: finish = | 12·65 |
| Start = | 4·25 | Start = | 12·30 |
| | 14·35 | | ·35 |
| | ·30 | Deduct | ·05 |
| | 14·05 | | ·30 |

Log. 1405 = 1476763
Log. 825 = 9164539

0641302
Log. 2075 3170181

7471121 = 55·8 per cent. bromine.
Theory for $C_{10}H_6Br_2$ = 55·9 per cent. bromine.

I copy this analysis from my work-book. SM.

[72393.]—**Magic Squares.**—"Inquirer" asks whether my statement on p. 39, with regard to "oddly-even" magic squares is correct; in other words, whether there are *nasik* squares with the roots 6, 10, 14, &c. I am aware that it is generally supposed that there are not; and an able writer in the ENGLISH MECHANIC has been under that impression too. (See Vol. XLVII. p. 60.) Probably this has been because efforts to make such squares have been exclusively directed to squares containing the natural series of numbers 1, 2, 3, 4 . . . $R^2$. I believe it is impossible to make these nasik; but if certain numbers be omitted from the series, nasik squares can be formed, as the example beneath, with the root 6, will show:

| | | | | | |
|---|---|---|---|---|---|
| 100 | 18 | 44 | 88 | 30 | 32 |
| 68 | 8 | 82 | 64 | 12 | 78 |
| 20 | 42 | 90 | 28 | 34 | 98 |
| 4 | 86 | 60 | 16 | 74 | 72 |
| 36 | 96 | 22 | 40 | 92 | 26 |
| 84 | 62 | 14 | 76 | 70 | 6 |

This square will be found to be nasik on applying the test quoted last week, p. 127—every row, column, and diagonal (as the square now stands, or after the transpositions), adding up the same number—in this case, 312. I may perhaps be permitted to add that about a year or two after I had discovered that oddly-even nasik squares existed, I found that the same discovery had been made, quite independently, by Mr. James Cram, the author of an ingenious and suggestive little book on magic squares. His book was printed anonymously and for private circulation, but a copy will now be found in the British Museum, catalogued under his name.

New Athenæum Club. T. S. BARRETT.

[72405.] — **Demagnetising Steel.** — Watches, &c., may easily be demagnetised without being rotated (a process hardly calculated to do them much good) by means of an electro-magnet and alternating current. My own watch became strongly affected whilst repairing a magneto machine, but I succeeded in completely removing all traces of magnetism by placing the watch on the poles of a small electro-magnet connected with the magneto machine. Then, as I gently turned the handle, thus creating alternating polarity in the magnet, I gently drew the watch away. This occurred about ten months ago, and the watch has not been troubled with magnetism since. I think this plan is better than any I have seen in print, as the watch is not rotated. ARTHUR HOBDAY.

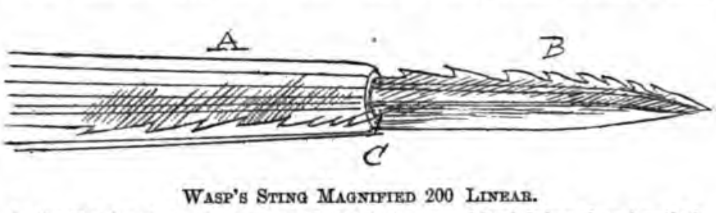
[72415.]—**Locomotive Colours.** — G.N.S.R., light green; H.R. light green, nearly same as G.N.S.R.; H. and B.R., I think, are crimson lake, but I am not sure, as I do not have my books at hand; picking-out colour of H.R. is, I think, two narrow black lines; H. and B.R. I do not know; N.E.R., broad black band, with one white stripe on each side of it. The N.B.R. engines have no names, nor have the N.E.R., or G.N.S.R. The H.R. have names usually on the splashers. I do not know whether the H. and B.R. have names or not. The new number-plates of the N.B.R. are oval brass ones, with black enamel figures; old ones were blue enamel (ground) with brass figures. N.E.R., the newest engines, simply have the figures painted on the hind splasher—usually yellow figures; old engines have plates, crimson enamel, with brass figures. G.N.S.R. are oval brass plates (something like the N.B.R.), with black figures. I am not sure H.R. and H. and B.R. locomotives.

R. S. BRUCE.

[72425.]—**Phonograph.**—The "wax" used for phonograms is composed of equal parts of stearate and oleate of lead, using gum damar to harden. Would Mr. Grey (Newcastle) assist us by suggesting mode of manufacture of above substances? As to details of construction, I would have been pleased to have given them (see p. 535), and thereby saved me a lot of correspondence; but presumably the sketches would take up too much space. Hence, if "Phono." will advertise address, I will send detailed drawings and full description of double diaphragmed phonograph. CAVE DIAMOND.

[Why not send them *here*, as asked, for the general benefit?—ED.]

[72435.]—**Sting of Wasp.**—"Autolycus" makes a curious blunder in his reply when he says, "It is a mistake, however, to suppose that a wasp's sting is barbed." As a matter of fact, the wasp's sting consists of a fine sheath, shaped like a hollow punch. In this sheath are contained two barbed lancets, which can be projected and withdrawn at the insect's sweet will. It does not require a magnifying power of 2,000 linear to show these very distinctly. I annex a sketch of a sting I have just mounted in Canada balsam, as seen with an A eyepiece, and a little 9s. French ¼in. o.g., magnifying about 200 times linear. S. BOTTONE.

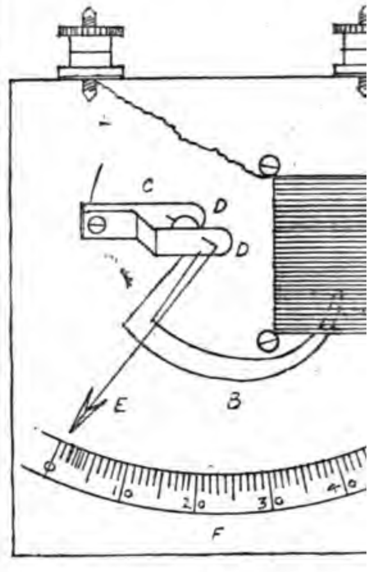


WASP'S STING MAGNIFIED 200 LINEAR.

A, the sheath; B, one barb protruded; C, the second barb lying almost entirely in the sheath.

[72439.]—**Automatic or Electric Fountain.**—As you have some accumulators, you could use a small electro-motor to drive a small set of pumps for the fountain. F. C. ALLSOP.

[72440.]—**Voltmeter to Read to 50**
a sucking solenoid A, about 1½in. long
ternal diameter. Wind it evenly with ab
No. 40 German-silver wire, silk covere
made, soak in melted paraffin wax. Fast
a backboard, as shown in cut, and tak



wires to terminals. Now cut out of thin
(about $\frac{1}{30}$in. thick) a hanging piece B,
must be affixed a double-pointed trunnion
plays between back and front bearings
which also carries the pointer E that mark
on the quadrant F to be used vertically.
grade roughly by means of the storage
one being equal to two volts. Do not
ammeter. S. B

[72452.]—**Clay.**—Silica occurs in two
as free silica, 2, combined with bases.
mine the total amount of $SiO_2$: Heat abou
of the powder in a platinum dish with
sulphuric acid for about eight hours,
evaporate to dryness. When cold, boil th
with water, carefully filter, dry, and wei
weight gives the total quantity of silic
sample. Transfer the residue to the plati
and boil repeatedly with a saturated s
sodium carbonate, filtering each time.
residue, first with hot water, then wi
slightly acidulated with hydrochloric
finally with pure water. Dry and
weight subtracted from the weight of th
after treatment with sulphuric acid,
amount of true $SiO_2$. To the filtrate obta
treatment with sulphuric acid, add a sli
of nitrate of lead $Pb(NO_3)_2$, and allow
liquid to stand for some hours. Filter off,
the lead sulphate, adding the washings to t
pass $H_2S$ through the liquid to remove
of lead. Filter, and evaporate solution t
We have now got the alumina, iron, mag
alkalis as nitrates. Heat until no more
nitric acid are evolved. Moisten the resid
concentrated solution of ammonium ni
heat on water-bath until no further ev
ammonia is perceived. Add hot water, fi
the alumina and ferric oxide, dry, ig
weigh. Heat the mixture with dilute sulph
and filter. Reduce the iron by means of
and titrate with $\frac{N}{10}$ $KMnO_4$. Deduct t
of the ferric oxide from that of the mixe
and the difference gives the amount of Al
ST.

[72453.]—**Clay.**—I used the expressio
two grams"; this has appeared in print
two grains." As fifteen grains go to the
makes me look rather small. Asso

[72458.]—**Knock-Knees.**—Dr. Allins
a book being tied between the knees at

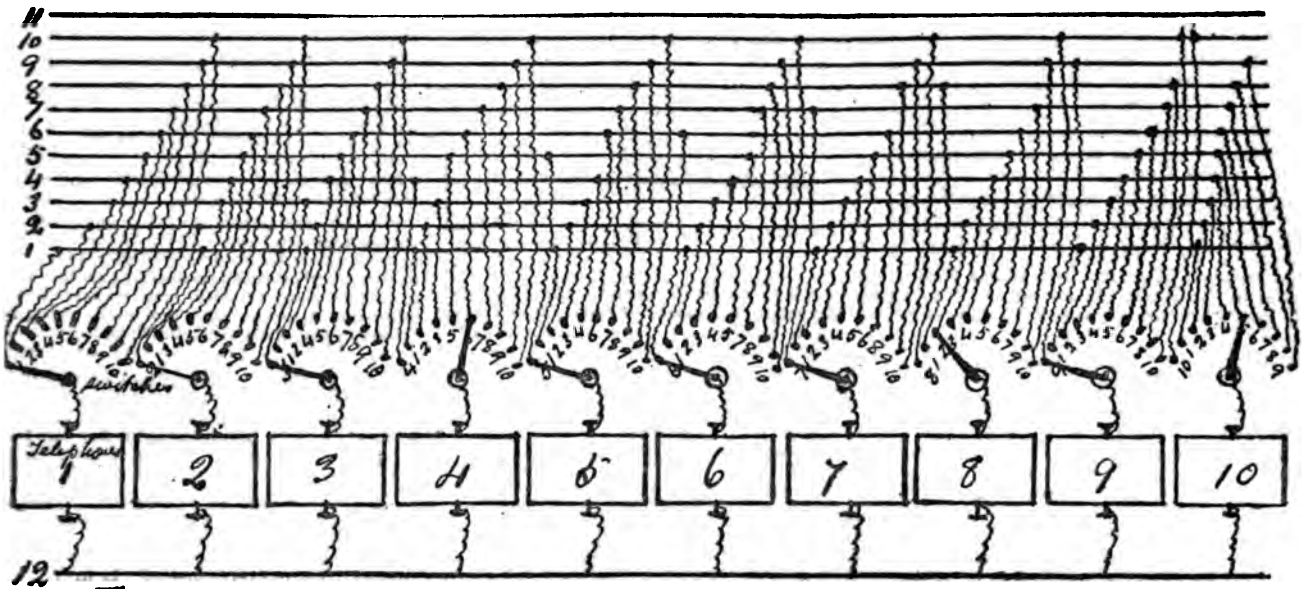


Fig. 7.

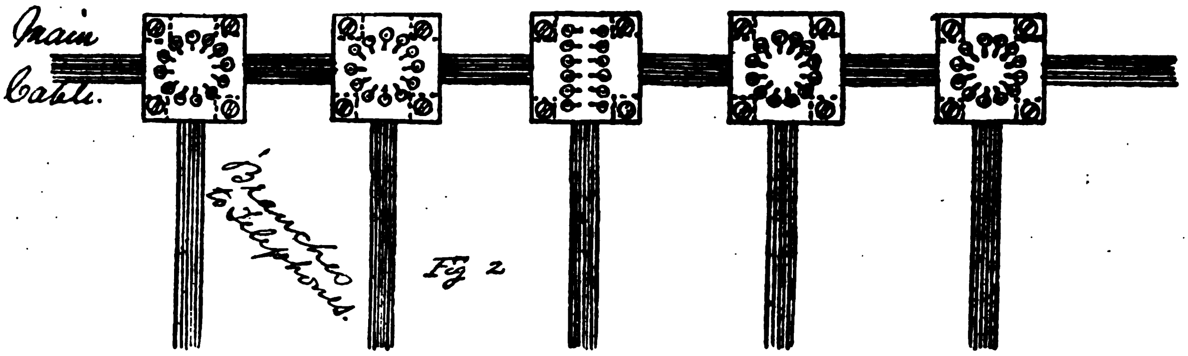


Fig 2

ving again in the morning. The book should anged for a thicker one every week.

G. A. BATTES.

462.]—**Wimshurst Influence Machine.**—ks to Mr. Bottone for reply. Will he kindly vhy the machine when turned the reverse way not spark? Electricity is generated on the te cylinders, but is not collected by the combs.

P.

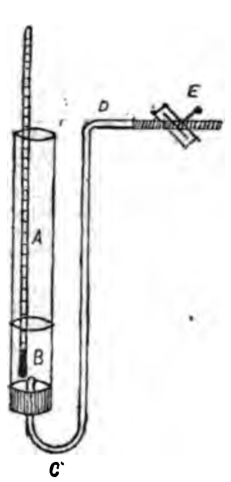
467.]—**Removing Thick Varnish from raving.**—If the print is a valuable one, and doing properly, don't attempt it yourself; you don't mind spoiling it for the chance of s, proceed as follows: On one of the corners a few drops of methylated spirit, and if, after ute, you can take the varnish off with a piece ft rag, continue to clean the whole off, a at a time, using the spirit freely, and a fre- change of rag; but if the spirit does not ve the varnish, you might try by laying the in a tray, and pouring boiling water over it, sometimes causes the varnish to split and up, so as to be easily removed with a soft . Prints are invariably sized before being shed, and the hot water dissolves the size, g the varnish loose; but be careful not to rub rint while wet. If the print is mounted on s on a strainer, it will be necessary to cut it und the edges, so you can lay it flat to operate I've done them both ways myself; many a

JOB.

471.]—**Telephone Systems.**—In reply to it," I herewith give him the fruits of what experience I have had in the matter of running hone cables. About two years ago I received rder to "have wires run for switch-boards to rts of the factory where we have telephones e." There were 10 telephones in the various s and shops, and I concluded, after a few ates' thought, that, although subject to a greater unt of induction than separate wires would be, under the circumstances, there being no great d for secrecy, a cable would answer my pur- the best. I first measured for the length of le required, and I ordered one to be made of 12 s, each wire to be covered with a different oured material, and the whole to be covered in gether, so as to form one cable—10 of the wires I nded for the line wires of the 10 telephones, one r a "return," and one for a spare wire. Fig. 1 a diagrammatical sketch of how I connected the struments to the lines, and Fig. 2 is a drawing showing the manner in which I made the junctions in the cables. The former explains itself, except that each switch-lever must be put back to its own number after finishing conversation in any other circuit. With regard to Fig. 2, I cut the main cable just where I wanted to join in each telephone. I then shaped eight pieces of wood (the two extremes did not require junction) about 4½in. by 4½in. by ½in., to which I affixed at the four corners small pieces of wood about 1½in. by 1½in. by ½in., in order to raise the blocks up so as to allow the cable to pass underneath. I pierced twelve holes in each block for the wires as shown. I then twisted the three ends of No. 1 wire together and passed them through the first hole and carried them around under a washer and screwed them down. I did the same with each of the other eleven wires respectively, and a neater or more compact junction could scarcely be desired. Besides, the several wires can so easily be got at at any time if necessary for testing or any other purpose.

J. G.

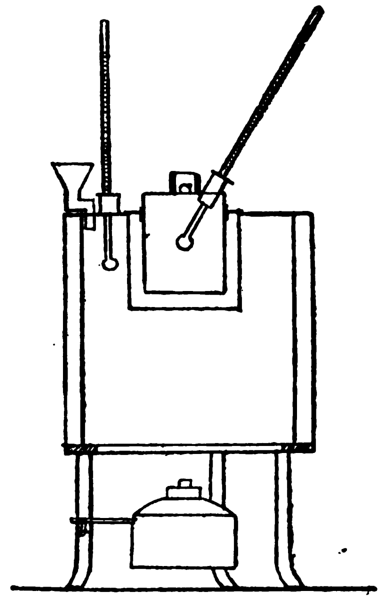
[72480.]—**Flashing Point.**—Here is a sketch of an apparatus, by means of which the flashing



point of an oil may be easily determined. A is a glass cylinder about 3cm. in diameter, and 12cm. long. The bent tube D C ends just within the wooden cork in a fine orifice. At D it is connected by rubber tubing with a pair of bellows, the flow of air from which can be controlled by a pinch-cock, E. A is about one-third filled with oil, and the whole apparatus in placed in a water-bath up to the level of the oil. Air is now passed in, and E is so adjusted that about 0·5cm. foam is kept on the surface of the oil. At each rise of 1° C., the test is made by bringing a lighted taper to the mouth of A, and at the "flashing point" the vapour ignites. In last week's issue but one, in my answer to query headed "Chemical Analysis," for the word "throughout" read "thiosulphate."

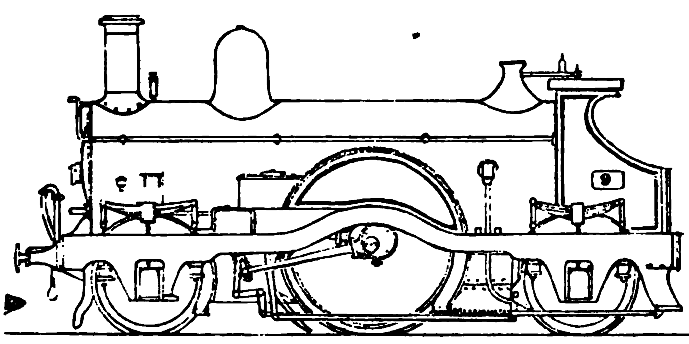
ST. CLAIR.

[72480.]—**Flashing Point.**—The now recognised



testing apparatus consists of a cylindrical water bath surrounded externally by an air jacket, which is heated by a lamp. A cavity is provided on the upper surface of the bath of more than sufficient size to receive the small closed cup in which the oil to be tested is placed, so that this cup, when placed in the cavity, is surrounded also by an air jacket, inclosed above by the flange or rim which supports it. A thermometer passing into the water bath shows the temperature of the water, while another one, attached to the oil cup, shows the temperature of the oil. I give a section of the apparatus, but for an exact test so many details are prescribed that I must refer "J. T." to an exhaustive description given by Mr. (now Sir Fred.) Abel, *Journal* Society Chemical Industry, Vol. I. p. 471. H. B. F.

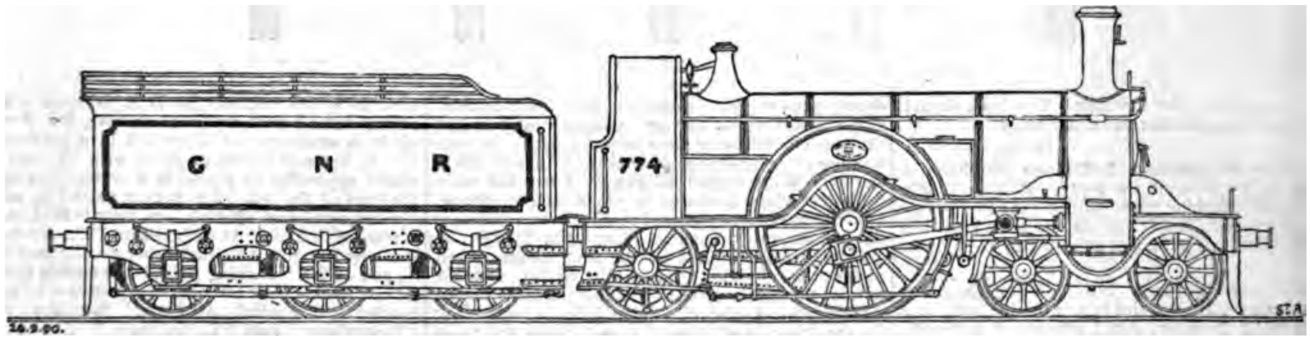
[72493.]—**Great Western and Great North of Scotland Railway.**—In answer to "Loco. No. 2," I send sketch of No. 9 G.W.R. The



dimensions are:—Driving wheels, 7ft. 8in. diameter; leading and trailing wheels, 4ft. 6in. diameter; tubes (length), 10ft. 8in.; from leading wheel to driving, 9ft. 6in.; from driving to trailing, 8ft. 6in.; smoke-box, 2ft. 9½in.; footplate to rails, 4ft. 3in.

DOUGLAS LEITCH.

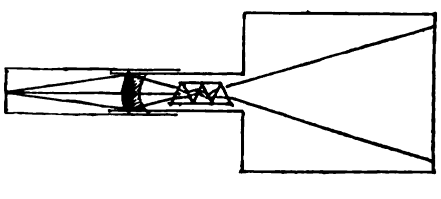
[72497.]—**G.N. Railway Loco.**—Herewith I beg to forward sketch of Great Northern express locomotive, as requested. ST. AUBYN.



[72501.]—**Galvanic Current Generated by Muscular Action.**—There is a reference to the experiments of Dubois-Reymond in De la Rive's "Traité d'Electricité, III.," p. 38, of which the following is a free translation:—"The observer dips the fingers of both hands in two vessels of salt water connected to the terminals of a very sensitive galvanometer (27,000 turns of wire) by means of slips of platinum completely deprived of electromotive force. When the needle has come to rest, he contracts as strongly as possible all the muscles of one arm, taking care not to move the fingers in the liquid. At this instant the galvanometer receives an impulse indicating a current from hand to shoulder of the contracted arm." Then follow theoretical conclusions, and further on it is stated that a greater effect is produced if the skin is first removed from the arm at points placed in connection with the galvanometer. In De la Rive's second volume, p. 445, there is a page of references to works or papers on the physiological effects of electricity, and Dubois-Reymond's work is given in "Annalen der Physik," *passim*—"Untersuchungen über thierische Electricitat," Berlin, 1848. T.I.

Belfast. J. BROWN.

[72506.] — **Spectroscope.** — If "Fain" will adopt the following arrangement, he will find no difficulty in observing the absorption lines and obtain a spectrum of any length. Most likely the failure to observe the lines is due to the slit being too wide. I use the following arrangement for photo-spectroscopy, and make my slit wedge-shaped ·2mm. wide at one end, and narrowing down to 0 at the other. This gives a spectrum the lines of which are not sharp, but bright at one end, and at the other sharp but faint. Focussing is effected by drawing out the tube carrying the slit. No other lens is necessary. I have also a second parallel slit to replace the wedge one, and by covering half this slit by any film of colour, solution, &c., I obtain



side by side a solar spectrum and a spectrum showing absorption of substance used. I can easily photograph from D to H, and see up to A. I obtain a spectrum 6in. long, and use a reproduction of a 6in. lithographed solar spectrum on a collodion plate as a scale, and have not the slightest difficulty in recognising any line and giving it its exact wave-length. The litho spectrum being divided into 180 parts, with an eyepiece I easily distinguish any particular division and line corresponding to it in spectrum. FOTO FILE.

[72507.] — **Dynamo.** — To MR. BOTTONE. — A dynamo with 6oz. No. 18 on the armature, that is about 17 yards, will give about 17 volts pressure, if driven at about 2,750 revs. per minute. If coupled up as a shunt machine, this dynamo will light two or perhaps three 10-candle power lamps, marked 15 volts, and taking about two ampères each. Hence output of machine, under these circumstances, about four to six ampères at 15 volts to 17 volts pressure. S. BOTTONE.

[72508.]—**Thin Enamel on Glass.**—It will be almost impossible to get absolute opacity with such thinness. But, if you collodionise and sensitise an ordinary wet plate, and then develop, after a very short exposure, with pyrogallic acid, you will get a pretty black film, which, when fixed and dried, can be easily lined with your ruby diamond.

S. BOTTONE.

[72509.]—**Explosive Liquid.**—I know of no compound which explodes on contact with water. Several chemical bodies take fire spontaneously when thrown on water. For instance, metallic potassium when thrown on water takes fire (and sometimes explodes), burning away to caustic potash, and liberating gaseous hydrogen. Calcium phosphide also burns when thrown on water, giving a very bright light. ASSOC. N.S.S.

[72509.]—**Explosive on Touching Water.**—I know of no single body that will explode on touching water. But there would be no difficulty in making a kind of cartridge containing a pellet of sodium at one end, covered with ordinary powder, which would fire the charge on touching the surface of the water. Of course, you are aware that potassium catches fire, but does not explode, on touching the surface of water. S. BOTTONE.

[72510.]—**Slide-rest.**—It appears to me by what you say that your tightening-up piece is out of truth; or else you have been using your rest in one end for a considerable time, and consequently it has worn. CYMRY.

[72510.]—**Slide-Rest.**—I think you should take out the screw of your rest and push the slide to and fro without it; this will show you at once if the rest is not parallel, but larger at one end than the other. If it is, it is a simple matter to put it right, and need not cost you much. F. A. M.

[72511.]—**Carpenter's Brace.**—By all means use an American brace. If the bits are pushed well home the jaws, being adjustable, grip them so firmly as to entirely prevent that wobbling so objectionable in English patterns with fixed socket. The bits, moreover, cannot be left in the work, owing to the brace gripping them above the shoulder.

CALD[illegible].

[72513.]—**Noise in Telephone.**—I should fancy you have got an intermittent bad contact in the circuit. If you had five cells on to the microphone it is small wonder the microphone hummed; but it is difficult to determine the cause of the noise when the microphone is out of circuit. F. C. ALLSOP.

[72513.] — **Noise in Telephone.** — Speaking from my own experience with the battery and telephone, I find one cell quite enough for a short telephone circuit. I should say you have too much current. Try one cell with good E.M.F. and little current. Why use same battery power to telephone as to ring up? This, I think, is decidedly wrong. You must switch on for ringing, or rather switch off for speaking. F. G. WILLATT.

[72514.] — **Brazing Copper and Brass.**—Certainly. Mix a little block tin with copper and zinc in order to melt quickly; but the following you will find very good: Copper, 50 per cent.; zinc, 50 per cent. W. CARMICHAEL SMITH.

[72516.]—**Testing Hardness of Water.**—One of the best methods is that of Dr. Clark. The process is described in Frankland's "Water Analysis."

ASSOC. N.S.S.

[72516.] — **Testing Hardness of Water.**—There is no other method than the usual process employed in analysis. The soap test is not of universal utility, and can only be employed [illegible] moderately-hard waters. Titration with acid [illegible] the best method for very hard samples. Sx.

[72516.] — **Testing Hardness of Wate**[illegible] Wanklyn's method is the simplest, and is as follo[illegible] "Into a stoppered bottle (capacity about 200cc., [illegible] exact size of little importance), which has be[illegible] cleaned and rinsed with distilled water, 70cc. [illegible] the sample of water is to be poured. The stopp[illegible] is put into its place, and the bottle is shaken up. That having been done, the standard soap solu[illegible] is to be measured into the water by means of [illegible] burette or pipette graduted into cubic centim[illegible] After each addition of the soap solution the bo[illegible] containing the water is to be shaken up, and [illegible] point is by and by noted when a lather forms. [illegible] order to observe the formation of the lather the bottle should be laid on its side, and the lather, [illegible] be satisfactory, must be capable of persisting [illegible] five minutes." If the water is more than 1[illegible] hardness the sample must be diluted with distil[illegible] water. The instructions, I am afraid, would ta[illegible] more space than I am entitled to. The cost [illegible] apparatus to carry out the above test, obtained [illegible] an operative chemist's, would be about as follows: One Mohr's burette with pinchcock, 50cc., 3s. 6d.; one stand for ditto, 2s.; one shaking bottle, capacity about 200cc., with marks at 70cc., 1s.; [illegible] litre Wanklyn's standard soap solution, in bo[illegible] 4s. 6d.; total, 11s. When you have found [illegible] hardness of the water by the above test it is [illegible] possible to tell you the quantity of lime-water [illegible] add to soften it, as lime-water will only precipitate bicarbonate of lime, and the cause of hardness [illegible] may be due to sulphate of lime, carbonate of ma[illegible] nesia, sulphate of magnesia, &c., and probably [illegible] combination of the whole of them. If you care [illegible] send me about a gallon of the water, I shall o tell you how far lime-water will soften ıe proper proportions to use.

Chas. E. Gittins.

orge's House, Eastcheap, Oct. 3.

.]—**Testing Hardness of Water.**—The ›f testing the hardness of water is by adding rd solution of soap to the sample of water, ıg the quantity of the soap solution required a permanent lather. The following is a ıa of the *modus operandi*:—First make a solution of soap by putting small quantities ıe of 8grm. of lead plaster and 6grm. of ssium carbonate in a mortar, and rubbing ıil they are thoroughly mixed, add a little ed spirit and triturate thoroughly, let ıme time and filter. You must then ise this so that 14·25c.c. of it are equivalent of a solution of calcium carbonate, which ·0002grm. in 100,000 of water. When this take 50c.c. of the water to be examined, ;ently from the burette containing your soap 1c.c. at a time, shaking thoroughly after ition; continue to do this until you get a rmed which lasts for five minutes, and then from table the hardness of the water.

| ›ap ın. | Hardness. | Vol. of Soap Solution. | Hardness. |
|---|---|---|---|
| | ·48 | 9·0 | 11·80 |
| | 1·27 | 9·5 | 12·51 |
| | 1·95 | 10·0 | 13·31 |
| | 2·60 | 10·5 | 14·06 |
| | 3·25 | 11·0 | 14·84 |
| | 3·90 | 11·5 | 15·63 |
| | 4·57 | 12·0 | 16·43 |
| | 5·29 | 12·5 | 17·22 |
| | 6·00 | 13·0 | 18·02 |
| | 6·71 | 13·5 | 18·81 |
| | 7·43 | 14·0 | 19·60 |
| | 8·14 | 14·5 | 20·40 |
| | 8·86 | 15·0 | 21·19 |
| | 9·57 | 15·5 | 22·02 |
| | 10·30 | 16·0 | 22·86 |
| | 11·05 | | |

ıtity of lime-water to be added will, of ›epend on strength of lime-water, and also ıardness of water. You can, however, culate, for you will have to add enough ›nvert the soluble bicarbonate present into ıble carbonate. As to books, nearly all on ive chemical analysis will supply what you

R. B. T. W. Z.

]—**Coil-Winder.**—There is no difficulty g the coil evenly with the winder you have ›d, provided the following precautions be ı. On the spindle of the coil a spring must ›revent the coil from turning backwards. lar spring must press against the bobbin ivers the wire. 3. The bobbin must be at ›able distance from the coil, otherwise, in :he wire will tend to lap over the adjacent

S. Bottone.

|—**Coil-Winder.**—I cannot see how you wind secondary wire on your coil, as I a short time ago using No. 34 wire, and ıt on a spindle exactly as you state, and d the wire on from end to end of coil in ə minutes, allowing the wire to run ny hand and holding it at a distance of fourteen inches from the coil, insulating : as I proceeded with a coating of shellac 1oz. dissolved in 4oz. methylated spirit). ıat if I held my hand too near the coil, nches, I could not wind it evenly at all. ı; I think you will manage.

W. N. C.

|—**Dynamo.**—To Mr. Bottone.—Wind ature with ½lb. No. 22 d.c.c., and the ıets with 4lb. of the same wire. Connect ıt. I think you will find that this will s right. Please report result.

S. Bottone.

|—**Leverage.**—The bar will certainly Weight on A is 18lb. plus weight of bar; ›rely the sum total of all the weights.

Assoc. N.S.S.

—**Leverage.**—Weight on cord equals r 18lb. The weight cannot be increased, how you place the weights, as they are cted to any independent body.

Caldemone.

]—**Dynamo-Winding.**—To balance the No. 20 wire on your ring armature, in l machine, you might put on 8lb. No. 22 ›nnect up in shunt. The probable output evs. per minute, will be 40 volts, and 3 or ı.

S. Bottone.

.]—**Watch-Gilding.**—In stoning watch r gilding, the last operation is to work the e round and round; the finer the stone and ler the curls, the better and finer the gilding

Angloam.

[72523.]—**Watch Gilding.**—"Country Watchmaker" will find the following all right for frosting watch movement:—2½oz. nitric acid; 2oz. muriatic acid, full strength; dip for a few seconds; then rinse in water. If not frosted enough, dip again; then scratch-brush with a circular motion; then gild.

13, Chipka-street, E. Geo. Lowe.

[72524.]—**Limelight.**—Do you not understand that the gases in the cylinders are under pressure, and that in each case the gas is issuing into the air and will take the way of least resistance?

Sm.

[72524.]—**Limelight for Lanterns.**—Cylinders with regulators are quite safe—much safer than bags, which, by the bye, are *not* safe things at all. No gas regulator that I know of could let gas pass into a bottle. The worst thing that can happen is mixing in the leading rubber tubes when one bottle has run out; but even this you would have warning of, because your light would burn very dull and red before this could take place. With a regulator on each bottle and a light burning dull, turn off either gas at the burner (not at bottle), and if this burns worse, turn back again to previous position, and regulate with other burner tap. Let us suppose your H was running out, and in turning off a burner you hit on the H tap; then your light would go worse, so you at once turn on again, and turn off a little the O tap, when the light would improve, because you would have been getting too much O for the H. It is, however, a better rule to always work with a full amount of gas in your bottles. Should you require any further help or hints, and will advertise your address in this journal, I will see what I can do for you. F. G. Willatt.

[72525.]—**Exhaust Pipe.**—This should be led into the open air, as the gas is not thoroughly consumed, or cannot be depended upon; hence you may be accumulating an explosive compound in your chimney without knowing it, so it is as well to be safe. Jack of All Trades.

[72529.]—**The Straight-Line Chuck.**—I should be very glad if I could help "Phedrick," but my apparatus is so different to his, I fear that it is hardly likely. It is not long since I finished my chuck, and as yet I have not had much practice with it. Mine is bolted down upon the lathe-bed, the Rose-engine movement being given by a rocking-rest. "Phedrick's" is, I suppose, bolted to the front of the headstock, and therefore it rocks with it so as to produce the waved cutting. The chain connects the mandrel and the slide of the chuck, so that they move together at the same relative rate, and so reproduces on the work fixed to the slide of the chuck the waves upon the rosettes. The motion must, of course, be slow, and may be confined within certain limits if desired by the segment stops. Since the motion of the chuck is not continuous, neither can the motion of the mandrel be so. You must turn it slowly by the little hand-wheel for fixed-tool work, and by the tangent screw for work with drills and cutters; withdrawing the tool and turning backwards to take another cut. F. A. M.

25, Grange-road, Eastbourne.

[72530.]—**Zoology.**—The cheese-hoppers, or maggots, are gentles; that is the larvæ of a small dipterous insect or fly belonging to the family Muscidæ, and known as Piophila casei. They are usually to be found in poor cheeses that have been allowed to get too wet. I have heard of people who professed to like eating them. Alfred Lloyd.

[72531.]—**Small Boiler.**—Rivets should be $\frac{3}{16}$in. diam., 1in. apart. Salammoniac should be used after riveting, and the plan you indicate—viz., tubes fixed from top of firebox to top of boiler, is the best recognised plan now; but I would suggest, in order to make a good job, that the holes had better be tapped and screwed instead of expanded. Please get button-headed rivets, and button when you rivet on outside. W. Carmichael Smith.

[72533.]—**Alternating Current.**—The chief advantage is that the current can be transmitted to any distant point at a high potential through the mains (which may therefore be smaller and much less expensive), and then transformed down to a comparatively low and safe potential on the premises of the consumer. Equal consumption of the carbons is quite a minor point. It is not absolutely necessary on account of sparking at commutators if the potential is not much over 2,000 volts. At medium potential the alternating C. is most dangerous. At high potential both are dangerous.

E. C. B.

[72533.]—**Alternating Current.**—For an arc lamp, the use of the alternating current causes both carbons to consume equally. An alternating-current dynamo is quite as liable to sparking as a direct-current one. The chief advantage of the alternate-current machine lies in the fact that it is possible to reduce the current of high potential and small current into one of lower potential and larger current at any desired point in the circuit by means of a transformer; and as it is much cheaper to carry a small current of high potential to a distance than it is to carry a large current of lower potential, alternate currents are coming into use for large installations where long distances have to be traversed.

S. Bottone.

[72534.]—**Battery Cells.**—If you use one cell, you obtain the E.M.F. due to one cell. If you increase the number of your cells, you also increase the E.M.F. Sm.

[72534.]—**Battery Cells.**—Separate cells are absolutely necessary unless you wish to have the plates always connected in parallel, which of course makes it one cell of low resistance. If you were to connect the plates all in series they would be short-circuited through the liquid and the power wasted; one cell would be certainly as good or better.

E. C. B.

[72534.]—**Battery Cells.**—Since the zincs would be faced by negative plates on each side, and would send current in both directions, the current would virtually be nil, since the forces would be opposing ones. So great is the influence of the presence of moisture between the separate cells of single fluid batteries, that far better effects are obtained when these cells are placed on glass strips standing edgewise. S. Bottone.

[72534.]—**Battery Cells.**—Your battery would not give any more power than one cell. For instance, supposing we have three cells connected in series in an undivided trough. The currents of the two inner zincs would flow through the liquid to each carbon and short-circuit themselves by the connecting piece at top; but the two end plates Z and C would still be open, as it would require a piece of wire outside to complete the circuit, and the only current available would be from the two end plates mentioned; the other would form batteries within themselves, as it were, and would be about as much useful in producing a stronger E.M.F. as a brick. You will have to use separate cells for each battery, there being no other way out of it.

Mick.

[72535.]—**Willans' High-Speed Engine.**—The heading of this query should be as above, "Willans'," instead of "Williams's." T. H. S.

[72544.]—**Xylonite.**—What imitation tortoiseshell I have met with has been made of horn.

Sm.

[72545.]—**Armature.**—To Mr. Bottone.—I cannot answer this query, as I do not understand the question as it is propounded. S. Bottone.

[72546.]—**Adjustment of Reflectors.**—If "G. G. B." will write me, I will send him a copy of the letter in question.

Fordingbridge. T. Westlake.

[72548.]—**Continuous Indicator.**—The movement shown in Fig. 110 of "Practical Electric-Bell Fitting" can be altered to suit your requirements. Put an extra spring and contact-post to the vane, so that it breaks the indicator circuit when the vane falls, and makes it when reset.

165, Queen Victoria-street. F. C. Allsop.

[72549.]—**Analysis of KOH.**—Why don't you buy a book on analysis? Sm.

[72551.]—**Ink.**—Sepia. Sm.

[72551.]—**Ink for Lantern Slides.**—What is it to be used upon—gelatine? Try Judson's dyes in bottles. Jack of All Trades.

[72552.]—**Air-Pump.**—Unscrew the cylinders; the valves will be exposed. They consist of strips of oiled silk tied over holes. Examine and renew oiled silk if necessary. Sm.

[72553.]—**Crystoleum.**—Do not use castor-oil. Affix the photograph with starch, and rub with a bit of wood till in absolute contact with the glass. Rub away the paper with fine sand-paper till the image can be seen from the back. Saturate with warm spermaceti. I have never had any failures yet. Sm.

[72554.]—**Battery Power.**—Use eight of the largest size Leclanchés (porous pot form).

F. C. Allsop.

[72554.]—**Battery Power.**—Reckoning that each mile of wire, No. 18, has a resistance of 26 ohms, and that the three miles are half go and half return, the actual resistance of the circuit would probably be about 39 to 40 ohms. Now, it takes about ¼ of an ampère to ring a fairly good bell. We may call the electromotive force of the Léclanché cell 1·6 volt, and its internal resistance 1·2 ohm. Hence 10 cells in series should be just about enough to ring the bells, since $\frac{10 \times 1{\cdot}6}{10 \times 1{\cdot}2 + 40} = \frac{16}{52}$ or a little less than ⅓ of an ampère. If this is not found sufficient add gradually a cell or two, noting results.

S. Bottone.

[72561.]—**Auxiliary Powers.**—If you will not go in for electric plant, I am afraid that there is no help for you, for compressed air would run into considerable plant. Jack of All Trades.

[72564.]—**Boat Motor.**—To Mr. Bottone.—I should put about 6lb. No. 16 on the armature, and 12lb. No. 16 on the fields, coupled up in series. If the field-magnet carcase were of the Manchester type, the F.M. cores might be 2½in. diameter, by 5in. long. S. Bottone.

[72566.]—**Cement for Loose Artificial Teeth.**—You do not say what the teeth are like, on metal plates, on pins, or which, mastic cement or sulphur. I have sweat them on with chloride of zinc and tin. Jack of All Trades.

[72568.]—**Pocket Accumulator.**—To Mr. Bottone.—Each cell of accumulator takes a charging pressure of 2·5 volts, hence as the bichromate cell gives but 2 volts at least, and your three cells require 7·5 to charge them (if charged in series), you will need four bichromate cells. It will take about three quarters of an hour to discharge the cells. When charged the current will depend on the resistance put in circuit; the E.M.F. of all three in series will be 6 volts, the resistance perhaps ·05 of an ohm. Supposing an outer resistance of 4 ohms were used (such as presented by a 6-volt lamp), the current would be about 1½ ampere, and the cells would probably be discharged in half an hour. After an interval of thirty hours, unless the cells were most carefully made, it is likely they would retain no charge at all. S. Bottone.

[72568.]—**Pocket Accumulator.**—I cannot exactly inform you of the results you would be likely to get from your accumulator, but will give details of one I made. It consisted of two cells, each containing two plates of perforated lead 5in. by 1½ by ⅛; when charged for about an hour from a 4-cell battery it lit up a 3·5 volt lamp for about 20 minutes. (*a*) Your accumulator will need at least five cells to charge it, and left on for about one hour, when it would no doubt give a continuous light for about 15 minutes; of course, you can extend the working of your accumulator over a space of, say, two or three hours, then it would last perhaps 35 to 40 minutes of intermittent work. (*b*) The current would no doubt be about 6½ volts—(1) the first go off it will light one lamp for about 15 minutes straight off, or two in parallel for about five or six minutes. (2) The current would be about eight or ten minutes lost on account of the smallness of the cells, and being closed at the top, which allows the cells so great a chance of short-circuiting. In good formed cells of the Planté type, one will heat to redness for a few minutes a short piece of platinum wire two or three weeks after charging. Mick.

[72569.]—**Assaying White Metal.**—I should not employ cupellation, but the humid method, if I wished for accurate results. Sm.

[72571.]—**Dynamo.**—The following are among the probable causes of your failure:—1st. The armature wire leaks to the armature core. 2nd. The field magnet wires leak to the F.M. cores. 3rd. The brushes are wrongly set with regard to the commutator slits. 4th. You are driving in the opposite direction to that which you ought to do to produce current. 5th. The field magnet wires are wrongly connected to each other, so that you have two poles of a similar name. Raise the brushes from the commutator, connect up to your battery, then, after a few seconds, lower the brushes on to the commutator. If the machine does not now run as a motor, you may be almost certain there is great leakage. Test for this. If it runs, note the direction of rotation, and drive in same direction as a dynamo. S. Bottone.

An exhibition of the handicrafts prevailing in the West of Scotland is to be held in Glasgow during the winter, and will be opened probably on December 15 by "an illustrious personage." The object of the exhibition is to raise funds for the establishment of a "people's palace" in the east end of the town.

**Cost of Electromotive Power.**—On the cost of power from electric motors the *Electrical Engineer* says: "It is to be borne in mind that the motor business depends largely for its success upon the rates at which the consumer can secure his current. We have received within the last few days the new schedule of power rates recently adopted by the Brush Company, of Baltimore, 'after a very careful consideration.' It is as follows:—1/10 H.P., 2·50dol.; ¼H.P., 3dol.; ½H.P., 5dol.; 1H.P., 10dol.; 2H.P., 16dol.; 3H.P., 21dol.; 4H.P., 26dol.; 5H.P., 30dol.; 6H.P., 33dol.; 8H.P., 42dol.; 10H.P., 50dol. This scale, which goes into effect on July 1st, seems reasonable for a city presenting such conditions as Baltimore does, with a large population engaged in a variety of pursuits, but not distinctly of the industrial type, and not presenting so great a diversification of small industries as one finds, for example, in Boston or Newark. Still, the motor business has been fairly well worked up in Baltimore, and there are now 375 motors, representing about 200H.P. of daily consumption of current. With the revised schedule this number and quantity should increase quickly."

# UNANSWERED QUERIES.

*The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.*

Since our last "Tuebor" has replied to 71985; T. S. Barrett, 72065; G. A. Battes, 72055.

72020. Tricycles, 497.

72208. G.W.R. No. 16 Broad Gauge 7ft. Coupled Loco., p. 20.
72211. Skin Perforations, 20.
72226. Working Time Tables, 21.
72236. Locomotive Speed, p. 21.
72247. Ivory Card Case, 21.
72258. Steam Coil, 21.
72260. Hydrostatic Problem, 21.

# QUERIES.

[72572.]—**Coloured Lights.**—Can any reader tell me how to make different coloured lights? I want to mix with paraffin oil something that will be safe from explosion.—Colour Lights.

[72573.]—**Electric Light for Dark Room.**—Will some reader kindly inform me the best way to fit up the electric light (ruby) in my dark room, to suspend from the roof? The light to be equal to an ordinary gas jet and worked by batteries.—Photo. Electrical.

[72574.]—**Vibration.**—Will some of your numerous readers help me in the following? I want to convert vibration into rotation, mechanically, or any other way. It must be made in such a manner as not to stop vibration. Any suggestion or plans will greatly oblige.—Dyfi.

[72575.]—**Naples.**—Would Mr. Bottone or any other reader kindly give any information about living there? Am told I must go there for the winter, and would like to know something regarding the place.—Invalid.

[72576.]—**Chromic-Acid Battery.**—Will someone kindly give me the proportions of carbon and zinc in a quart chromic-acid battery, so as to give the most powerful result with 2 carbons and 1 zinc?—Regulus.

[72577.]—**Dynamo Output.**—A dynamo is said to have an output of 300 volts, 10 ampères. Does this mean that when it is making 300 volts there is a current of 10 ampères in the circuit or armature? The P.D. at terminals being 300. If I join either terminal to earth, do I get half—i.e., 150 volts, 5 ampères from either terminal? What actually occurs in the armature when a coil is burned by a short circuit? Will any of "ours" kindly explain?—Equi-Potential.

[72578.]—**Sugar-coating Pills.**—Will "Jack of All Trades" or any other reader tell me how to apply the coating? I know the ingredients.—Maud.

[72579.]—**Electric Motor.**—Some few days ago there appeared in the *Daily Telegraph* a communication *re* a conveyance propelled by electricity, and it was spoken most highly of. It carried three adult passengers, and did a 50 mile journey at the rate of 10 miles per hour for the outlay of 2s. Can this be a fact? It was described as a "new family coach" in the shape of a phaeton, easily started, easily guided, and easily stopped. I remember some three years ago something of the kind being described in "our" paper. Can any reader tell me if anything of the kind can be seen in or near London? I am an immediate purchaser of something of the kind, if assured of its utility, and the law will allow its use on the roads. As I understand the law, this is not likely; but, still, it is a fact that an electric omnibus has been running in London.—E. W.

[72580.]—**Draughts.**—No doubt many of your readers are situated in the same way as myself—viz., have taught their children games (draughts having had special attention) until the children prove the best players. Can any of "ours" give me a few hints as to the scientific game of which I have heard so much? I have heard that when played scientifically it is impossible to beat a player if he has first move. Is this true?—Pater.

[72581.]—**False Notes in Pianos.**—Can any of "ours" tell me the cause of the following annoyance? I have a piano; the treble notes are never in tune. In fact, when two of the three strings are wedged the remaining one sounds just as though there are two strings not in unison. As this is the case more or less with every string, it really is quite a nuisance, so much so that I have serious thoughts of selling the instrument.—Worried.

[72582.]—**Tempering Skates.**—I have a couple of pairs of Raymond extension roller skates (made entirely of steel) which got burnt at a fire. Will any reader tell me how they are tempered, and to what degree?—Anxious Inquirer.

[72583.]—"**Comes" Polaris.**—Will some astronomical friend kindly describe for my benefit how to look for *comes* Polaris? I have seen the object mentioned as a thing to be discerned by cheap (and presumably poor) telescopes, but I have never been able to see it. Is it close or distant, faint or bright, and in what direction from Polaris with regard to the pointers? I have a good 3in. telescope, with which I have easily divided Castor on a clear evening—power 180.—Astro-Stargazer.

[72584.]—**Fountain.**—I want to construct a small fountain for a table which will use the same water over and over again. The power for raising the used water again to the reservoir must be provided by the water itself. The whole must not exceed 16in. in height.—C. E.

[72585.]—**Vacuum Gauge.**—I have charge of a horizontal condensing engine (jet condenser), indicating about 50H.P. The vacuum gauge figures up to 30. My employer says the gauge should always indicate that amount of vacuum, but I cannot get above 27. I have packed all glands, and the valves all appear to be right. What else should I do to get more? The engine I had previous to this the gauge only figured up to 15. Please explain the difference.—Young Hand.

[72586.]—**Vacuum.**—How can I produce a vacuum in a few flasks, without the use of air-pump? What is an aspirator? Should be glad if anyone would explain its action and give instructions for making one, and method.—C. E.

[72587.]—**Making Gold Band Ring.**—I am in a great difficulty, having started to make one of the above. I have used moulds made from chalk. The gold being melted in a crucible over a blacksmith's fire, I find that the metal cools almost too quickly to pour out. I get after ten or twelve trials only a failure and waste of gold. The gold does not run all round the mould, the ring being unequal and unjoined. Could I melt the gold in the mould of chalk with an oxy-hydrogen jet, and run it that way? I mixed a little pewter with the gold and some small quantity of silver. What is the best way to proceed? Will somebody help me out of the difficulty by a suggestion based on experience? Borax was used for flux.—Vir Sapientiæ.

[72588.]—**Submarine Boat.**—Will some reader give particulars and sketch of the new spherical submarine boat, recently invented by an Italian, and said to be about to be adapted by the English Admiralty, or state where any sketch may be obtained?—Brighton.

[72589.]—**Locomotives.**—Will "Meteor" or other correspondent kindly give the designer's name, date of building, and cylinder, and driving wheel dimensions of the following engines:—L.N.W. "Sefton" 1840, outside cylinder single wheel, outside bearings to trailing and leading wheels; also 2030 6-coupled goods engine; N.E.R. 1160 4-coupled outside cylinder bogie engine; G.W.R. 158 4-coupled passenger engine, with outside bearings?—P. W. P.

[72590.]—**Lathe Carriage.**—Will someone kindly tell me what is the right distance for a lathe carriage to travel to cut threads of a mixed number, as 1⅝ per inch, or 3⅜ per inch, V.C.? My lathe is 4 threads per inch on guide screw. And what is the least distance for my lathe carriage to travel to cut a double thread ⅛in. pitch? I should like to know the easiest way.—J. R.

[72591.]—**Cupid and the Rings.**—Seeing a crowd outside a jeweller's shop, I stopped to satisfy my curiosity, when I discovered inside the window a glass shade inside which were various articles of jewelry. Centre stood a small figure with a small wheelbarrow full of rings. The figure, called Cupid by the proprietor of the shop, would go round the case and stop at any of the articles which were numbered, by any of the spectators outside calling out the number. Is this worked with battery or not? If not, kindly explain, and probable cost.—Moss, Aldershot.

[72592.]—**Medical Battery.**—Will some reader kindly tell me how the various cells of a medical battery are joined up so that one can have the choice of, say, five strengths out of a 20-cell battery? I am about to fit up such a battery, but come to a dead stand at this. I should also like to know how to use a Faradaic coil (at choice) with the current from the cells.—Charlton.

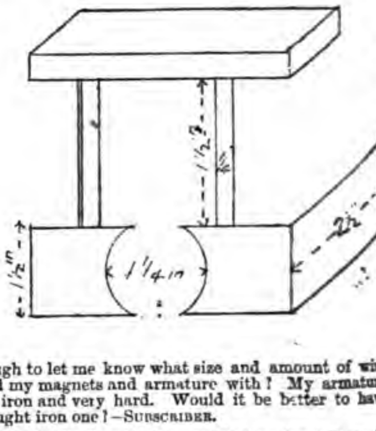
[72593.]—**Boiler Rings.**—Would some practical person please say which are best to use, rings made from iron or steel, to put in tubes of a locomotive boiler? Also thickness of rings as generally used.—Tube Ring.

[72594.]—**Aquarium.**—Time is coming on to prepare for frosts. Could any reader say whether there is a plan so as to avoid frosts cracking glass or injuring in any way exposed aquarium? Must I really empty it for the winter? Size, 3 by 2 by 2ft.; locality, Norfolk. A friend suggests that if a ½in. hole be bored through the ice, and kept clear so as to allow air to pass through, the ice when giving will not expand and do damage. Any information will be received with thanks.—Baker.

[72595.]—**Loss of Head by Bends in Laying Water Pipes.**—Am laying 600ft. wrought-iron pipe, 26in. diam., leading water to turbine. Nature of ground and buildings compels me to have two 90° bends, one at 410ft. and one 500ft. from commencement. What head of water do I lose by above bends?—950c.ft., 40ft. head, 600ft. long.—A Mexican Reader, Tepic, Mexico, Sept. 9, 1890.

[72596.]—**Light Pony Trap.**—Will some reader kindly oblige me with dimensions, instructions, and sketches for making a light pony or donkey trap capable of carrying three or four persons?—Delta.

[72597.]—**Dynamo.**—I have the castings for a small dynamo, size of drawing sent. Will Mr. Bottone be kind enough to let me know what size and amount of wire to wind my magnets and armature with? My armature is cast iron and very hard. Would it be better to have a wrought iron one?—Subscriber.



[72598.]—**Sails.**—Will some kind reader tell me how to colour canvas the rich brown colours used by fishermen for their sails?—J. C. L.

[72599.]—**Tidal Waves.**—Would any of our readers kindly give me particulars of the tidal waves in the river Severn and the river Seine in France? Also say what is

me, and if it occurs in other rivers in the
om ?—YACHTSMAN.

**lectric-Bell Clock.**—I have a tall case
:k to which I would like to put an at-
t may be set at any hour required to
ric bell fixed in adjoining room. Would
l electrician kindly assist me in how it may
particulars and sketch for same.—SOMERSET

**lectric Pendulum.**—Would Mr. F. C.
other kind friend say how a pendulum
put to an ordinary electric bell, with par-
etch ?—SOMERSET LAD.

**Thymol Disinfectant.** — Will any
er kindly say what is the solvent for thymol
infectant fluid, and what should be the pro-
ymol, the solvent, and water ?—C. L.

**agneto Indicators.**—I should be glad
er would say how the following indicators
up and the course of current ? Also if the
bell both work at once or not. There are
which represent six stations. They are
nagnets, only one bell where the indicators
icator armature has a cup at one end, and
rcury in. The other end releases the in-
then falls. A kind of plug switches are
ct any two stations together. They are con-
er by flexible cord. Earth wire is used for

**laster of Paris Appliances.**—Can
me by telling me anything about plaster of
as a means of relieving spinal curvatures ?
work which I have consulted on the point
n as consisting of folds of window muslin (in
ster is inclosed) wrapped closely round the
tient having previously donned a woollen
, and which must be worn without creases.
t the confinement of the natural secretion of
wo or three months affect the health of the
eriod named being the time which, according
entioned, such an appliance will last ? Is
ance preferable to a corset constructed on
lieve such a complaint ? Any information on
ill be greatly valued by—Z. A.

**ressure.**—Given a tube filled with a fluid
re, does the pressure always act radially
s of the tube whether the tube be bent or
herwise ?—J. L.

**rotoplasm.**—It is stated in a discussion
*htly Review* that what was said to be a bed
when it was discovered in 1868 was found
lists of the *Challenger* in 1875 to be only sul-
. Will some reader give an account of what
scovered on both occasions, and show how it
t the discovery of protoplasm turned out to
mistake ?—J. S. C.

**esting Emeralds.**—Would some of your
y tell me a reliable way of testing whether a
is in my possession is a real emerald or an
have submitted it to a jeweller, but he says
cide.—G. H. W.

**erman Silver, to Polish.**—I have 120
rman silver in its rough state. I want to
t way to polish it, and get a nice, bright sur-
s there any kind reader who can tell me the
kest way to do it ?—T. D.

**ortland Cement.**—Can any of "ours"
information as to any method of burning
ent with coal otherwise than in the Hoffman
information, together with sketches or de-
iln, will be esteemed by—CEMENT.

**ithanode.**—To MR. BOTTONE OR MR.
—If this material is the best negative ele-
it not used more generally ? But how can it
for all primary batteries ? Will it not be
sed in place of carbon in the Bunsen cell ?
ion arrangement of a battery for which it
able and superior to carbon.—P.

**ock-a-Bonddu.**—What is the meaning
n of this name for the fisherman's favourite
insect is it supposed to represent ?—ALFRED

**Maps.**—What is a convenient method of
d keeping the ordinary road maps, such as
unting men and cyclists, so that they can be
for reference or use ? One accumulates a
of these maps, and they vary much in size
—namely from 4½in. by 2¾in., up to 7in. by
issued by the same publisher and on the
being sometimes folded to different sizes.
them difficult to find when going for a tour.
LOYD.

**Violin.**—Can any reader inform me how to
ck and belly of violin the proper shape—viz.,
art ? Is it bent by some special appliance ?
of wood is used, and also how stained ?—

**uessing a Person's Age.**—Will some
by telling me of a method for doing this ?
one plan that was given in the "E. M.," but
ake it come right without knowing the age
It was in "Replies to Queries," No. 72378,
0.—V. JENSEN.

**Brazing.**—Is there any kind reader can tell
raze—such as repairing copper pans for boil-
sugar ?—TINMAN.

**Engine Query.**—Could any fellow-reader
ormation on the following faults in gas-engine
Crossley Bros.) :—1. Why gas-engine fires in
2. Missing sometimes, although governing
n gas valve ? 3. Cause of firing in air-pipe
tion engines ? In cases as above, slides new ;
a few weeks.—COMPRESSION.

**Action of Inks on Marine Glue.**—I
much obliged to anyone who will inform me
lue would be affected by writing inks, and if
uld be a better substitute ? I want to stop
in earthenware inserted in ink.—ARGUS.

[72618.]—**Winding Armature of Dynamo.**—Is it not the case that theoretically one layer of wire on the armature core gives the best results as E.M.F., and freedom from heating, &c. ? This, however, necessitates a larger armature, and consequently a larger dynamo for a given output than when several layers of wire are wound one on the top of the other. Will you please say how many layers of wire are allowable on the armature, and what effect each additional layer has on the ultimate output ?—COMMUTATOR.

[72619.]—**Producing Darkness.**—In Roscoe's "Spectrum Analysis" he says, on the subject Interference of Light, that it is possible to produce darkness by making the crest of one wave correspond to the hollow of another. Would some one tell me how this can be done in practice ?—E. S. CHURCHILL.

## USEFUL AND SCIENTIFIC NOTES.

PEOPLE who "change their minds" can now justify their apparent inconsistencies on the authority of a German histologist, who has calculated that the human brain contains 300,000,000 nerve cells, 5,000,000 of which die and are succeeded by new ones every day. At this rate, we get an entirely new brain every sixty days.

**Aluminum.**—Pure aluminum melts and becomes fluid at about 1,200° Fah. The amount of impurity in aluminum materially alters its melting point. One per cent. of iron raises the melting point over 100°. It does not remain firm like lead almost to the fluid point, and then suddenly give way, but has a stage of from 100° to 1,200° Fah., in which the metal becomes pasty, loses much of its power and cohesion, and during which stage, if the metal be gently pressed together, it can be readily welded. It is, however, very red short at this temperature, and will not stand hammering to weld the metal without crumbling down. If the metal is not too long a time in this pasty condition, it does not seem to become injured after being again cooled down. A sheet of aluminum 12in. square and 1in. thick weighs 14·03lb. ; a bar of aluminum 1in. square and 21in. long will weigh 1·17lb. ; a bar of aluminum 1in. in diameter and 12in. long will weigh 0·918lb.

**Largest Cistern.**—It is said that the largest cistern in the world is under the machine shop at the Charlestown, Mass., Navy Yard. It is 100ft. in diameter, with a depth of 40ft. It was built in 1858 by Master Labourer Otis Little, and supplied water to the great machine plant. The cistern was fed from a number of wells on the higher land near Chelsea-street by means of underground aqueducts. More than 850,000 bricks were used in its construction. This mammoth well has not been utilised since the introduction of Mystic water into Charlestown in 1865. It is possible that, regarded purely as a reservoir of fresh water, this is the largest cistern. But there are gasholder tanks in this country very much larger.

**Ericsson's Submarine Gun.**—The Ericsson submarine gun is to be exhaustively tested, Congress having appropriated 30,000dols. for that purpose. The gun in the *Destroyer* is 36ft. long and 16in. in diam., firing a projectile weighing 1,450lb. and 25ft. long, charged with 300lb. of high explosive, with 12lb. of slow-burning prismatic powder, the initial velocity being such that 300ft. through the water is travelled in less than three seconds. So much Captain Ericsson determined before his death, but the projectile has never yet been fired charged with explosives. The *Destroyer* is 130ft. long, only 12ft. beam, and 11ft. deep ; designed to fight bow-on at a distance of about 300ft., and protected only by a slanting transverse armour plate at an angle of 45° with the horizontal. The notion of a submarine gun originated with Benjamin Franklin ; and Whitworth, many years since, made some very successful experiments with his flat-headed projectiles.

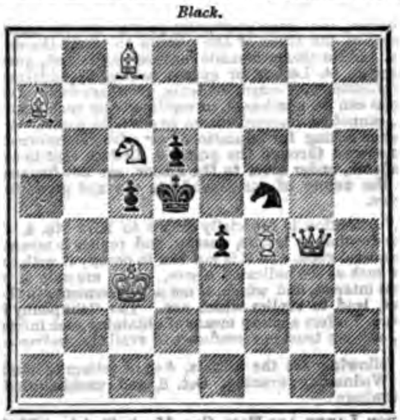
**Croton Aqueduct.**—The new Croton Aqueduct is 38·12 miles in length from Croton Lake to Central Park, New York. Of this 29·63 miles is tunnel through solid rock, or in some places loose soil, which is worse ; 2·37 miles is pipe line under ground ; and 1·12 mile is an open trench. The tunnel throughout most of its length has been lined with brick. This has called for about 163,000,000 bricks, or sufficient to build thirty-three structures of the size of the New York *Tribune* building. If the area of the inside surface of the tunnel were laid out as a plane, it would amount to 162·83 acres, one-fifth of Central Park. Over 2,800,000 cubic yards of material were excavated, and if this were added to the 3,250,000 cubic yards of masonry placed, the mass would be equivalent to 83 per cent. on the volume of the great Pyramid of the Cheops, in Egypt. A better comparison lies in this, that this material would be sufficient to build a wall 10ft. thick and 55ft. high around Manhattan Island, thirty miles in length on the water front. Over 5,800,000lb. of dynamite were used in blasting for the tunnel and forty-two shafts that lead down to it. Twenty-eight of these shafts will be left open after the aqueduct goes into operation. The total cost of this work up to last June was 23,558,030·45dol. There will be more to come, but comparatively not much.

## CHESS.

ALL communications for this department must be addressed to "J. PIERCE, Knollside, Yawl, Lyme Regis, Dorset."

PROBLEM MCCXXIII.—(Tourney problem No. 3.)

*Black.*



*White.* [6 + 5

White to play and mate in two moves.

SOLUTION TO 1221.

| *White.* | *Black.* |
|---|---|
| 1. Q-Kt 8. | 1. Any. |
| 2. Mates. | |

### NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1221 by Biene, A. A., W. A. Clark (sure mates, but hardly enough of them), W. L. Martin, J. Kistruck, W. Sangster, W. Gleave (pretty, but very easy), C. P. P., A. Fellows, J. H. Eastwood, and Fr. Fernando.

W. L. MARTIN.—Thanks for entrance fee duly received.

FR. FERNANDO.—Duals will not count in direct two-movers, as only the first move need be given, but they will count in the sui-mates.

INTELLIGENCE from Hon olulu states that the volcano of Kileaua shows renewed activity. It is said that a new lava bed has been formed, and that the cones which sank some time ago rose a height of 50ft. in one day.

"THE widest plank on earth," the *Humboldt Standard* states, is on exhibition at the railroad depot in that city. It was cut at the Elk river mill, and is 16ft. in width. It will be among the Humboldt exhibits at the World's Fair in Chicago.

**Lebel Rifle.**—The famous Lebel repeating rifle, which is not only the arm of France, but also to a large extent of Russia, is 1·825 mètres long, including the sword bayonet, and weighs with the bayonet and eight cartridges 4·815 kilogrms. Without the bayonet its length is 1·307 mètres, and its weight 4·180 kilograms. The barrel is of tempered steel, bronzed on the outside, and is 0·80 mètre in length with a calibre of eight millimètres. The reservoir holds eight cartridges end to end, and in the operation of firing a fresh cartridge is automatically removed from the reservoir and inserted in the breech. The eight shots can either be fired in quick succession, or singly, as in an ordinary rifle.

**Electricity from Belts.**—An interesting note, says the *Electrical World*, comes from a correspondent in Woonsocket, R.I. Some time since there was trouble with one of the arc machines in use, and after a careful investigation by Mr. Pierce, the electrician, who kindly furnishes the facts, it was found that the static discharge from a belt to the frame, and thence to the armature, perforated the insulation so that the machine current had followed it, and burned out the armature coil. The trouble once found, a very simple and effective remedy was employed. Grounded rods were bent from the pulleys so as to take the static discharge from the belt. It is well known that quite a powerful spark can be obtained from belts under certain circumstances, but this is a remarkable instance of its effect.

THE sea-serpent being dead, and the big gooseberry smashed, what are called forecasts of the phonograph are turning up. One even older than that of Cyrano de Bergerac has been found by Lieut.-Col. A. de Rochas in the April number of the *Courrier Véritable*, a small monthly organ published in 1632. "Captain Vosterlich," it reads, "has returned from a voyage in Australasia. He reports having passed by a strait below that of Magellan ; he landed in a country where nature has furnished men with certain sponges which retain sounds as other sponges do liquors. So that when they wish to ask something or confer at a distance they speak into one of the sponges and send it to their friends, who, having received it, press it gently and make the words come out."

# ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* **Editor** *of the* **English Mechanic, 332,** *Strand, W.C.*

## HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Oct. 8, and unacknowledged elsewhere:—

London Lathe and Tool Co.—Monte Christo.—W. C.—Engineer.—H. T. E.—Lavant.—Edward C. Bousfield.—Jay Bee.—X. Y. Z.—Gossamer.—A. V. B.—Gut Scraper.—B. I. S.—S.—C. E. Stretton.—R. J. Urquhart.—Tom Moore.—Manchester Gramme.—Engine Driver.—Merlin.—D. L.—A. F.—J. A. H.—North Western.—Locomotive.—Abertify.—J. A.—R. B. T. W. Z.

G. A. B. (Why not consult our Astronomical Notes? See, for instance, those on p. 96. Perhaps it is not a planet at all, but Altair or Vega. 2. Astronomers do not *know* the diameter of the Sun: they estimate it—with tolerable accuracy, we imagine, considering the difficulties. Refer to the back volumes, or consult some elementary textbook of Astronomy. There are various methods of calculating the distance of the Sun, the most trustworthy, perhaps, of which was described in No. 911, with illustrations, p. 1, Vol. XXXVI. Sept. 8, 1882.)—E. P. J. (The crystals you have obtained from the clay are probably selenite (calcium sulphide), which form the subject of a recent query—72419, p. 90. They are of no particular commercial value.)—P. T. M. (Do not recognise it from your description. We have seen something of the kind, but do not know where it can be purchased. If it were of much utility, it would be well known by this time.)—Miserable. (There is nothing specially remarkable in a young man being troubled with pimples. Put the question to Dr. Allinson, through the *Weekly Times and Echo*. We should scarcely call "pimples" a "skin disease" in a young man.)—Fine Weather. (Briefly, an "anti-cyclone" is that in which the wind blows round an area of higher pressure in the same direction as the hands of a watch. 2. Cirrus clouds are those having a fibrous or curly, wispy appearance, generally high up in the atmosphere—from Latin *Cirrus*, a curl.)—M. H. L. (We do not know of a paper devoted to the trade of scale and weighing-machine makers.)—Apprentice. (It is so invidious the recommending of textbooks of the kind, that we do not care about it. Any bookseller can show you works on algebra.)—A. (For the manufacture of electrical instruments see back volumes, and the works frequently mentioned in Replies.)—Kalulu. (Any patent agent will answer the question for a moderate fee. Perhaps the makers will tell you whether the patent has expired or not.)—H. A. (You will find a good deal about luminous paint in back volumes—see, for instance, p. 471, Vol. XXX. Jan. 23, 1880. On p. 256, Vol. XXIX. May 23, 1879, there are the particulars of a patent obtained in this country, and at the Patent Office you can obtain specifications of all the inventions of phosphorescent powders and luminous paints.)—G. W. Patterson. (Models are not required to obtain a patent. The invention is briefly but clearly described on the form of application which bears a stamp value one sovereign, and that plus a shilling for the affidavit stamp and a few pence for the forms, is all the outlay necessary for a period of nine months, which may be extended to ten. Then a complete specification must be filed with drawings. The forms of application can be obtained at many post-offices. Apply to one of the agents advertising in our columns for a "manual." 2. We do not know of any easy method of ascertaining the time, and seeing that the shot would fall 16ft. in one second, it would require elaborate apparatus to ascertain the "exact time" for one foot.)—St. Clair. (If you address the query to the Secretary of the Chemical Society, Burlington House, London, W., he will forward full particulars as to admission.)—M. N. W. (Really such information should be sought in a local directory or a trades directory.)—One in a Fix. (Please see Hints above. You can buy them at any gasfitter's shop.)—J. Eagles. (We do not answer by post. We never heard of a boiler weighing 50 tons anywhere near London, except perhaps a boiler for a steam-vessel.)—One Hand. (We have reproduced some of the articles which form the volumes referred to as "Practical Blacksmithing." Three volumes have been issued by Mr. T. Richardson, New York, and they can be had from Kegan Paul and Co. London is quite sufficient address, but you can put Paternoster-square if you like.)—Enquirer. (Does not the value of a violin—unless by an "old master"—depend on its "speech" in the hands of a player? How can anyone say without trying it or examining it? 2. Roll the skins up in a damp cloth, and when softened, "work" them well by rubbing and twisting them with the hands. 3. Yes, camphorated chalk is considered a good tooth-powder.) Explorer. (Presumably you mean Dr. Nanssen's Expedition. Nothing is settled at present; but you will find all about it in back numbers.)—Young Hydraulic. (Do not remember them. Do you mean the Cantor lectures by Prof. Perry on Hydraulic Machinery? If so, you will find them in Vol. XXXVI.)—Amateur. (Not necessary to "seal" them; but for convenience, may be kept in position with electrical cement or sealing wax.)—M. H. D. (Simply to provide as much insulation as possible. See Culley's "Practical Telegraphy," Longmans, eighth edition, p. 147. The object of the shape is to be able to screw the bolt into the porcelain itself.)—R. C. Meekren. (Model returned. You might submit it to the Admiralty; but we do not think they will take up the idea, even if proved effectual in an actual test.)—Pedagogue. (See Proctor's work on "The Sun." The "law of perspective" has very little to do with sunspots, we suspect. Have you tried the experiment of the long tunnel and the brilliant light?)—Ignorant. (There is Browne's "Art of Pyrotechny," published by L. U. Gill, 170, Strand, and Kentish's "Pyrotechnist's Treasury," published by Chatto and Windus; but any bookseller can supply such works, or you can probably find such information as you require in back volumes.)—Sapper. (Presumably you want a work on Ventriloquism, which is an art not to be acquired *per saltum*. Some people have a natural aptitude for it; but the whole thing is mainly a delusion, and depends much on the skill of the performer.)—E. C. Bool. (We do not remember, but roughly about eight years ago. Certainly, send replies or queries in the same envelope addressed to the Editor.)—La Lumiere (Please see many replies in back volumes and the indices. Electric lighting has had more than its fair share of space.)—'Ohm Sweet 'Ohm. (See previous answer. The Fuller or the chromic-acid cell would perhaps be best in the conditions given; but the bichromate would do very well if arranged to lift the zincs out of the solution when not in use.)—W. N. C. (You mean French polish, as it is termed. That requires much practice; but details can be found in many places in back volumes, even in recent numbers.)—A Reader, Bolton. (Model Locomotive articles appeared in Nos. 1312, 1313, 1314, 1315, 1316, 1319, 1321, 1324, 1331.)—H. H. H. (Do not understand the elongated bulb at the "top"; but at any rate the mercury has to be placed in the bulb and shaken over, heating to expel air. The method has been frequently described; but experience is required.)—Transmitter. (That is a question you had better ask of your solicitor. Before very long the patent in the way will be out, and anyone will be able to do what you mention.)—C. W. (Probably the same as seen by another correspondent.)—Amateur and A. A. (We really cannot engrave any more illustrations of small dynamos simply to ask Mr. Bottone's opinion about them, and how much wire, &c., they will take. We will help any querists in reason; but we shall be asked next to illustrate all sizes of tea-kettles to find out how many cups of tea each will be sufficient for.)

**"Rejuvenation."**—An Eminent Physician (M.D., R.N.), &c., writes:—"I have twice visited Mr. C. B. Harness' Electropathic Establishment, at 52, Oxford-street (London). I had long been a believer in the efficacy of electropathy scientifically carried out, but was not prepared for the perfection of appliances there displayed. I was quite as much pleased as surprised. Thousands of ailing ones may here seek for and find what I may term *rejuvenation*, in contradistinction to premature old age. I recommend electropathy in many ailments, especially the following:—Nervous exhaustion, chronic debility, ennui or melancholy, amenorrhea, dysmenorrhea, rheumatic gout, chronic rheumatism in any form, functional heart complaints, neuralgia, and chronic ailments of the digestive canal." Every man and woman in search of health should wear one of Harness' Electropathic Belts. Those who are unable to call and avail themselves of a free personal consultation are invited to write at once for descriptive pamphlet and book of testimonials. Note only address, 52, Oxford-street, London, W.

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**Astronomical Telescope,** 12¼in. Equatorial, "With" Reflector, Wedge Photometer, Micrometer, Electric Illumination, Astronomical Books and Instruments. Opera Glasses, Plate Machine, Case Mathematical Instruments.—Below.

**Astronomical Observatory,** 12ft. dome, transit and computing rooms, two sets of Patterns for Equatorial stands, two Dynamos, Tricycle, Grindstone, Sugg's Cromartie Lamp.—Below.

**Astronomical Clock,** by Cooke, York; two Aneroid Barometers, three Bichromate Batteries, new Wimshurst Machine, 15in. ebonite cylinders; 15in. Terrestrial Globe, by Newton.—Below.

**Astronomical Transit,** 2⅜ O.G., silver circles, striding level, collimating eyepiece; 21 Lantern Photographs, Fletcher's Tubular Gas Stove, apparatus various. List, stamp.—Box 20, Liversedge.

½H.P. **Beam Engine,** fitted with governors, throttle vlave, slide valve, &c., cost £20 to make. Exchange for Gas Engine or offers.—John Pedley, 8, Stuart-street, Luton, Beds.

**Astronomical Telescope,** Refractor, good, wanted in exchange for Microscope and Chronometer, value £25.—Bassett, 83, High-street, Stoke Newington

Wanted, any **Lathe Parts,** finished or unfinished; also old brass or copper. Can offer first-class exchange. Offers invited.—T. Tipping, Painswick, Gloucestershire.

**Safety Bicycle,** ball bearings, in good order. Exchange anything useful.—R. Gornall, Damside, Pilling, via Garstang.

52in. **Bicycle,** ball bearings, good machine. Exchange.—R. Gornall, Damside, Pilling, via Garstang.

1 dozen new **Electric Bells,** best English make, warranted, polished hard-wood cases, iron frames, silk-covered wire; very highly finished. cost 60s Exchange. Approval deposit.—M., 13, Woodberry Grove, Finsbury Park, N.

**Tandem Tricycle,** Sociable, single tricycles, safety bicycle, small engine. Either of above in exchange to value, for Shafting, Pulleys &c., to drive Lathes.—Tupper, Redhill.

**Electro-Plating Dynamo.** recently done up, good as new. bargain. Exchange old plated goods or old silver.—White, 4, Trafalgar-street, Brighton.

Grand model **Screw Steamer,** cost £12. Accept any reasonable offer in very old foreign Postage Stamps, a collection preferred.—Westhorp, 1, Spring-road, Ipswich.

Wanted, **Vacuum Tubes** and other experimental apparatus. Good Exchange.—Sugden, 99, Wyndham-road, Camberwell, S.E.

Wanted small **Platinum Crucible** or other exchange offer for Gem Air-Gun, with darts, pincers, and 900 slugs.—Microscopist, 344, Caledonian-road, London.

**Microscopic.**—Polished pine cabinet, with trays containing 144 high-class microscope slides, value £3 8s. 6d. small Chemical Balance or other offer for whole, or part.—Microscopist, 344, Caledonian-road, London.

**Engine Parts,** complete, 8H.P.; also some 1½H.P. on bed-plate. Will take engineer's tools, exchange.—Edwards, 19, Southampton-road, London, N.W.

**Viol-di-Gamba;** curiosity. Should say 1,000 old. Will take Gas-engine, Bicycles, or part in Cash.—Cromwell-street, Sunderland.

**Dynamo,** model parts, armature and field wound, pulley, brush-holders, mahogany-base, terminals, complete. Exchange camera, or offers.—W., 7, Douglas-street, S.W.

**Banjo Music,** Songs, and Tutors, or cash given in exchange for guitar music.—McGorman, 5, Dublin.

Exchange good steel **Boiler,** length 2ft. 6in., 12in., for Bicycle, all fittings complete.—P. B., 138, Radcliffe, near Manchester.

Large model **Engine and Boiler,** scale 3d. Exchange for 6-volt, 8c.p. Edison-Swan Lamps, No. 28 Hayman, Downhead-road, Crediton.

What offers for small **Gas Engine?** Can be driving lathe. Apply by letter. Worth £10.—G. P. W., Winchmore-hill, N.

Will exchange Ross' **Wide-angle** Lens, 8½ by 6½, central revolving diaphragm, for Bourdon Gauges to value.—W. B., care of Messrs. Nelson and Sons, Manufacturers, Sherland Works, Twickenham, S.W.

Large size **Cylinder Frictional Machine,** plete with cabinet, &c. Exchange printing press, type, lathe, thing useful.—Durrant, Polytechnic, Queen-street, Great

What offers for three 4-cell Miner's **Portable** tric Lamps (Chancliff's Patent). Photo apparatus William R. James, 139, Abertillary-road, Blaina, Mon.

Will exchange silver hunting **Geneva Watch,** order, and Gold Albert, for strong parallel bench vice of good —Ovenden, Devonport.

1in. scale **Model Express Locomotive,** cylinders, four coupled wheels, leading four-wheeled bogie, motion, engines complete without boiler.—See below.

Also Beck's Popular **Microscope,** two eyepieces, objectives, splendid instrument. Exchange lot for first-class tyred safety.—C. Hays, 121, Blackburn-street, Bolton.

Exchange small model **Steam Engine,** strong boiler, safety valve, &c.; 100 volt, 16c.p. lamp, with brass for offers. 5 and 10c.p. lamps.—Wheatcroft, Fore-street, Exeter.

Portable **Chemical Vapour and Steam** in box, Zither, Electrical, Magnetic. Galvanic, Experimental ratus for science teaching. Exchange for Lantern and Slides. on application.—Electrical, 72, Price-street, Birkenhead.

**Daniell Battery,** 5-cell, new, for lighting lamp, &c. Tricks, Illusions, Medical Coil. Exchange wire, offers.—X., 62, Cambridge-gardens, North Kensington.

English Mechanic
RLD OF SCIENCE AND ART.
RIDAY, OCTOBER 17, 1890.

## O CONSTRUCT A QUARTER HIMING CLOCK.—I.

following articles it is proposed to full directions, with drawings, to ateurs possessed of the necessary h sufficient skill and patience, to a quarter chiming clock from the terials. The clock we shall first will be a bracket clock, standing . high, striking the hours on a eel gong, and chiming the quarters of either four or eight bells at will. we propose to describe the same stand in a long case, and run hts instead of springs, and with ulum beating dead seconds instead rt pendulum necessary in a bracket ch a clock, provided the work- s sound, will go and keep time for of a century; and with careful will last even longer than that. deed, be something to be proud of, ossess this great advantage over a z., its whole existence, from the completion to the day it falls to ll be one of continual usefulness.

l now consider the general prin- n which such a clock works. After h particular part will be described and full directions given for making

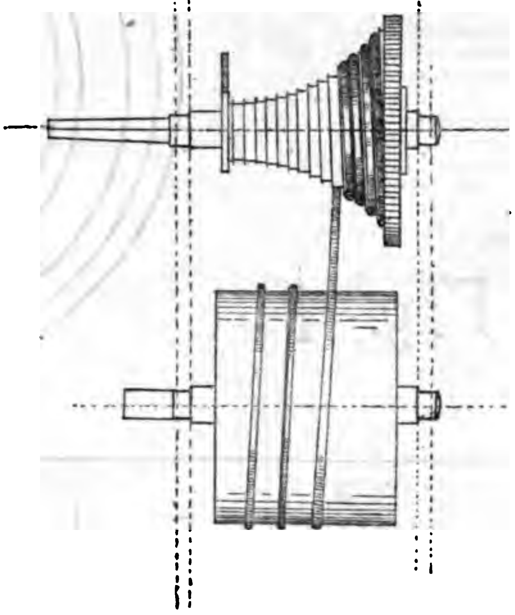
aders know that a simple time- ists of a train of wheels, to the first power is applied by means of a spring. The train transmits this lly to an escapement, which serves pendulum vibrating, and, at the , provides a means of registering ions. A clock may, therefore, be an apparatus for maintaining and the vibrations of a pendulum. All such as striking and chiming, are velopments of the recording part aratus.

lock to keep good time the driving- st be invariable. The train-wheels o arranged and constructed as to e power evenly, and without undue he escapement. As the train- cessarily have to release the striking ing trains at frequent intervals, sing actions must be made as light le. The escapement must be so hat, whilst imparting motion to the , it interferes with the regularity rations as little as possible. The must be of such a weight as not to l by slight variations in the driving d be suspended in such a manner rates freely with very little friction, affected appreciably by changes in re. These, briefly, are the require- good timekeeper, and it is obvious ecure them careful and accurate sential.

. 158) is a general view of the clock with the dial and hands removed, e striking and chiming mechanism. -wheels and pinions, hidden behind are marked by plain circles to r position. This figure is not given ing diagram, nor is it drawn to ular scale; but is merely intended e reader a comprehensive view of on and functions of the various hat the working of the whole clock horoughly understood before pro- rther.

lock we are now considering there trains of wheels. In the centre is "going" train, that is, the time- rt of the clock. To the left is the " train; to the right is the "chiming" train. A, A$^1$ and A$^2$ are respectively the barrels of the three trains, and contain the mainsprings, held by the three ratchets and pawls 12, 12$^1$ and 12$^2$; B, B$^1$ and B$^2$ are the three fusees, cone-shaped drums upon which the chains or lines are wound in the act of winding the clock. As the clock runs down these chains are gradually wound round the barrels off the fusees. This is so arranged that, as the springs unwind and become weaker, the chains pull on the larger end of the cones, thus equalising the power. Fig. 2 shows barrel and fusee action, with the spring half-wound.

Fig. 2.



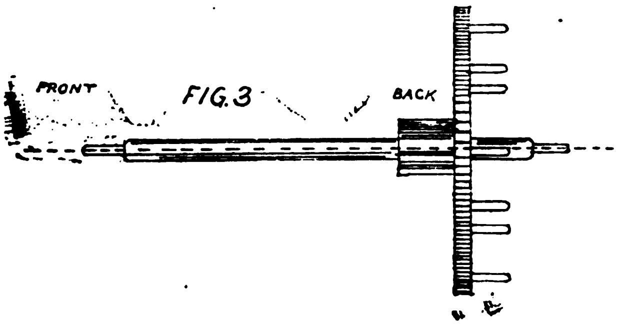


FIG. 3

Keeping now to the going train, C is the next wheel. This wheel, turning once in the hour, is placed in the centre of the clock and carries the minute-hand. It is, therefore, called the "centre wheel." This gears with the "third wheel" D, the next in order. This again drives the escapement wheel E, commonly called the "'scape-wheel." The 'scape-wheel, in its turn, acts upon the steel pallets F, which finally transmit the power to the pendulum, not shown in the figure, being at back of clock.

Proceeding with the striking train where we left off, the next wheel to the fusee is the "pin-wheel" D$^1$. This wheel has eight pins perpendicular to its plane, which, as the wheel revolves, actuate the arm Z attached to the hammer which strikes the hour gong, each pin causing one blow. This hammer is not shown in Fig. 1, being at back of clock. Fig. 3 shows the pin wheel.

The pin wheel drives the "pallet-wheel" E$^1$, so called because its front pivot comes right through the front plate of the clock, and carries the "pallet" 4, which gears with the rack 2, to be afterwards described. The next in this train is the "warning-wheel" F$^1$, which has a pin projecting from it, allowing it to run about three-quarters of a revolution at "warning time," that is, a few minutes before the hour is struck. This is termed the "run," and serves the purpose of freeing the train wheels in readiness to strike when released, without hesitation. Fig. 4 shows the warning wheel.

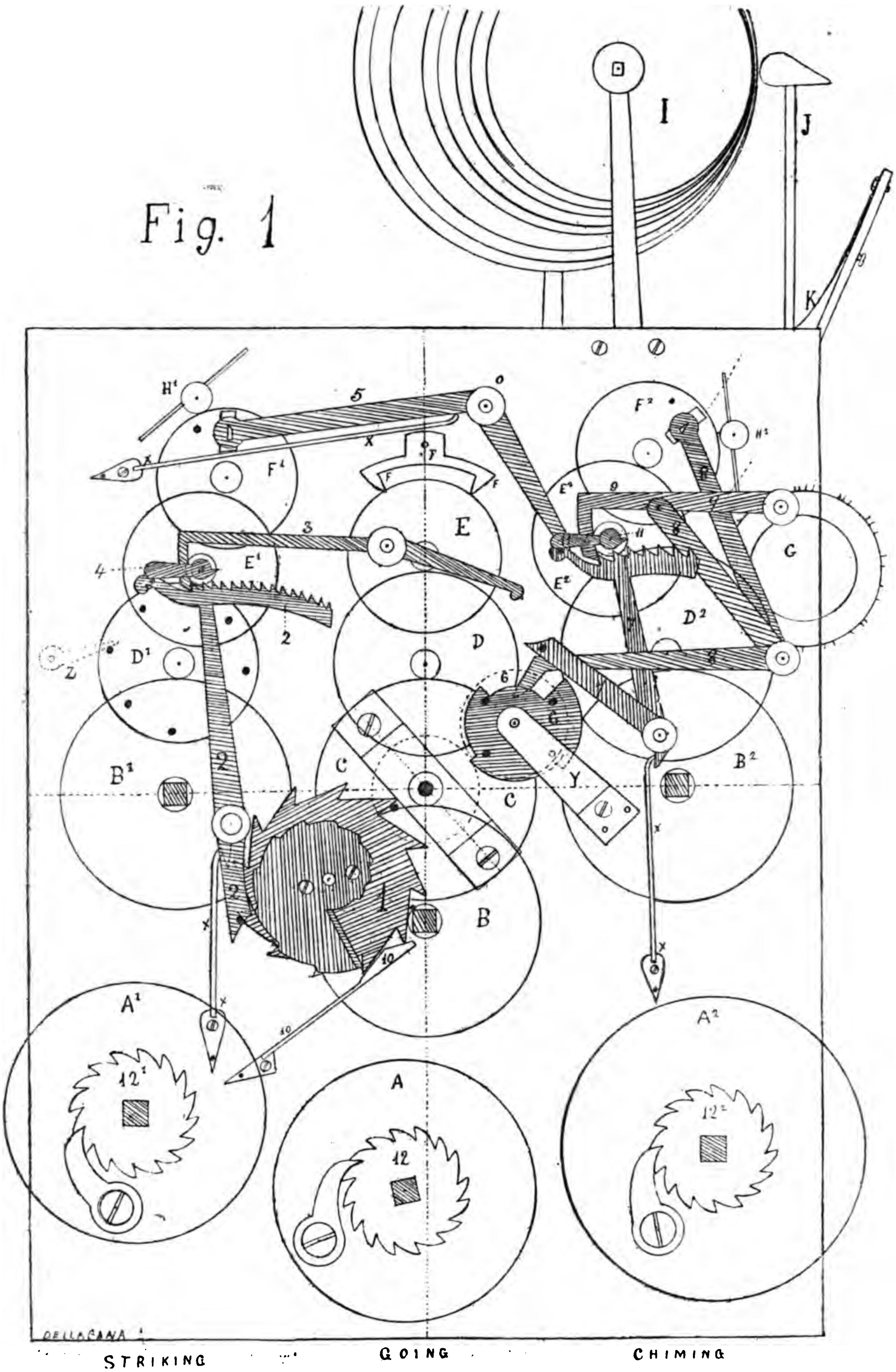
The warning-wheel gears with the "fly" H$^1$, which, offering a resistance to the air as it revolves, prevents uneven striking, and regulates the speed of the train. This completes the striking train. Fig. 5 shows the fly.

In the chiming train, the next wheel to the fusee is the "second wheel" D$^2$. This drives the chiming-drum G, with pins like the barrel of a musical box, operating the tails of the hammers J, which strike the chiming bells I. K are springs keeping the hammers in position. The second wheel, D$^2$, also drives the pallet-wheel E$^2$, similar to the pallet-wheel of the striking train. This drives the warning-wheel F$^2$, also similar to striking-train warning-wheel. This in its turn drives the fly H$^2$, answering the same purpose as fly H$^1$.

It may here be said that the wheel-axles in clocks are usually called "arbors," and will be so spoken of in these papers.

Turning now to the striking and chiming mechanism, we find that the centre-wheel arbor comes through the front plate of the clock, and carries the "cannon pinion" friction-tight upon it. Clockmakers call this the "minute-wheel," but as the wheel it drives is also called the "minute-wheel," for the sake of simplicity we will refer to it as the "cannon pinion," as it would be called in a watch. Over the cannon pinion is a bridge screwed to the plate, with a pipe in the centre, through which the hollow cannon-pinion arbor passes freely. The cannon-pinion gears with the minute-wheel 6 (Fig. 1), held in position by a brass cock Y. The minute-wheel has as many teeth as the cannon pinion, and consequently revolves at the same rate, once an hour. The minute-wheel has a pinion, which drives the hour-wheel, said hour-wheel having twelve

Fig. 1


I
J
K
H¹
H²
5
o
x
F
F¹
F²
E
E¹
E²
3
4
2
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D¹
D²
Z
G
6
8
9
11
B
B¹
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12¹
12²
DELLAGANA
STRIKING
GOING
CHIMING

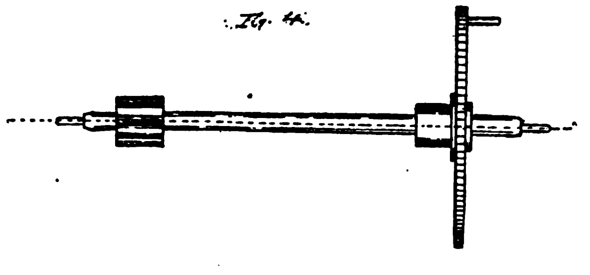


Fig. 4.

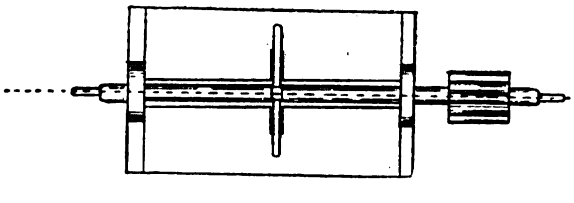


Fig. 5

many teeth as the pinion which
It, therefore, revolves once in
ours, and carries the hour-hand.
-wheel has a pipe centre, which
ily on and around the bridge and
nd E (Fig. 6). The hour-wheel is
in Fig. 1, for the sake of simplicity,
nothing to do with the striking,
or going mechanism. Fig. 6 shows
what complicated arrangement of
annon pinion, bridge, and hour-
c. A is the plate, B the centre-
or projecting through it, C the
inion, friction-tight upon it; D the
d E the pipe screwed to the plate;
minute-wheel, and G the hour-
I is the minute-hand, and I the
d. The dotted line shows where
hould come.
ng again to Fig, 1, on the front of
plate is mounted a flirt wheel, 1,
sition by the steel piece 10. This
el has twelve teeth, and is
und one tooth at every revolution
non pinion by a pin in the latter,
the figure, but not lettered. The
ng the flirt or star wheel presses
steel piece 10, which is held against
by a spring. The steel piece 10
keeps the star wheel steady, but
pletes its forward motion after the
non pinion has driven a tooth over
ting angle. The star wheel carries
l," which determines the number of
be struck. The snail has 12
its circumference, regulating the
which the rack 2 can fall. This
voted to the plate towards its lower
is held constantly against the snail
g X, except when prevented by the
3. That is, when the hook 3 is
e rack falls till a pin in its lower
on a step of the snail. When this
upon the highest step of the snail,
an only fall a distance equal to one

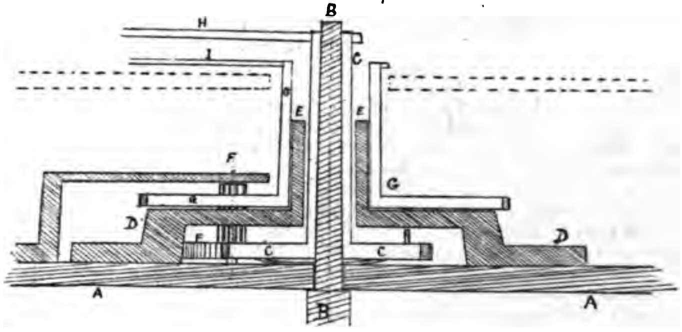


Fig 6

tooth in its upper part; while when the pin falls upon the lowest step of the snail, the rack is allowed to fall a distance equal to 12 teeth.

The pallet 4 (Fig. 1) shown larger in Fig. 7, is really a pinion of one tooth, having a wing attached to it opposite this tooth. The tooth is for gathering up the rack, and the wing stops the pallet and pallet-wheel when the rack is all gathered up. The pallet is fixed on the projecting arbor of the pallet wheel, as before stated. In Fig. 7 A is the project- pallet-wheel arbor, B the tooth of pallet, C the wing, D a portion of the rack it gears with, and E is the pin upon which the wing C will come to rest when the last tooth is gathered up.

The pallet engages with the teeth of the rack in the direction of the arrow, and, as will be seen from the figure, lifts it one tooth at each revolution. This is termed the "gathering" action. The hook 3 (Fig. 1) holds the rack as the pallet gathers it up. It merely rests upon the rack teeth with its own weight, and allows the teeth to pass under it in their forward motion, but prevents them returning. The hook is not shown in Fig. 7 for the sake of clearness in showing the action of the pallet. The gathering action continues till the rack once more assumes its normal position, when the wing C (Fig. 7) is stopped by the pin E in the extremity of the rack. The number of teeth in the pinion on pallet-wheel arbor, and those in the pin-wheel which drives it are so proportioned, that for every revolution of the pallet, the hammer, operated on by the pins in pin-wheel, gives one blow on the gong. Thus, when the snail allows four teeth of the rack to fall, and the pallet gathers them up again, the hammer in the mean time delivers four blows on the gong.

The steel piece 5 (Fig. 1) is pivoted on the plate at O, and has a projection at its upper end, which passes through a slot in the front plate, and when the piece is raised slightly to the extent of the slot, stops the pin in the warning-wheel, which revolves just behind the plate. When the striking train is brought to rest by the wing of the pallet resting on the pin in the rack, this pin in the warning-wheel is furthest away from the slot in front plate. By means of the spring X, the piece 5 has a constant tendency to rise and stop the pin in warning-wheel, but is kept from doing so by a pin in the chiming-rack 7, engaging with its tail-end and holding it down, only allowing it to rise when the chiming-rack 7 is dropped.

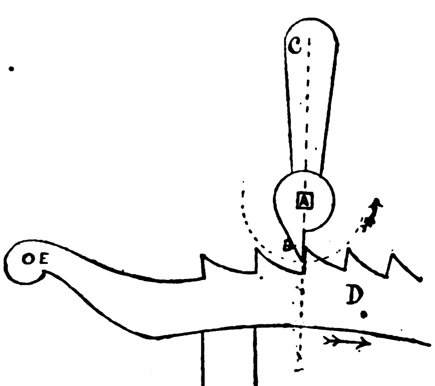


Fig 7

Now as to the chiming mechanism. The minute wheel before mentioned, which gears with the cannon pinion, has four equidistant pins projecting from it, shown as dots in Fig. 1. It also carries on its arbor the snail 6, having four steps, against which the tail of the chiming-rack 7 falls, after the same manner as the striking-rack, as will be readily seen from the figure. It is evident that one pin on the minute-wheel will raise the lifting-piece 8 every quarter of an hour. This lifting-piece is pivoted near the edge of the plate and has two arms extending upwards, rigidly fixed to it. One, the uppermost, has a projection going through a slot in the plate, and engaging with pin in warning-wheel $F^2$ in the same manner as in striking train. The other arm, when raised, lifts the chiming-rack hook 9 and lets the rack fall. 11 is a gathering-pallet similar to that in the striking train. The steel piece 8, with its three arms, has a natural tendency to fall with its own weight, as has also the rack-hook 9. The rack, when released, is made to fall against the snail by a spring X acting on its lower end.

Now let us carefully consider what happens when, by the going of the clock, the minute wheel, by one of its pins, raises the arm 8, say, at the first quarter.

As the arm 8 rises, it lifts the rack-hook 9, and lets the rack fall upon the highest step of the snail, and consequently to the extent of one tooth. The pin in rack, dropping away from beneath the wing of the pallet 11, the latter begins to revolve. But in the mean time the upper arm of 8 has blocked the path of the pin in warning-wheel just behind the plate. This pin, therefore, comes in contact with the arm, and the train once more comes to rest. This is the "run" before mentioned. The pin in the minute wheel, slowly continuing to advance, at last passes the arm 8 which it lifted, and lets it fall once more. This at once releases the warning-wheel, and the chiming train is free. The pallet, revolving, gathers up the rack, and the wing comes to rest on the pin once more, having made a complete revolution. This one revolution of the pallet-wheel has been sufficient to allow the chiming cylinder to revolve and chime the first quarter. The same occurs at each quarter, one, two, three, and four teeth of the rack respectively having to be gathered up before the train comes to rest. So much for the chiming.

But in chiming the last quarter, something else happens also. When the chiming rack falls its greatest distance (four teeth), it falls against the tail-end of the striking-rack hook 3 (Fig. 1). This releases the striking-rack, which falls so many teeth, according to the position of the snail. The pallet 4 is also released, and the "run" of the striking train takes place till the pin in warning-wheel F¹ stops against the arm 5, projecting through the plate, which has been allowed to rise and stop its path through the falling of the chiming-rack. The discharging-pin in minute wheel continues its course, and lets the arm 8 fall again, the fourth quarter chimes are struck, and as the last tooth of the chiming-rack is gathered up, the arm 5 is pulled down by the pin acting on its lower end, and the warning-wheel of the striking-train is released. This train is then free to run; the pallet gathers up the rack, the pin-wheel operating on the hammer once for every revolution of the pallet till the rack once more regains its normal position, and the wing on the pallet comes to rest again on pin in striking-rack.

This action should be most carefully studied. At first sight it most likely looks a very complicated mass of wheels, levers, and racks; but if the foregoing is read carefully, and the figures referred to constantly, it will soon be thoroughly understood.

The construction of the whole of this mechanism will now be described piece by piece in a manner which, I trust, will enable amateurs to put together a thoroughly reliable and serviceable clock.

Those of my readers who are watch or clockmakers will see, as the description is proceeded with, that in many operations methods are described which they would not think of adopting. This for various reasons. First, the amateur does not possess special tools; secondly, in the ordinary run of mechanical work he has got used to certain methods of doing things, and making his lathe as near as possible a universal tool. In these papers I will, therefore, endeavour to describe ways and means within the power of the average amateur, and the ordinary run of tools to be found in his workshop. Thirdly, for a great many operations, familiar enough in the trade, makeshift ways are given, to which his unaccustomed hands will lend themselves more readily.

The clock, again, is not an exact copy of the everyday quarter chiming clock, but differs in several minor details. To sum up, these papers are written for *amateurs*, to whom, I trust, they will prove of service.

## ETCHING GLASS.

WHAT is stated to be an improved method of etching upon glass has been patented in this country by Messrs. B. Z. Meth and H. Kreitner, of Berlin. It differs from the older methods, in the fact that the etching is accomplished by a cold process with the aid of rubber stamps, the etching of such articles as bottles, lamp glasses, glass plates, and similar objects being considerably accelerated, and the cost of treatment reduced. In carryiug out the process, an etching solution is prepared in the following manner:—10 grammes of pure fluoride of ammonium, ½ a gramme of common salt, and ½ a gramme of carbonate of sodium are well pounded up in a porcelain mortar, and mixed in a gutta-percha bottle with 4 grammes of highly-concentrated fuming hydrofluoric acid and 2 grammes of concentrated sulphuric acid; the bottle being well shaken. In a separate vessel, made of lead, ½ a gramme of crystallised fluoride of potassium is dissolved in 1 gramme of common muriatic acid heated in a hot-water bath. Of the latter mixture 1 gramme is added to the mixture previously prepared; the contents of the bottle being again agitated and mixed with two drops of silicate of sodium and 1 drop of spirits of sal-ammoniac. A small quantity of the etching solution thus formed is dropped upon a sheet of indiarubber covered with a cloth pad, which is rubbed until almost dry; whereupon, by means of an indiarubber stamp, bearing the design to be reproduced, a portion of the liquid previously absorbed by the pad is transferred to the surface to be etched, with the result that the design is eaten out. Should a deposit be formed in the guttapercha bottle in consequence of the etching solution not having been used for some time, such deposit may be dissolved by hydrofluoric acid.

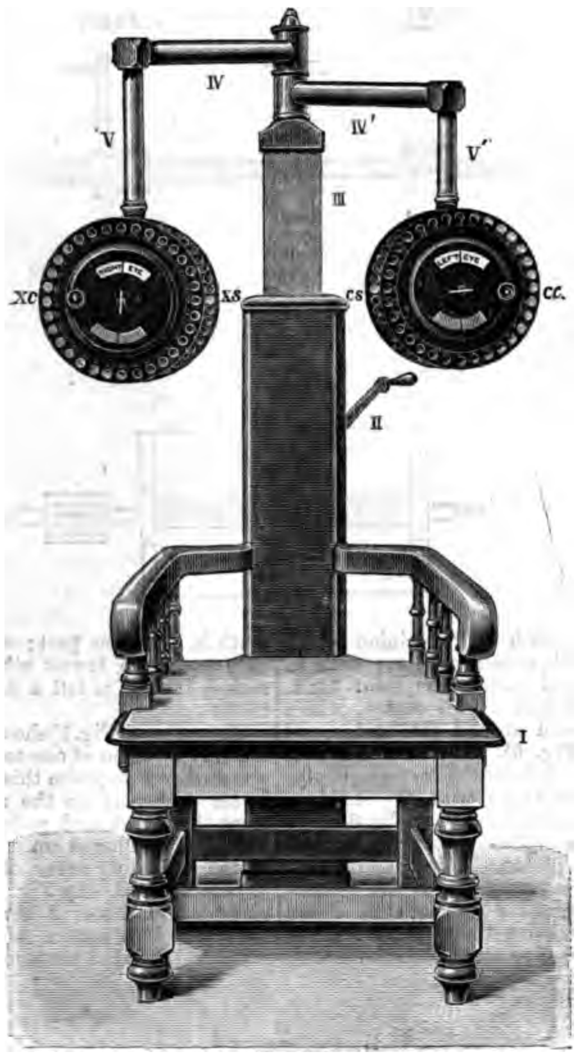


FIG. 1.

## FOURNET'S COMPOUND OPHTHALMIC REFRACTOMETER.

IN the engravings annexed we illustrate the compound ophthalmic refractometer devised by Mr. A. Fournet, of 18, Bentinck-street, Welbeck-street, London, W.

The physical changes ever in process in all eyes, are shrinkage of the globes and growth of the crystallines. This process, common to all individuals, produces a progressive disturbance in the sight beheld, the sight or view to be seen being more or less accurately focussed at one period as compared with another period, without be it understood, the power of Sight—or the light nerve—the retina, being reduced or enfeebled. The immense area embraced by so small an organ as the eye is achieved by the "reversed minification" of the light-obstructing scenery—the visible being visible in light only, that the view beheld or the objects seen, be of their real size in an expanse or space that forms an unartificial perspective. "Reversed minification," but more properly "convergent refraction," as produced by those natural condensers, the crystallines, is the reason that we see the world its right size by an inverted retinal image—to see as much being an impossibility by other means: were the eyes as flat mirrors, but little superficies could be seen at a time. If more superficies could be obtained, an artificial perspective would have to be c as by a diminishing glass—"divergent refrac How small, in such a case, the reality have to be made, the size of the eye ind Therefore, refraction of the eye implies "c gent refraction." The shortness of the c gence, the point at which the focus has formed for the eye to see, the size of the sufficiently shows. Thus, the amount s visible matter to be seen with a given se seeing, a given retina, entirely depends refraction of the optic apparatus of the eye

If the optical apparatus is too converg the internal diameter of the eye, the reti only receive impressions of images, when images have been approached sufficiently the approachment producing the increase of of focus required. The organ, here, havi much natural convergence, is plus (+), endow such an eye with the power of r nature in the far distance, in other wo make use of all its stock in trade for that excess of natural convergence must b ficially neutralised by the same amou "divergent refraction" represented by cáve lens (s –).

The condition by far the most prevalent i opposite to excess of convergence—insuffi of convergence is most general. Alone, th cess of physical changes condemns all ey disturbance of refraction, and that, in th versal direction—namely, decreasing conve which means, a convergence ever creeping and farther away. The focus of the apparatus of all eyes is ever increasing—a lens means a longer focus—and a shr globe, less depth than before. This p change is so marked that an uneducated sight or myope notices his range of visio increasing. This fact points that if intel man is to keep his convergence always the index of his retina, he is, perforce, dest wear glasses during the major portion of h An eye with insufficiency of convergence i pelled into a muscular straining, and a ding waste of nervous power, to see at all, be it in the distance, the exercise of accomation being compulsorily displaced for that ose. Insufficiency of natural convergence for the constant wearing of that amount of cial convergence which compensates for the ral deficiency to arrest wasting of nervous r and to focus better. Where the conence isminus (−) the lens must be plus (s+).

fitting the eyes with glasses, age is a dary question, the state of the natural conence being the primary one, as, by reason e initial errors of refraction, the lenses to be might have to be weaker or stronger than laid down by the rule of a given power for en age.

r. A. Fournet, author of "Is Bad Sight on Increase?" "The Philosophy of Sight," Bentinck-street, Welbeck-street, London, invented the compound ophthalmic refractor, by means of which the eyesight is tested out using drops of belladonna or atropine.

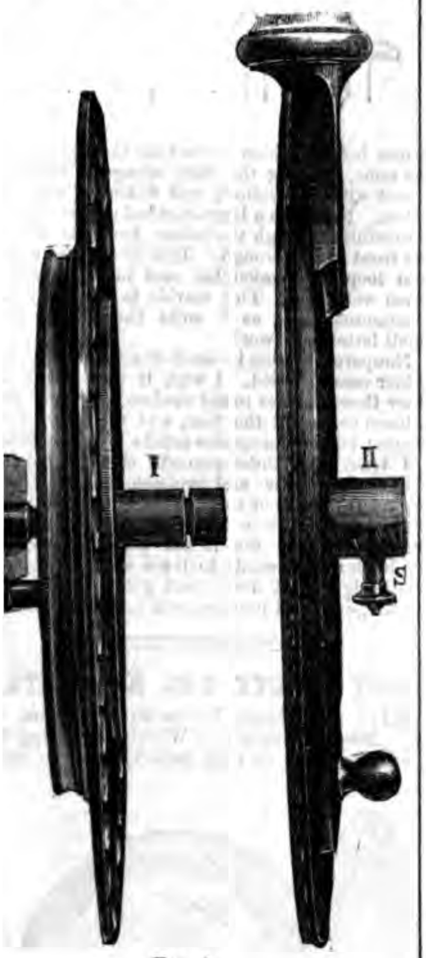


FIG. 2.

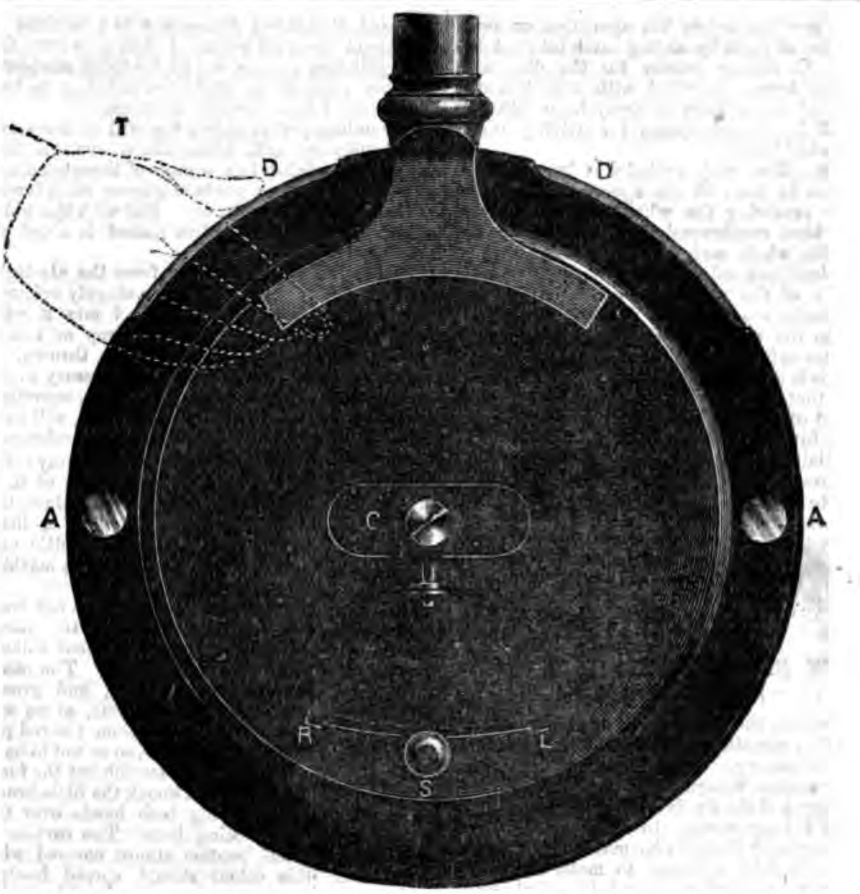


FIG. 3.

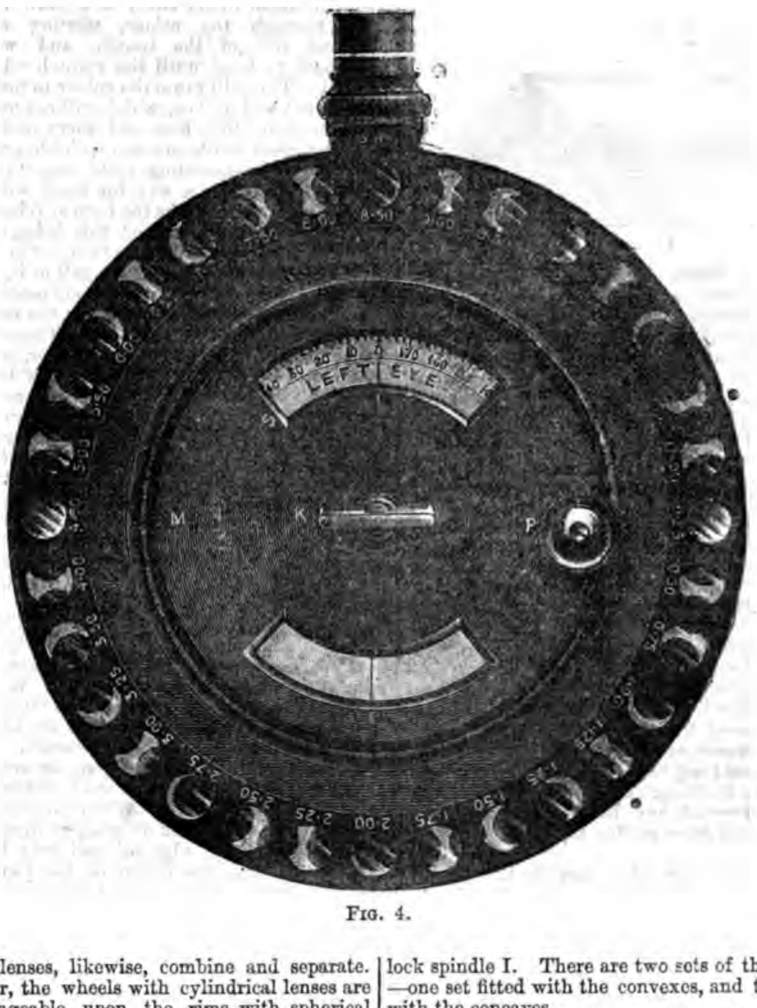


FIG. 4.

instrument is distinct from an optometer, ast serving to measure the limits of vision, t the refractometer determines the lens or ination of lenses required for distance-, in order that the correct computation for ng or working glasses may be obtained.

. 1 represents the instrument, in the chair hich the patient may sit comfortably. A ton spectacle-frame, having a black plate in f the eyes, leaves him the other only to see The apparatus being raised by a crankle to the level of the eye, he may now look gh one of the holes A A′ of Fig. 3 at test on a wall opposite him. The operator g the patient can, at his will, bring before hole that is being looked through any rical lens, or cylindrical lens, or combination of, with perfect command, ease, precision, apidity. I. Chair; II. Shaft and crank; III. ting pillar; IV. IV′. Brackets with right left lateral motion; V. V′. Pivoting susrs; X. S. Convex spheric lens for hypermea; X. C. Convex cylinders for hyperpic astigmatism;—these two sets comand separate as required; C. S. Conspherics for myopia; C. C. Concave ders for myopic astigmatism. These two sets of lenses, likewise, combine and separate. Moreover, the wheels with cylindrical lenses are interchangeable upon the rims with spherical lenses for the determination of mixed astigmatism.

Fig. 2.—I., wheel with cylindrical lenses; II., spherical lenses and screen; S, spring bolt to lock spindle I. There are two sets of these discs —one set fitted with the convexes, and the other with the concaves.

Fig. 3 (from the patient's side.)—A A′, apertures for vision (the right eye at the left hole, and the left eye at the right hole); S, sliding spring-latch for locking the series of spherical lenses in position before the apertures, or away from either of them by sliding catch into notches R or L; C, sliding carrier for the disc with cylindrical lenses, provided with a click to stop in front of vision holes or away from either of them; D D′, thumb spaces for driving round the spherical lenses.

Fig. 4.—Disc with cylindrical lenses locked in position in front of the spherics. M, milled head for revolving the whole disc; P, pinion, free to turn continuously in either direction, causing the whole series of lenses and a divided dial to simultaneously rotate on their axes independently of the revolution of the disc itself. The cylinder's axis of all the lenses being adjusted to the centre of disc or wheel; as each lens comes before the vision holes the inclination of its axis is as indicated by the dial, the variation of that angle being instantaneous for the whole set of lenses. The reading of the circle being in inverse direction for the two eyes, the divideddial is only partly exposed, K being the key to a movable shutter engraved for designating the eye to which the divisions belong. I I′, indices to the divided dial.

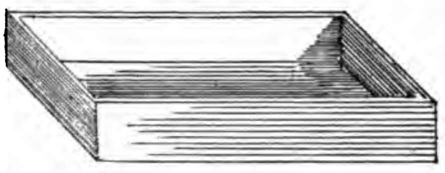
The instrument is patented in England, France, Germany, and the United States of America. It obtained the Silver Medal at the Paris Exhibition, 1889.

## HOW BOOKS ARE BOUND.—IX.

By "Practical Bookbinder."

To perform the operation of marbling successfully, certain tools and pieces of furniture will be necessary. The set-up will comprise a shallow wooden trough (Fig. 27); it need not be very large, and the size is of no consequence, provided it is large enough to take the foredge of the largest book likely to be marbled (of course, it would be false economy to make the trough small for the sake of small books); a little round stick, a few marbling combs of different widths (Fig. 28), a number of jam-pots, each provided with a little brush, for holding the colours, a bottle for ox-gall, another for spirits of wine, a large earthenware dish or a zinc pail for mixing size, a sieve, and a bunch of canes or birch rods, a stone slab and muller for grinding a little colour when necessary. This completes the outfit; but a few other things may be necessary, and can be added as the need for them arises.

FIG 27



The size is the first thing to think about, as this has to be prepared by the workman. It is made from gum tragacanth, which is commonly called "gum dragon," and water. In former times marblers were accustomed to set great store upon the water used for this purpose; they thought that rain or distilled water would only suit, but the ordinary town water serves the purpose well enough. Put a few handfuls of the gum in the pail and fill it up with water and leave it to steep over night; in the morning it will be very soft and nearly all dissolved. Take the canes and stir it well until the gum is completely dissolved. It may be too thick: if so, it can be thinned by adding more water. The proper thickness can only be got at by experience; it should not be much thicker than buttermilk. Pour it through the sieve into the trough. This will prevent any little hard undissolved lumps of gum from getting in, which would be troublesome.

The next thing to think about is the colours, and these can be procured already ground in air-tight jars from Messrs. Berry and Roberts, St. Bride-street, London. The colours used for marbling are all vegetable colours, and not long ago we used to get them dry from the colourman and grind and mix them ourselves; but this was a most wasteful process, and the time and labour expended were something enormous. When it became known that marbling colours could be supplied ready mixed, bookbinders were delighted. The colours are so cheap and so well prepared, that it is a shame now to a marbler if he cannot do good work. I will pass over the hand-grinding process, my advice to all marblers, whether amateur or professional, being to buy the colours I have already mentioned.

For ordinary work only a few will be necessary—for instance, red, blue, black, orange, and yellow. By mixing two or more of these together, you will be able to produce greens of different shades—brown, purple, &c. But with the addition of the green, the first named is about all that is used.

Take a little of each colour from the air-tight jars and put it into the jam-pots already referred to (one pot for each colour), and mix it with water (it must be very thin), a drop or two of ox-gall, to cause it to spread when thrown, or placed upon the size. It will be necessary to put more or less gall in some of the colours, according to the pattern wanted. This, of course, will have to be decided upon while preparing the colours.

We will suppose now that all is ready: the size is placed in the trough, the surface of it is free from bubbles or spots of dirt or dust, the colours are ready mixed in the pots, a little brush is placed in each pot, the gall bottle and spirits of wine are standing by, and the marbler has his wits about him.

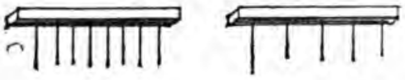
The design which we want to put on our book edges is called "blue spot." As the name implies, the blue is the most prominent colour, therefore we will leave it to the last. The other colours are generally red, yellow, and green. We will make red the bottom colour, so we will proceed by taking up the brush from the red pot and shaking it against the sides, so as not to have too much colour in it. Now stretch out the fore-finger of the left hand, and knock the little brush against it, quickly moving both hands over the trough while this is being done. The surface of the size will thus become almost covered with red colour (this colour should spread freely). Take the yellow brush and repeat; this colour should not spread so much as the red, neither should so much of it be sprinkled over the trough. Take the little round stick, and draw it carefully through the colour, starting at the left-hand side of the trough, and working from back to front until the right-hand side is reached. This will cause the colour to form into lines of red and yellow, which will not mix, but run into each other here and there as desired. Take the green brush now and sprinkle a number of large easily-spreading spots over this; the green while making a way for itself will cause the red and yellow to take the form of veins. The next thing is the blue, and this being the top colour should not be quite so thin as the others, and there must not be too much gall in it, otherwise it will look pale, and the spots will be too large. Sprinkle this colour as directed for the rest, and take care not to put on too much. There should be another pot standing by with water, and just one or two drops of gall in it, and a brush of course. Take this brush now and squeeze it well out, and place it between the thumb and fore-finger of the left hand, allowing only about half an inch of the hair to project beyond the fingers, strike this projecting hair upwards with the fore-finger of the right hand, and move the hands over the trough as before; this will produce a series of small white spots upon the edge when the book is dipped in; of course they must be very small, or we should have to name our design white spot.

The next step is to dip the books. These are of course standing ready, the three edges have been cut, and in some instances the back will be rounded, and the boards laced in. Whatever condition they are in, the foredge is dipped first. If the book is rounded the boards are lifted out of the joint, and the foredge is flattened. A pair of rough boards kept for the purpose are placed one on either side, to protect the book itself from being injured by the size. When this precaution is carried out, the book is grasped firmly with both hands, and the edge allowed only to come into contact with the colour on the top of the trough. It must not on any account be dipped too deep, for the size will run in between the leaves and cause no end of trouble. As soon as the edge has been dipped the book is laid down and a little water poured over it to wash the surplus size from it. Sometimes blowing a blast from the mouth will remove the size, and, of course, there will be no need of water. I have seen marblers take a little water in their mouth and squirt it over the edge. These are, of course, only different methods to produce the same result—i.e., cleaning the edge, which must be done while it is wet, and only experience can decide which method is best.

After one edge has been dipped the colour is scraped from the top of the size with the wooden scraper, and fresh colour laid on, always working the same way for the same design. There are, of course, a great many marbles, each one as different from the other as can be, and each having a distinct name. The marble described above can be easily varied by using the colours a little differently, for instance, making green the top colour instead of blue. In this case we would have green spot. The most common marbles are the Spanishes (which are termed blue Spanish, red Spanish, and so on, according as one or other colour predominates), Dutch, and Nonpareils.

To make the Dutch marble, begin by taking up the red brush and drawing it sharply across the size from left to right three or four times, thus making as many strips of red colour with spaces between them; now take the blue and do the same, putting the blue alongside the red; repeat with the yellow, and finish up with the green. Now take a large-toothed comb and draw it carefully through the colour from the back to the front of the trough. This draws the colour into loops or semicircles, and looks very nice when well done. This marble is generally put on account books, as it suits them better than small letterpress work.

FIG. 28

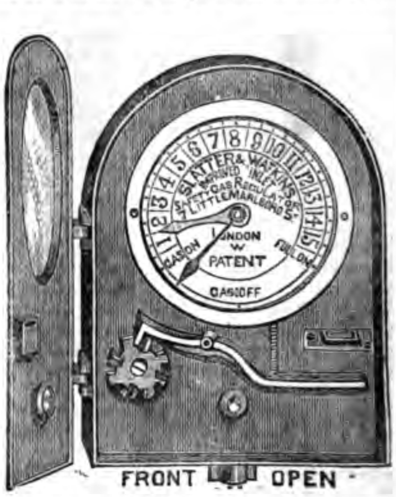


Nonpareil is done in much the same way, only a finer comb is used. I wish it were possible to show these marbles to my readers. I would give a dozen or two of the best, and also give their names; but in a magazine article it is impossible.

I trust that these remarks will be helpful, both to amateur and professional. Whoever begins to marble or to learn to marble will find that he will make a few mistakes at first; but there is nothing for it but perseverance, and the binder who wants to learn should set up a small rig-out at home, and get the necessary colours, etc., and practise until he is perfect.

## INLET SAFETY GAS REGULATOR.

This is a simple but useful invention by Messrs. Slatter and Watkins, enabling the head of a house or large establishment to check and regulate the inlet of gas from the main before it enters the meter, and to prevent anyone turning on the gas fuller than necessary for the sufficient illumination of the building. This is done by means of a stud on the ordinary regulator wheel, which enters a slot on a spur wheel, which is called the "stop wheel." The shaded hand on the dial, shown in the cut, marks at what point the supply is to be checked; when the shaded hand is at that point the gas inlet cannot be turned on further than will bring the black indicator hand level with the "stop" hand. The stop action is worked by the rack wheel on



FRONT OPEN

t below the dial, the dial-hand indicating ult of the movement. The door can, of be kept locked after setting the regulator, › prevent its being interfered with.

## THE REEVES PULLEY.

Reeves Pulley Company, of Columbus, ıdiana, U.S.A., have patented, through ;ent, W. P. Thompson, an improvement len split pulleys, the object of which is to in this class of pulleys for each of the ıs forming the pulley, a light and strong ical cross-bar, having its ends so secured im as to be practically inseparable there- ınd presenting, at its centre, a large surface for grasping the shaft and ing an opportunity for strongly clamping ›ss-bars of the two sections strongly r. Fig. 1 represents a side elevation

Fig. 1.

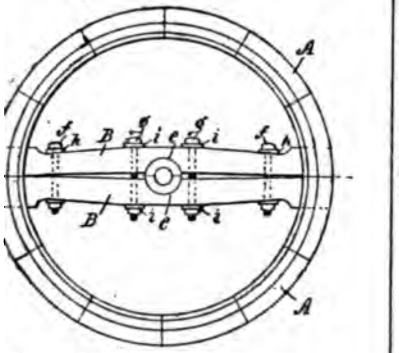
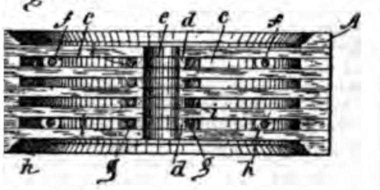


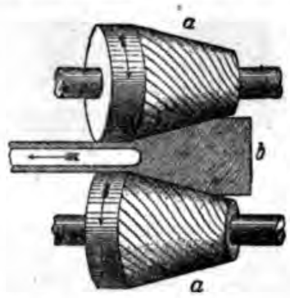
Fig. 2.



ɜntire pulley; Fig. 2 represents a plan, .ne *a*, Fig. 1, of one half of the pulley. n A is built up in two semi-circular of a series of annular wooden segments, thicknesses being secured one upon the › form the width of face required, in the anner. B B B B B is a series of thin flat .rs, having their ends built into the rim forming a part thereof in such a manner cross-bars connect the two ends of the forming the half-rim, and are arranged side with open spaces, *c c*, between them. ʼeral cross-bars, B, are connected, mid- ;ween their ends, by short blocks, *d d*, together with the edges of the cross-bars, ›olid continuous surface, in which is cut l semi-cylindrical groove, *e*, adapted to a shaft or bushing. The edges of the .rs B are slightly hollowed, so that, when sections of the pulley are put together a complete circle, the opposed edges of sets of cross-bars are slightly separated ›entre. The two sections forming the ıre strongly clamped together by means es of bolts, *ff*, and *g g*, arranged in the › between the several cross-bars, and through washers *h* and *i*, arranged on r edges of the cross-bars. By this con- ı a light and strong compound cross-bar d, the strength of which may be adapted work required in different pulleys, by more or less of the bars B into the series. ›earing surface on the shaft, with light- naterial, is provided, and the boring of hrough the cross-bars to receive the g bolts is avoided. In operation, the ing of sufficient diameter to closely fill ral opening formed by the grooves *e* of sed pair of compound cross-bars, or being l with the usual well known split bushing, ıller diameter, the two sections forming ɜy, are secured together and to the shaft, the bolts *f*, passed through the spaces *c* the bars B of both sections, near their outer ends, thus drawing the ends of the rim sections closely together, and then by bolts *g* passed through the spaces *c* near the middle of the bars, clamping the middle of the bars (which, by reason of their edges being hollowed, yield slightly) strongly upon the shaft. A compound diametrical cross-bar as applied to a pulley formed in two separable sections has been described; but, in some cases, it is not desirable to have the rim separable, in which case the ends of the cross-bars are built into the rim in the same manner, but the segments of which the rim is composed are arranged so as to break joints over the meeting edges of the cross-bars, thus making a whole pulley, which is clamped to the shaft in the same manner by the central bolts *g*.

## SEAMLESS TUBES FROM SOLID BLOCKS OF METAL.

IT has long been possible to mould iron and steel like wax under the steam hammers of our factories, but it would seem incredible to even the modern engineer that these substances could be as easily handled as they are now, thanks to this new invention. What was Vulcan's forge compared with the art of the present day? Heretofore, when tubes were to be produced, the glowing metal was rolled into sheets between two hard rollers which worked parallel to one another, and then these sheets were riveted or soldered. If special strength was desired, the tubes could be bored or rendered more durable by being galvanised. Several years ago it was rumoured that tubes had been successfully rolled from the block, and that tubes made in this manner had a resistance five or six times as great as that of tubes made in the ordinary way. This rumour was received with great incredulity, which was strengthened by the fact that the article did not appear on the market. Now the inventors, the Mannesmann brothers, have come before the public with their perfected method, and at one blow the technical possibilities of construction have been greatly increased.



THE MANNESSMANN PROCESS.
*a a*, the rollers; *b*, the block of metal.

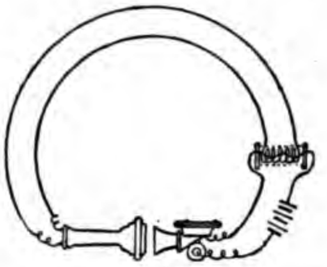
In the Mannesmann machine the rollers are provided with spiral grooves, and ridges are placed at angles to each other. Their movement is in different directions, causing shoving and turning of the red-hot metal bar placed between them, and when these impulses are thwarted, the surface of the bar is carried along, leaving the centre or core stationary. The "skin" of the bar is literally "drawn over its ears," and thus the tube is formed. It is possible to make tubes which are closed at both ends, and it has been ascertained that such tubes contain a gas formed of a mixture of hydrogen and 1 per cent. of nitrogen, which must have been pressed out of the iron.

The structure of the Mannesmann tubes is very peculiar, and the metal is treated in such a manner as to greatly increase the cohesion of every part. After repeated experiments, it has been calculated that this new material will stand a pressure of 4,000 atmospheres—that is, each square centimètre of the tube can sustain a pressure of 4,000 kilogrammes (about 8,000lb.) The machine operates with crushing strength. The inventors have succeeded in constructing flywheels which store up from 8,000 to 10,000H.P., which, when the brakes are applied, is given off again in 30 seconds, this being sufficient time for the completion of a 2in. tube 4 mètres long. The metal is kneaded like a soft mass, and there is no form that it cannot be made to assume.

The applications of the Mannesmann material are very numerous, and will make many changes in present technical methods, for it will be apparent to even the laity that these light tubes, to which any desired form can be given, and which retain the strength of a bar of metal, will admit of constructions which formerly seemed impossible. Thus an entirely new field is opened to bridge builders, who have found it difficult to obtain material which was sufficiently light, and at the same time had the requisite strength for long spans. The new method will also be a great aid to progress in the manufacture of weapons. We rejoice that this discovery is the work of Germans, for we are often classed among the dreamers, and here is a truly practical invention.—*Ueber Land und Meer.*

## A CURIOUS TELEPHONE EXPERIMENT.

SOME weeks ago, while Messrs. Hibbard and Pickernell, of the American Telephone and Telegraph Company, were experimenting on a line between Ithaca and Cortland, New York, the following curious action between the telephone and a long-distance transmitter was noticed. Mr. Pickernell was engaged in talking on one pair of wires, while Mr. Hibbard was listening on another pair on the same pole line, 20 miles away. Both circuits were equipped with transmitters and receivers. Mr. Pickernell's voice came in on circuit No. 1 by direct transmission so as to fill the room, and, in fact, made such a noise that Mr. Hibbard was unable to listen for traces of induction on circuit No. 2. Doubtless the patrons of the long-distance service will appreciate such obstreperous transmission; but in this case the receiver on circuit No. 1 must be strangled, or the test could not go on. To do this Mr. Hibbard placed the offending receiver against the mouthpiece of the transmitter on the same circuit, so as to close it up and prevent the escape of Mr. Pickernell's voice into the room, when, lo! a shrill and sustained musical note of high pitch was emitted, which drowned all other sounds. The pitch varied occasionally through an octave, but was exceedingly uniform in volume, and did not break while the telephone was held against or near the transmitter. The explanation of this action is as follows:—



The vibrations starting in the transmitter actuated the telephone through the primary and secondary circuits, the telephone throwing the impulse back to the transmitter through the air volume separating the two instruments, the transmitter reacting as before, the impulse acting with sufficient rapidity to form a musical note.

We believe this is the first recorded observation of "back talk" between a telephone and transmitter. The energy for maintaining this action is stored up in the battery, which must be in good condition. The accompanying diagram shows the simplest method of accomplishing this result.—*Elec. Review.*

## THE "THERAPEUTIC" SMOKING PIPE.*

THIS improved form of smoking pipe is introduced to the notice of the medical profession primarily to provide a means of combating the smoker's habit, and to do away with the injurious element in it to which its baneful effects are due, by abstracting the noxious constituents of tobacco smoke, whilst leaving the aromatic principles unaffected, thereby making it available for daily use by delicate or invalid smokers, to whom total prohibition would often be little short of a punishment. The so-called "smoker's heart and concomitant cardiac troubles," "smoker's amaurosis," "smoker's sore-throat," and other laryngeal, pharyngeal, and nasal diseases exemplify this, and I have no hesitation in saying that such cases may be permitted the use of their tobacco from this pipe at a time when possibly it could not be allowed from any of the kinds with which I am acquainted. Secondly, the pipe may be made useful as a means of turning to practical account, and utilising the habit of smoking as an adjunct to treatment by inhalation of volatile medicaments, so that the vapour of the remedy employed may be directed to the affected surfaces. Tobacco smoke is a mixture of several volatile ingredients, the chief of these being (*a*) the volatile liquid alkaloid nicotina or nicotine, which is "a colourless oil at ordinary temperature, but volatilises at 480° Fahrenheit" (Garrod); (*b*) a volatile oil nicotianin or tobacco camphor; (*c*) volatile aromatic principles; (*d*)

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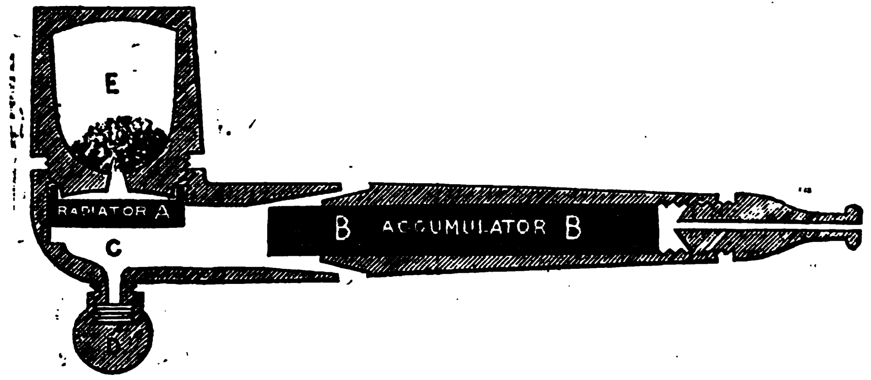
* By C. W. JONES, M.B., Bowdon, Cheshire, in the *Lancet.*



watery vapour. "The action of smoking as a nervous stimulant is probably not due to the nicotine itself, but to the stimulus of the smoke on the sensory nerves of the mouth and nares, which reflexly stimulates the vaso-motor centre, and so dilates the vessels of the brain" (Brunton). Hence the desirability of getting rid of the nicotine. In the "Therapeutic Pipe" principles for removing the nicotine are carried into practical effect. A reference to the diagram will show that the pipe by a modification in the boring is divided into the three chambers E, C, and that occupied by the fitting B B, E being the bowl for tobacco, C a chamber below E, and occupied by the "radiator" A, which is simply a box with a perforated top and bottom, and fits tightly on the bush on the under surface of the bowl by means of a projecting rim. If this box be filled with any fine powder, all the smoke passing through the interstices will come in contact with the particles of powder and be robbed of its heat, which is carried away by radiation through the pipe head. If the powder be a volatile one, this fact is available for therapeutic purposes. The smoke next enters the "smoke chamber" C, where it is further cooled. Thereafter it passes along the tube-like chamber contained in the stem and occupied by the "accumulator" B, B, which consists of a bundle of prepared fibres about 3in. in length, and by the contiguity of the fibres to each other this bundle forms a series of capillary tubes. I have obtained smoke absolutely free from acridity. D is a cup for drainage. Both the fittings A and B are readily replaced by new ones when exhausted, so that a pipe which is always clean is not the least of the considerations to be borne in mind. To make it effective as a therapeutic agent, the patient should be instructed to exhale the medicated smoke through the nose, by which act it is carried into the pharynx. Chloride of ammonium, tannic acid, salicylic acid, benzoic acid, and sulphur have all yielded satisfactory results, especially the first two. Another possible use of the pipe is that of an insufflator, for by taking out the accumulator B, and charging either the radiator A, or the empty stem with the powder to be insufflated, and then without using tobacco, perform the act of smoking, the current set up will carry the powder well back into the fauces, the suction greatly facilitating this. Most of the wholesale chemists will be able to supply all requirements. Messrs. Woolley, chemists, of Manchester, and Sumners, chemists, of Liverpool, already have them with fittings supplied to stated formulæ.

## THE ELECTRO-MAGNET.—III.*

### Generalities concerning Electro-Magnets.

MATERIALS.—In any complete treatise on the electro-magnet it would be needful to enumerate, and to discuss in detail, the several constructive features of the apparatus. Three classes of material enter into its construction; first, the iron which constitutes the material of the magnetic circuit, including the armature, as well as the cores on which the coils are wound, and the yoke that connects them; secondly, the copper which is employed as the material which conducts the electric currents, and which is usually in the form of wire; thirdly, the insulating material employed to prevent the copper coils from coming into contact with one another, or with the iron core. There is a further subject for discussion in the bobbins, formers, or frames upon which the coils are in so many cases wound, and which may in some cases be made in metal, but often are not. The engineering of the electro-magnet might well furnish matter for a special chapter.

### Typical Forms.

It is difficult to devise a satisfactory or exhaustive classification of the varied forms which the electro-magnet has assumed; but it is at least possible to enumerate some of the typical forms.

1. *Bar Electro-Magnet.*—This consists of a single straight core (whether solid, tubular, or laminated), surrounded by a coil. Fig. 3, p. 118, depicted Sturgeon's earliest example.

2. *Horseshoe Electro-Magnet.*—There are two sub-types included in this name. The original electro-magnet of Sturgeon (Fig. 1, p. 118) really resembled a horse-shoe in form, being constructed of a single piece of round wrought iron, about half inch in diameter, and nearly a foot long, bent into an arch. In recent years the other sub-type has prevailed, consisting, as shown in Fig. 9, of two separate iron cores, usually cut from circular rod, fixed into a third piece of wrought iron—the yoke. Occasionally this form is modified by the use of one coil only, the second core being left uncovered. This form has received in France the name of *aimant boiteux.* Its merits will be considered later. Sometimes a single coil is wound upon the yoke, the two limbs being uncovered.

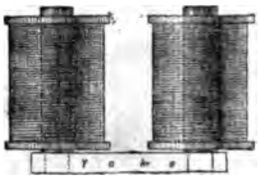


FIG. 9.

3. *Iron-clad Electro-Magnet.*—This form, which has many times been re-invented, differs from the simple bar magnet in having an iron shell or casing external to the coils, and attached to the core at one end. Such a magnet presents, as depicted in Fig. 10, a central pole at one end surrounded by an outer annular pole of the opposite polarity. The appropriate armature for electro-magnets of this type is a circular disc or lid of iron.

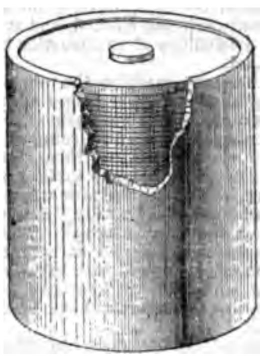


FIG. 10.

4. *Coil-and-Plunger.*—A detached iron core is attracted into a hollow coil, or solenoid, of copper wire, when a current of electricity flows round the latter. This is a special form, and will receive extended consideration.

5. *Special Forms.*—Beside the leading forms enumerated above, there are a number of special types, multipolar, spiral, and others, designed for particular purposes. There is also a group of forms intermediate between the ordinary electro-magnet and the coil-and-plunger form.

### Polarity.

It is a familiar fact that the polarity of an electro-magnet depends upon the sense in which the current is flowing around it. Various rules for remembering the relation of the electric flow and the magnetic force have been given. One of them that is useful is that when one is looking at the north pole of an electro-magnet, the current will be flowing around that pole in the sense opposite to that in which the hands of a clock are seen to revolve. Another useful rule, suggested by Maxwell, is illustrated by Fig. 11, namely, that the sense of the circulation of the current (whether right or left-handed), and the positive direction of the resulting magnet force are related together in the same way as the rotation and the travel of a right-handed screw are associated together. Right-handed rotation of the screw is associated with forward travel. Right-handed circulation of a current is associated with a magnetic force tending to produce north polarity at the forward end of the core.

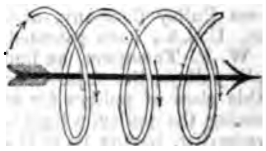


FIG. 11.

### Uses in General.

Regarded as a piece of mechanism, an electro-magnet may be described as an apparatus for producing a mechanical action at a place distant from the operator who controls it; the means of communication from the operator, to the distant point where the electro-magnet is, being the electric wire. The uses of electro-magnets may, however, be divided into two main divisions. For certain purposes an electro-magnet is required merely for obtaining temporary adhesion or lifting power. It attaches itself to an armature, and cannot be detached so long as the exciting current is maintained, except by the application of a superior opposing pull. The force which an electro-magnet thus exerts upon an armature of iron, with which it is in direct contact, is always considerably greater than the force with which it can act on an armature at some distance away, and the two cases must be carefully distinguished. *Traction* of an armature in contact, and *attraction* of an armature at a distance, are two different functions. So different, indeed, that it is no exaggeration to say that an electro-magnet designed for the one purpose is unfitted for the other. The action which an electro-magnet exercises on an armature in its neighbourhood may be of several kinds. If the armature is of soft iron, placed nearly parallel to the polar surfaces, the action is one simply of attraction, producing a motion of pure translation, irrespective of the polarity of the magnet. If the armature lies oblique to the line of the poles there will be a tendency to turn it round, as well as to attract it; but, again, if the armature is of soft iron the action will be independent of the polarity of the magnet, that is to say, independent of the direction of the exciting current. If, however, the armature be itself a magnet of steel permanently magnetised, then the direction in which it tends to turn, and the amount, or even the sign of the force with which it is attracted, will depend on the polarity of the electro-magnet, that is to say, will depend on the direction in which the exciting current circulates. Hence there arises a difference between the operation of a *non-polarised* and that of a *polarised* apparatus, the latter term being applied to those forms in which there is employed a portion—say an armature—to which an initial fixed magnetisation has been imparted. Non-polarised apparatus is in all cases independent of the direction of the current. Another class of uses served by electro-magnets is the production of rapid vibrations. These are employed in the mechanism of electric trembling bells, in the automatic breaks of induction coils, in electrically-driven tuning-forks such as are employed for chronographic purposes, and in the instruments used in harmonic telegraphy. Special constructions of electro-magnets are appropriate to special purposes such as these. The adaptation of electro-magnets for the special end of responding to rapidly-alternating currents is a closely kindred matter. Lastly, there are certain applications of the electro-magnet, notably in the construction of some forms of arc lamp, for which it is specially sought to obtain an equal, or approximately equal, pull over a definite range of motion. This use necessitates special designs.

### The Properties of Iron.

A knowledge of the magnetic properties of iron of different kinds is absolutely fundamental to the theory and design of electromagnets. No excuse is therefore necessary for treating this matter with some fulness. In all modern treatises of magnetism the usual terms are defined and explained. Magnetism which was formerly treated of as though it were something distributed over the end-surfaces of magnets, is now known to be a phenomenon of internal structure; and the appropriate mode of ing it is to treat the magnetic materials, the like, as being capable of acting as good ors of the magnetic lines; in other words, ssing magnetic permeability. The precise now attached to this word is that of a al coefficient. Suppose a magnetic force— us say, to the circulation of an electric in a surrounding coil—were to act on a cupied by air, there would result a certain of magnetic lines in that space. In fact, nsity of the magnetic force, symbolised by er **H**, is often expressed by saying that it roduce **H** magnetic lines per square centi- air. Now, owing to the superior magnetic of iron, if the space subjected to this mag- ce were filled with iron instead of air, there e produced a larger number of magnetic square centimètre. This large number in expresses the degree of magnetisation in the is symbolised by the letter **B**. The ratio of expresses the permeability of the material. al symbol for permeability is the Greek So we may say that **B** is equal to $\mu$ times r example, a certain specimen of iron, when d to a magnetic force capable of creating, in agnetic lines to the square centimètre, was be permeated by no fewer than 16,062 mag- es per square centimètre. Dividing the latter y the former gives as the value of the per- y at this stage of the magnetisation 321, or eability of the iron is 321 times that of air. meability of such non-magnetic materials cotton, and other insulators, also of brass, and all the non-magnetic metals is taken as g practically the same as that of the air. mode of expressing the facts is, however, ated by the fact of the tendency in all kinds o magnetic saturation. In all kinds of iron gnetisability of the material becomes ed as the actual magnetisation is pushed In other words, when a piece of iron has gnetised up to a certain degree it becomes, t degree onward, less permeable to further sation, and, though actual saturation is ached, there is a practical limit beyond he magnetisation cannot well be pushed. as one of the first to establish this tendency magnetic saturation.

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* Extracted from the Cantor Lectures delivered by Prof. SILVANUS P. THOMPSON, B.Sc., before the Society of Arts.

## JL AND SCIENTIFIC NOTES.

**ando Po.**—The Polish African traveller, Rogozinski, has lately spent some time on d of Fernando Po, in the Bight of Biafra. discovered there three lakes hitherto un- and a warm spring, the water of which s in its properties the waters of Carlsbad. ski has been engaged in erecting a monu- the island to the memory of Richard the explorer of the Niger region, on behalf oyal Geographical Society.

**ric Traction.**—The Budapest Electric , built by Messrs. Siemens and Halske on rground-conductor system, has, it is said, commercial success. Some 20 cars run on the length of which is 7·9 kilomètres. The for April were—for each electric car, £102; horse-car, £37. Since the date of this the difference in favour of the electric been still further increased. The greater tained by the electric car (11 miles per hour, st 5) is responsible to a great extent for rishing state of affairs. The town council recently given permission for the building ll electric line on the Zipernowsky single- ystem. An experimental length of three es, from Messrs. Ganz's factory to Stein- at present being laid.

**Coal Trade to London from Hull.**—A tween Hull and the Thames is now being for gas, house, and steam coal supplied e West Riding collieries, and promises to ost successful. Large quantities of coal are g put on to the Hull and Barnsley Railway ment to the Thames from the Alexandra the former place, which belongs to the company. This bears out a paragraph in pectus of the company alluded to, "that ay and dock must lead to a large extension rade in Yorkshire coal for export, and the of a coal trade to London by sea in com- with the present transport by land." There three steamers at least with coal running the two points—the *Beckton* (called after cipal works of the London Gas Light and mpany), the *Ryhope*, and the *Monica*. The charge by railway for coal sent from any the West Riding to London, all things , is 7s. 11d. per ton, whilst the rate by the l Barnsley Railway from the South York- llieries to the dock at Hull is only 3s. 5d. including waggons, and from there to the it should not be more than 3s. 4d. or 3s. 6d. which latter is about what is paid from the hich is much further off than the Humber ondon.

## SCIENTIFIC NEWS.

THE comet discovered by Mr. Barnard, of the Lick Observatory, on the 6th inst. will reckon as *d* 1890. It is not likely to be of much interest to telescope observers generally; but in a recent number of the *Astronomical Journal* (225), Mr. Barnard has a note which may interest many telescopists, for he thinks it possible to observe some of the short-period comets at aphelion. The instrumental appliances at his disposal are, however, far in advance of anything else, and, besides, he has the clear atmosphere over Mount Hamilton to help him in "following" the comets. The subject is worth attention by those who have telescopes of sufficient optical capacity.

In the same number of the *Astronomical Journal* there is an interesting paper by Mr. Stockwell on eclipses, historical and otherwise. The *Athenæum*, commenting on his paper, says:—"There are many instances in history in which an occurrence of darkness has been supposed to be due to a solar eclipse, though it must really have been caused by some meteorological phenomenon. Probably the so-called 'eclipse of Xerxes' was one of these. Homer, as is well known, throws in a sudden darkness whenever it suits his purpose, and although that in the seventeenth book is, from the famous prayer of Ajax for light, more familiar to most readers than others, there is no reason to suppose that it is anything but a poetic invention."

Prof. Tacchini, of the Royal Observatory of the Roman College, has a note in the *Comptes Rendus* on the solar phenomena during the first half of the present year, in which he calls attention to the fact that whereas protuberances have continued to predominate in the southern hemisphere, spots and faculæ have been most frequent in the northern. Details will appear in the publications of the Italian Spectroscopical Society.

That well-known naturalist—well known, at least, to students—Mr. John Hancock, died last week at Newcastle-on-Tyne, aged 84 years. An enthusiastic student of nature, his life was almost wholly devoted to what is known as natural history. He inherited his taste for natural history from his father, and to the departments of entomology and ornithology early devoted his attention. Early in life he turned his attention to the art of taxidermy. The results of his lifework in this direction now adorn the shelves in the museum of the Natural History Society at Newcastle, and they form one of the finest collections of British birds in the kingdom. In 1851, at the Great Exhibition in London, Mr. Hancock exhibited a series of groups illustrative of falconry. These are now in the Museum at Newcastle, and form part of the collection presented to the Natural History Society. Mr. Hancock was one of the most careful observers of bird life in this country, and his opinions were held in high esteem by all ornithologists.

By the death of Prof. James Edwin Thorold Rogers, the world loses one of the most able and distinguished masters of the science of political economy it has ever seen, and Oxford one of its ablest sons. Mr. Rogers was born in 1823 at West Meon, Hants, and passed from King's College, London, to Magdalen Hall, Oxford, in which university he took his B.A. degree, and came out first-class in classics. At one time Mr. Rogers was in Holy Orders, but relinquished that position in order to be able to enter Parliament. It may be safely said that no man was better known in Oxford than Prof. Rogers.

The first series of lectures delivered under the auspices of the Sunday Lecture Society, will be commenced at St. George's Hall, Langham-place, on Oct. 19, when, at 4 p.m., Prof. Silvanus P. Thompson will deliver a "lay sermon" on "Waves of Light." On October 26 Dr. B. W. Richardson, F.R.S., will lecture on "Working Hours for Working Men." Other lectures will be as follows:—Nov. 2nd, A. Elley Finch on "The Order of Nature—its Relation to Human Life and Happiness." Nov. 9th, Dr. Andrew Wilson, F.R.S.E., on "Why and how we Eat our Dinner." Nov. 16th, Willmott Dixon, LL.B., on "Captain John Smith, the Heroic Pioneer of English Colonisation in America." Nov. 23, Arthur Nicols on "The Evolution of our Globe: from a Nebula to a Star, and Finally to a Habitable World." Nov. 30th, Sir A. C. Lyall, D.C.L., LL.D., K.C.B., K.C.I.E., on "The Natural Growth of Religion in India." Several of these lectures will be illustrated by the aid of the oxyhydrogen lantern.

Mention of the lantern reminds us that Mr. C. Carus-Wilson has devised a luminous crayon for the use of lecturers when the room is darkened for the lantern to have its full effect. Intended primarily for drawing on the blackboard, Mr. Carus-Wilson thinks his invention will also be useful for students who have to take notes in the dark.

Dr. Abbott, writing to the *Times* about his Toynbee Hall lecture (see p. 141), says that he understated his case when he said that we see the Pole Star where it was 12 years ago. "The correct statement would have been, 'It was there 40 or 50 years ago.'"

It is stated that Foucault's famous experiment with the pendulum to demonstrate the motion of the earth is to be repeated at the Eiffel Tower, the pendulum being suspended from the centre of the second platform. A bronze wire, 115 mètres (377ft.), will carry a steel ball weighing 90 kilogrammes (198lb).

There is no longer any doubt as to the starting of the Antarctic exploring expedition, for the Australian colonies have taken the matter in hand, and have accepted Baron Dickson's offer to provide part of the funds if the colonies subscribed £5,000. It is believed that Baron Nordenskjold's expedition will be absent for several years, as its field for scientific observations in the departments of geography, hydrography, meteorology, terrestrial magnetism, zoology, geology, &c., will be unlimited. In so far as trade is concerned the discovery of harbours suitable for wintering in, the examination of watercourses leading towards the South Pole, and an estimate of the value of products that may afterwards be found, such as sperm oil, whalebone, and sealskins, will form the more important results. Ballooning and sledging are expected to play an important part in the work of the expedition.

In a Gresham lecture Dr. Symes Thompson last week referred to faulty nutrition, and spoke of the increased knowledge of the cause of gout and rheumatism, which, he said, lay at the foundation of sound pathology. The French school of medicine was better than the German in this respect, and London was practically the largest field for the study of gout. Fifty years ago medicine as an art was practised. Now the futile effort to make medicine an exact science seemed likely to delay progress. We must think of diseases in groups and define their boundaries. Hybrids having something of the rheumatic and something of the gouty character were not uncommon. "Poor man's gout" was often not gout at all, but rheumatic arthritis. It might also be real gout with faulty circulation, weak digestion, and proneness to tissue decay. In 1848 Garrod showed that gout was due to an excess of uric acid in the blood prior to and during the attacks. The modern wave of opinion was in favour of the nerve origin of gout, the chemical changes being secondary.

A large party, including representatives of the Admiralty, the War Office, and the Board of Trade, went to Swansea the other day to see the process of rolling seamless tubes (which we illustrate on p. 163) carried on at the works established by Messrs. Mannesmann and Siemens (of Berlin) at Landore. The principle has been explained before, but will be easily comprehended from the illustration above referred to.

The first meeting of the Organisation Committee of the Geographical "Welt-Kongress" has been held at Berne. It was resolved that the congress should meet as soon as possible after the celebration of the centenary of the Swiss League in 1891. A preliminary sketch of the programme was drawn up. The definite election of members of the committee, Swiss and foreign, was postponed until the next meeting, which will be held in Neuchâtel.

THE present winter term sees the opening of Queen Margaret College, Glasgow, as a new medical school for ladies. This gives to Scotland the distinction of possessing two schools for the training of lady doctors. In addition to those of London, Edinburgh, Dublin, and Belfast, this fifth school is necessary in order to meet the continuous demand from the East for lady doctors.

# LETTERS TO THE EDITOR.

*[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]*

*All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

*All Cheques and Post-office Orders to be made payable to* J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

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## ON THE WATCH FOR THE SOUTH—PORT OF SPAIN—LOGARITHMS—STELLAR PHOTOGRAPHY: AS TAUGHT IN NEWCASTLE—THE GOOD NATURE OF "ANOTHER F.R.A.S."—METEORIC DUSTFALL ON THE MOON—COMES TO POLARIS—PRACTICAL WORK WITH THE TELESCOPE.

[31705.]—The method of finding the Meridian, of which "Cantankerous" has extracted a description from *Truth* (in letter 31681, p. 126), is new to me; but the principle on which it is based is obvious enough. Were the sun stationary in the heavens, like a star, he would apparently travel round the earth in a path parallel to the Equator in 24 hours of sidereal time—i.e., he would describe an arc of 15° in one hour. But a watch face is divided into 12 equal spaces, each therefore = 30°, the interval through which the sun would move in two hours. Hence, if we neglect the equation of time, *and are careful to hold the watch parallel to the Equator*, the mode of proceeding of Mr. Labouchere's American friend will give us a very tolerable approximation to the South point. But we must not attempt the experiment with the watch lying horizontally; and, moreover, the end of this month is a peculiarly unfavourable time to try it at all; inasmuch as a good watch is between 16 and 17 minutes behind the real sun, and we may get our South point nearly 4° wrong from this cause alone. Of course, if the watch is lying on its back (save at the North Pole) we may get wildly out at any time of the year; but under the restrictions I have specified, the method is at once simple and ingenious.

I am writing these lines far away from my own library, and, in fact, from any means of reference whatever, so that I cannot say how I came to speak of the journey "from Trinidad to the Port of Spain" (to which "H. B. F." calls attention in reply 72496, on p. 130). But I have an impression, well or ill founded, that I simply copied the title of one of the chapters of Miss Brown's book itself.

In reply to "T. S. B." (query 72563, p. 132), tables for finding the logarithms of the sums and differences of numbers have but a limited application among computers. I cannot say whether actuaries employ them much; certainly astronomers as a class do not. Hence I should hardly expect that the publication of a fresh set of such tables would be remunerative. With reference to Sang's table of logarithms, I must reiterate what I have just said in the preceding paragraph—that I am far enough away from any works of reference. Doubtless Dr. Glaisher was my authority for the statement anent Sang's ten-figure logarithms. I will look the matter up, though, on my return home, in the course of two or three weeks.

The young man who "does" the Astronomy for the *Newcastle Daily Journal* has recently, in schoolboy phrase, been "going it"; for, in the impression of that journal for October 1st appears an article headed "Photographic Map of the Sky," which has certainly not been surpassed as a specimen of science for the million for many a long day. *In limine*, our mentor informs us that "The penetrating power of the photographic lens and the excessive sensibility of the plates materially assist the student in his observation of the astral conditions of the firmament, and enable him to obtain meteoric evidence which the best of telescopes has hitherto failed to supply."

Now I happen to know something of evidence, oral, written, and circumstantial, both in its legal and scientific aspect; but "meteoric evidence" is too much for me, it is indeed; even in connection with "the astral condition of the firmament"! But the end is not yet. Remarking, *en passant*, that there are 42,000 square degrees in the spherical sky, our author proceeds to enlighten us as to the instrument to be employed to obtain "meteoric evidence," and here again he had better speak for himself:—

"At no very distant time any person having a simple micrometer will be enabled to produce on plates and cardboard those interesting representations which until now have been essentially within the province of the astronomer and the best organised observatories. The contemplation of the star-lit sky through the telescope, which has so great an attraction for many commendably curious and inquisitive people, will be simplified and brought within reach of everyone who takes an interest in the matter. Anyone owning a micrometer, by simply moving it into his front or back garden, will be enabled to obtain those results in which he experiences such innocent delight."

I humbly venture to think that the production of stellar charts by anyone taking "a simple micrometer" into his "front or back garden"! must be *the* very last straw to which the fracture of the camel's vertebræ is proverbially attributed.

I regret to find, from letter 31684 (p. 142), and must apologise for the fact, that I put the saddle on the wrong horse, *re* the omission of any mention of Mr. Packer's observation of a star in the cluster V Messier in a paragraph in a periodical with which "Another F.R.A.S." is connected. But in connection with my alleged "prejudices," I should really like to know whether no cases of refusal or neglect to insert communications from men who decline to bow down to "magnificent theories," or of depreciatory reviews of books written by such people, have ever come within the cognisance of my critic in the pages of the journal which his communications adorn?

Mr. Peal (letter 31688, p. 142) says that he "cannot see why it (meteoric dust) should fall in patterns"; but unless we are prepared to admit that the contour of the various shadings which diversify the moon's surface has changed since lunar observation first commenced, it *must* fall in patterns, darkening parts already dark, and as carefully "dodging" the lighter spots, as the Egyptian darkness dodged the Land of Goshen. Why Mr. Peal should conceive that less meteoric dust falls proportionally on the moon than on the earth he does not explain.

"Astro-Stargazer" puts a query (72583) on p. 154 which can only be answered by saying that the *comes* to Polaris is a little star (between the 9th and 10th magnitude) some 19″ from its primary (the companion to Rigel is just about half as far off). Whether it is to be looked for above, below, to the right, or left of its primary depends upon the season of the year and the time of night at which it is viewed.

A friend has just sent me a reprint of a paper read before the Lancaster Philosophical Society as far back as the 30th of last January. It is by that well-known astronomer and correspondent of the English Mechanic, the Rev. T. E. Espin, and is entitled "Practical Work with the Telescope." As a guide to the amateur in the selection of lines of work calculated really to benefit science, this capital lecture deserves a wider circulation than I fear it is likely to attain. It is apparently published at Lancaster, at the *Observer* office; but I have no notion what its (certainly trivial) cost is.

**A Fellow of the Royal Astronomical Society.**

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## VERIFICATION OF STARS OF THE "URANOMETRIA ARGENTINA" FROM + 10° TO – 15° DECLINATION.

[31706.]—Finding that the maps of the "Uranometria Argentina" are excellently well adapted for opera-glass work, the magnitudes having been originally determined by that instrument, I thought it would be useful and instructive to verify so much of the maps as could be suitably observed in England by comparing them directly with the sky. I confined my observations to the zone included between + 10° and – 15° of Declination. During the last four years, 1886-90, the whole of the stars in the *U.A.* in that zone have been compared with the sky, an opera-glass magnifying five times being made use of. The greater portion of this zone has been observed twice—some portions of it three and four times.

The result has been to confirm generally the correctness of the magnitudes assigned by Gould to the stars. When any star was observed not in the maps, which was considered without doubt brighter than Gould's limit of 7 mag., or whose magnitude was plainly discordant compared with the *U.A.*, it was noted for special observation in order to detect, if possible, variation in its brightness. Attention was principally directed to stars of about 5, 6, or 7 mag., although at the same time every star in the map, whatever its magnitude, has been observed.

No case of decided variability other than that of the well-known variable stars has come to light. It should be remembered, however, that this has no pretensions to be an exhaustive and minute examination of Gould's magnitudes: it is simply the work of an amateur, carried on from time to time as weather and opportunities permitted, with a view to detect variation or change in brightness, and all palpable differences between observed and catalogue magnitudes have been noted. A few of the stars have been suggested by Mr. Gore for observation (which I did not note in the first place) independently. The principal discrepancies are included in the following list:—

I may mention, *en passant*, that I find the following a very convenient way of referring to stars on the map. The maps are ruled with meridians every 20m. of R.A., and parallels every 5° of declination. Denote the spaces of 20m. of R.A. on top of each map by letters, A B C, &c., and each 5° of declination on side of map by figures, 1 2 3, &c. A star is then referred to as in such and such a square or area, map number so-and-so—e.g., 2B map 12, 3C map 13, and so on. After a star is once identified on the map, and a little sketch made giving the neighbouring stars in that square, there is no occasion to use R.A. and Dec. in hunting up the star on the map.

The total number of stars observed in this comparison is 2,657.

Southern D.M. – 4° 7, 6·8m., Lalande 32, 8 observations; generally found to be 6·7 or 6·8. Not in *U.A.*

Southern D.M. – 3° 20, 6·7m., not in Lal., 8 obs. 6·8, 6·9. Not in *U.A.*

Gould 80 Piscium, 7·0m., Lal. 349. I always find this star plainly below 7m., estimates varying from 7·35 to 7·7. 20 obs.

Gould 83 Piscium. Declination of this star is wrongly entered as + in *U.A. Cat.* It should be – (South).

Gould 107 Piscium, 6·9m., Lal. 1952. Suggested by Mr. Gore for observation. 1886, Dec. 14, 7·35. 1887, June 16, 7·5; 26, 7·4; 27, 7·5; Aug. 21, 7·3; Oct. 9, 7·35. 1888, Jan. 2, 7·5. Then follow 9 obs., when it was 7·6 or 7·7. Possibly fading, 18 obs.

Gould 111 Piscium, 7·0m. Also suggested by Mr. Gore on account of the discrepancies in various catalogues. On 10 occasions, from 1887, Jan. 21, to 1889, Dec. 24, variously estimated 6·9 to 7·2, but 1890, Feb. 13 and 20, 7·4.

Gould 142 Ceti, 6½—8m. var. Gould says "certainly variable." Lal. 2598. 11 obs. show a range from 6·3 to 6·7 only.

Gould 118 Piscium, 5·9m. Suspected var. No. 33 in Gore's Cat. Always 6·3—6·4. Little or no variation detected. 14 obs.

Gould 160 Ceti, 6·9m., var. (?), Lal. 2798. Little or no variation. 7·5—7·9 from 11 obs. But on 1886, Dec. 14, I noted it 4 step < Gould 165 Ceti (5·9m.), also intrinsically below 7m. There is some discrepancy or error here which I am unable to explain.

Gould 165 Ceti, 5·9m. Found to be 5·5 or 5·6 on nine occasions, but on 1889, Jan. 29, 5·9; Nov. 26, 5·8; and 1890, Feb. 20, 5·3. Apparently irregularly variable to a slight extent.

Southern D.M. – 4° 312, 7·0m. On Sept. 22, 1886, 6·8; Nov. 25, 1888, 6·55; Dec. 29, 6·75; but the change is too small to afford reliable evidence of variation. 15 obs. Not in *U.A.*

Gould 139 Piscium, 6·9m. and Gould 140 Piscium, 6·6m. On 10 occasions I invariably made 139 brighter than 140.

Gould 224 Ceti, 5·8m. (F 66). Mr. Gore has found apparent variation in this star, which lies preceding a little N. of Mira, the celebrated variable. Taylor designated it variable, but Gould does not think so—found it only between 5·7 and 5·9. My observations probably indicate small variability; they range from 5·65 once on 1889, Feb. 4, to 6·25 on 1887, Feb. 12. The last five observations run 1889, Nov. 26, 5·9; Dec. 11, 5·8; 24, 6·2; 1890, Feb. 13, 5·7; 20, 5·9; the star being sometimes two or three steps > Gould 237 Ceti, and sometimes three steps less than that star. 19 obs. in all.

Southern D.M. – 4° 470, 7·3m. Lal. 5213. 6·7 to 7·0 on ten occasions. Not in *U.A.*

Lalande 6166 Ceti, 7m. Always found a little brighter than Gould 320 Ceti. Magnitudes 6·65 to 6·9 in ten obs. Not in *U.A.*

Gould 96 Eridani, 5·8m. 7m. Lalande. 1887, Dec. 13, 6·3; 1889, Jan. 2 and 22, about 6·0; Jan. 27, 29, and Feb. 4, below 7m. Evidently fainter than Gould's mag. 9 obs.

Gould 22 Tauri, var. 6¾ – 8m. Lal. 7172. My observations, 13 in number, indicate perhaps slight variation between mags. 7·3 and 7·8.

Lalande 8014 Tauri, 6½m. Once (1890, Mar. 5) 7·1; sometimes about 7·0, and sometimes brighter up to 6·65. 14 obs. Not in *U.A.*

D.M. + 4° 691, 7·2m. Lal. 8342. No doubt above 7m., although not in *U.A.* 15 obs. varying from 6·4 to 6·9.

Gould 32 Orionis, 6·6m. Birm. 96 Orionis. T notes to this star in Mr. Espin's new edition Birmingham show it to be variable. My c indicate undoubted variability, but it is difficult detect a period. 1887, Feb. 12, it was 7·4; 18 Jan. 29, 6·3, and Dec. 24, 6·2. 1890, Feb. 13, 18 obs.

Gould 20 Leporis, 6·0m. Birm. I. 76 Leporis. Various mags. from 6·0 on 1887, Feb. 28, to 6·5 on 1888, Feb. 3 and 12. Again, 1890, Jan. 23, 6· Feb. 13, 6·7; 20, 6·5. Noted as intensely red. 17 obs.

Lalande 11227, 7·5m. Gould. Generally estimated 6·0. Once, 6·25 on 1888, Feb. 3. 11 obs.

D.M. + 3° 1218, 7·8m. Generally found to be ates vary from 6·5 to 6·8. 15 obs. Not in

n D.M. – 1° 1231, 7·2m. Estimates, 6·4 2 obs. Possibly slightly variable.

12425, 7·1m. Gould
12438, 7·4m. Gould
12447, 7·1m. Gould

ays see the second star of this cluster than the third, a little, although Gould e second 0·3m. below third. 20 obs. and 2¾in. refractor.)

- 4° 1,335, 7·5m. Nearly always 6·4m. Not in *U.A.*

n D.M. – 6° 1775, 7·3m. 9m. Bessel. vary from 6·6 to 6·9m. Probably ariable, as it is sometimes a little brighter, fainter than Gould 89 Monoc. 14 obs. *A.*

178 Canis Majoris (V Puppis Espin), var. Jackson. My observations are as follows:

| | | | |
|---|---|---|---|
| ar. 12 .. | 6·37 | 1888, Feb. 28 .. | 6·0 |
| 16 .. | 6·4 | Dec. 25 .. | 6·2 |
| 19 .. | 6·4 | 29 .. | 6·1 |
| 24 .. | 6·32 | 1889, Jan. 29 .. | 6·4 |
| 29 .. | 6·35 | Feb. 20 .. | 6·3 |
| 30 .. | 6·3 | 1890, Jan. 23 .. | 6·2 |
| eb. 3 .. | 6·3 | Feb. 13 .. | 6·2 |
| 12 .. | 6·0 | 20 .. | 6·0 |
| 14 .. | 6·2 | Mar. 16 .. | 6·0 |

e show very little variation, if any.

- 6° 1688, 7·2m. Possibly variable. Estiry from 6·4 to 6·9. 15 obs. Not in *U.A.*

e 16240, 7½m. *U.A.*
e 16247, 7½m. *U.A.*

generally estimated the first of these about 8m.; the second a trifle fainter, on five occasions—1887, Feb. 26, 28, 27, and 1890, March 16—the second was ifle the brighter of the two. But a little this pair I observe two stars, which are *.A.*—viz., D.M. + 3° 1933, 7·5m. and o. 1933 has been variously estimated by 9 to 7·5, and 1932 from 7·0 to 7·7. Most these differences are due to errors in ; at the same time, it is curious that the ed pair should have been inserted in the ving out the palpably-brighter pair 1932 18 obs. of the group.)

n D.M. – 14° 2511, 7·3m. Generally be about 6·8, from 12 obs. Not in *U.A.*

33 Hydræ, 6·4m. Variously estimated o 6·4. 23 obs.

n D.M. – 9° 2630, 6·3m. Observed es vary from 6·55 to 7·0. Sometimes a hter and sometimes a little fainter than Hydræ 6·8m. Possibly slightly variable, my observations do not show any regularity iod. 34 obs. Not in *U.A.*

n D.M. – 10° 2635, 6·9m. No. 276 of irmingham. 6·9 to 7·2 from my obs., ten r.

n D.M. – 3° 2503.
n D.M. – 3° 2509.

two stars give a collective light in the slightly above Gould's 7m. Each 8·2m. M. Not in *U.A.*)

n D.M. – 5° 2794, 7·8m. Found from 6·7 4 obs. Not in *U.A.*

+ 0° 2546, 7·2m. 7m. Bessel. Generally . 19 obs. Not in *U.A.*

n D.M. – 12° 3031. A little above 7m. *A.* 4 obs.

n D.M. – 11° 3190, 6·3m. This star is *.A.*, although it is undoubtedly brighter ld's limit. My estimates range from 6·35 6·6, I think, represents its magnitude in scale. 25 obs.

e 26926, D.M. + 1° 2981, 7·2m. Geneerved about 6·35m. 20 obs. Not in

n D.M. – 13° 4226, 7·2m. Lal. 28550 3 (7½, 7, 6½) observed between 6·6 and 7·0. Not in *U.A.*

5 Ophiuchi, 6·9m. My first observation of made it hardly visible in binocular—31st 86, and since then I have invariably found m. 16 obs.

+ 0° 3530, 7·2m. Generally observed m. 16 obs. Not in *U.A.*

e 31546 Ophiuchi, 7m. Sometimes slightly nd sometimes slightly fainter than Gould (6·6m.) Hence it would appear to be ove limit of 7m. It is a little *f.* and *n.* of le U Ophiuchi. 19 obs., consisting prinsequences of brightness of this star and Gould 108, 116, and 123 Ophiuchi. Not

123 Ophiuchi, 6·6m. From the sequences red to, the position of this star varies—it asionally above and below No. 116. Proghtly variable. It is No. 487 of Espin's, am, whence it appears to have been ob and 7.

36124 Aquilæ. 6·9 represents about the average magnitude of 35 obs. It was once noted as 6·6m. (1886, Aug. 6). Not in *U.A.*

(A) D.M. + 5° 4190 6·9m. Lal. 37019.
(B) D.M. + 4° 4152 7·2m. Lal. 36997.
(C) D.M. + 5° 4177 7·0m.
(D) Gould 62 Aquilæ 7·0m. Lal. 37144.
(4 stars a little south of μ Aquilæ.)

A good many observations and sequences of these four stars have been made. A and B are probably very slightly brighter than 7m. A has often been noted as a little > B, sometimes decidedly so; while B has occasionally been seen the brighter. If there is any variation it is extremely small, and there are no indications of any regularity in the changes. Again, C and D have frequently been compared, with the result that sometimes one, sometimes the other, has been noted the brighter. It seems to be quite possible that a star may vary by only the tenth of a magnitude; if so, it would be extremely difficult to detect such variation. A photometer in such cases would probably be a more convenient means of detecting very small changes in brightness. 111 obs. Neither A, B, nor C are in *U.A.* B is 610 in Espin's Birmingham.

(*a*) Gould, 142 Aquilæ, 6·5m. } Lal. 39540 6½
(*b*) Gould, ,, 7·5m. } ,, 39542 6

Mr. Gore finds (*b*) considerably brighter than (*a*). I have 15 obs., and invariably find (*b*) ½m. greater than (*a*).

Southern D.M. – 5° 5299, 6·8m. Lal. 39516. Varies slightly above and below Gould 1 Aquarii (6·8m.) Magnitudes range from 6·55 to 7·0. Possibly slightly variable. 48 obs. Not in *U.A.*

Gould 143 Aquilæ, 7·0m. Estimates vary from 6·8 to 7·1; but it is doubtful if any real change is indicated. 30 obs.

Southern D.M. – 1° 4057, 6·8m. Lal. 40182. At times decidedly above 7m., the limit of *U.A.*, and yet not in it. Obs. vary from 6·6 to 7·1; but the change is possibly due to variation in Gould 7 Aquarii, the companion star. 61 obs.

Gould 7 Aquarii, 6·7m. This is No. 685 of Espin's Birmingham. Five obs. show it about 6·7. Either this or the preceding star probably slightly variable.

Gould 87 Aquarii, 6·8m. Birm. 596 Aquarii. Suspected variable. Variation, however, would appear to be but small. In August and September, 1887, it was 7·0; 1888, Nov. 25, 7·5; 1889, Dec. 11, 7·5; most other occasions, 7·2 or 7·3. These were intrinsic estimates generally. 21 obs.

Southern D.M. – 3° 5443, 7·2m. Lal. 43785 (7½). Generally observed 6·6 or 6·7; on a few occasions 6·8. Light probably constant, but evidently above the 7m. limit. Does not appear in *U.A.* 46 obs.

Lalande 44782 Piscium, 7 and 7½m. Not in *U.A.* Suspected variable, on account of diversity in estimates.

| | | | |
|---|---|---|---|
| 1886, Nov. 29 | not visible. | 1888, Aug. 13 .. | 7·3 |
| 1887, Jan. 12 | barely visible. | Sep. 5 .. | 7·4 |
| Aug. 21 .. | 7·6 | Oct. 27 .. | 7·5 |
| Oct. 9 .. | 7·2 | Nov. 25 .. | 7·1 |
| 11 .. | 7·5 | Dec. 29 .. | 7·2 |
| 13 .. | 7·1 | Oct. 19 .. | 7 |
| 16 .. | 7·2 | Nov. 25 .. | 7 |
| Nov. 15 .. | 7·4 | Dec. 11 .. | 7·3 |
| Dec. 4 .. | 7·2 | 1890, Aug. 16 .. | 7·2 |
| 19 .. | 7·4 | | |

Nearly all the above are intrinsic estimates, not differential.

D.M. – 8° 6021, 7·0m. Early observations run as follows:—

1886—Aug. 6. Considerably above 7m.
,, 7. Undoubtedly above 7m.
Sept. 5. Quite above 7m.; almost 6·5.
Oct. 6. ½ mag. > Gould 199 Aquarii (6·9), and therefore 6·4.

Then follows a long series of dates, when it was generally 6·9m. or thereabouts, except on 1887, Sept. 18, 6·7, and 1889, Nov. 25, 6·6. But its proximity to 83 and 84 Aquarii renders it very difficult to take unbiased estimates of its brightness. 30 obs. Not in *U.A.*

Gould 238 Aquarii, 6·5m. and Gould 248 Aquarii, 6·5m. I have always found 238 brighter than 248; and supposing the latter star's brightness unchanged, the magnitude of 238 consequently varies (from my obs) from 6·05 to 6·45. 21 obs.

Gould 239 Aquarii, 6·3m., Lal. 45980. Suspected variable. My results vary from 5·9 to 6·5; but the variation, if anything, is probably very slight, from these observations, which are 18 in number.

Gould 8 Ceti = 3 Ceti, suspected variable. Observations only indicate a change of three steps. In 1889, Nov. 25 and Dec. 11, it was 4·9; previous obs. give it 5·1 or 5·2. 13 obs.

For identification of many of the above stars I am indebted to Messrs. Gore, Espin and Sadler. I should also state that in most cases the observations extend over nearly five years, and are not all made in a short period. Nearly all the determinations of magnitude were differential, or by comparison with neighbouring stars, occasionally checked by an estimate of intrinsic brightness. The scale of brightness therefore corresponds with that of the *U.A.* I have an idea I sometimes make my magnitudes too bright. Should anyone be desirous of obtaining the exact details and dates of any of the foregoing observations alluded to, I shall be most happy to furnish them on application.

I cannot conclude these notes without referring to the kind assistance furnished me by Mr. J. E. Gore, F.R.A.S., &c., &c., who is himself a master in this department of astronomy, in quoting magnitudes, &c., from various catalogues otherwise inaccessible to me, and in looking up certain stars with the binocular. It is due in a great measure to his unvarying courtesy and encouragement that this piece of work has been carried through.

**E. E. Markwick.**

Haulbowline, October, 1890.

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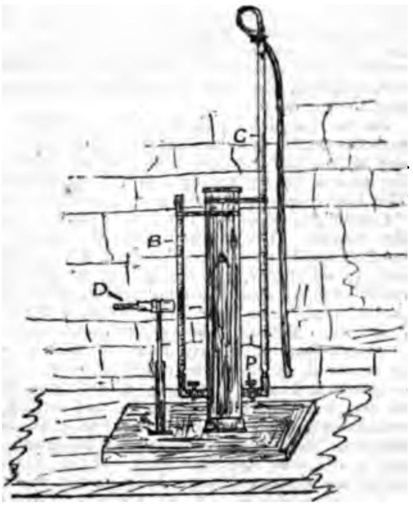
## THE DETERMINATION OF THE SPECIFIC GRAVITY OF IRON AND STEEL.

[31707.]—In a recent number of *Industries*, a correspondent using the *nom de plume* of "Metallurgist," describes an "Improved apparatus for determining the specific gravity of iron and steel," which allows of large masses of the metals being easily manipulated, and of check experiments being performed with the expenditure of little time and trouble.

The apparatus consists of a metal cylinder, A (of such a capacity as to hold sufficient water to completely cover the metal being tested when placed in it), connected with two glass graduated tubes, B and C. The tube B is provided with a marked glass float for reading off the water level in A, while the tube C, which is of 100 cubic centimètres capacity, divided into $\frac{1}{10}$th c.c., is provided with a stop-cock. The fixed telescope D is employed for reading off the water level in B (which, as is obvious, corresponds to the level in A), and to enable this to be done with great accuracy, it is provided with fine fixed cross wires.



In making a determination, three-parts fill the cylinder A with water, note the water level in B (in reading off, the mark on the float must exactly coincide with the cross wires in the telescope), and place the metal, the weight of which has been carefully determined, in the cylinder A. The next step is to bring the water in B to its original level, which is accomplished by sucking up the water by means of the indiarubber tubing in the tube C. When the level is adjusted, as shown by the mark on the float and the cross wires coinciding, the indiarubber tube is closed with a clip. The volume of water thus drawn up into C, *which equals the volume displaced by the metal*, is then read and noted. On account of the difficulty experienced in exactly adjusting the water level in B, the mean of at least six readings should be taken. Should the volume of the water displaced exceed the capacity of the tube C, as will be the case with large quantities of the metals, the excess is carefully drawn off by means of the tap P, into a graduated vessel, and the remainder measured in C as previously described.

The following test experiments are given:—

1,000grms. steel, carbon 4·32, displaced 129·44c.c., $H_2O$ = sp.gr. 7·7256.

1,000grms. nickel steel, carbon 0·18, displaced 127·70c.c., $H_2O$ = sp.gr. 7·8308.

1,000grms. Bessemer metal (no manganese), carbon, 0·07, displaced 128·63c.c., $H_2O$ = sp.gr. 7·7743.

1,000grms. wrought iron plate, carbon, trace, displaced 130·00c.c., $H_2O$ = sp.gr. 7·6923.

The correspondent states that he is greatly indebted to Mr. George Parry, jun., who suggested the construction of the instrument as described.

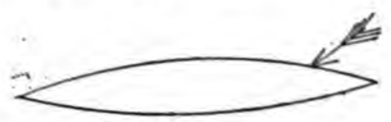
**An Analyst and Assayer.**

## PHOTO-MICROGRAPHY.

[31708.]—I VENTURE to think that if "Microbe" (letter 31676) will try clear glass with ruled lines, he will not use even an "Alpha" plate again. It is necessary to have a definite point to which to bring the focus, and unless he rules his Alpha plate, the more delicate his object the more unsatisfactory will be his results. "Microbe's" statement as to the D D objective is somewhat surprising; I have used it very successfully, and can only suggest that the cover-glass is much thicker than should be used with a ⅛in. objective, which the D D really is. I used an ordinary eyepiece, and should not consider a projection one suitable to such an object-glass. The elasticity of focus is due to the fact that the rays run so nearly parallel from objective to screen, especially with a camera of 38in., in which case only the centre of the field would probably be used. There would be no objection to the placing of a reasonable weight or other pressure on the cover-glass, to get rid of folds, provided the surface of pressure were equal in size to the cover; but I fear this would be no use, unless there were a great deal of fluid underneath, so that the section had room to spread. The cure must be sought in the direction of greater care in mounting.

"Microbe" will find a table of relation of light-gathering power to aperture in the R.M.S. aperture tables. He must, however, bear in mind that the table of illuminating powers there given refers to equal spaces. I have recently photographed at 1,000 diameters on an Edwards' Iso-plate, with deep yellow screen, and got full exposure from a ½in. paraffin lamp, with N.A. 1, in 2½ minutes—a fact which speaks volumes for the illuminating power of the apo. 2min. which, with No. 3 Projection eyepiece, was what I employed. I confess the result surprised me.

As to the N.A. 1·63, the letter of Prof. Abbe puts the matter in such a light that I doubt whether any satisfactory solution will ever be reached, and the reason for my saying this will appear shortly. The interested party to whom I referred was not "Coarse Adjustment," but it is useless to go into the matter. The fine-adjustment question now resolves itself into this:—The form I use is applicable to all stands, the string and weight only to easily working slow motions, which, *pace* "Coarse Adjustment" are more likely to shift than fairly firm ones. A No. 4 Zeiss eyepiece is too high to use photographically on any lens; if such a power be required, it should be obtained from a higher objective and lower eyepiece. Knowing something of Dr. Van Heurck's methods, and having seen something of his results, I confess that, in my opinion, they will not bear comparison with much of the English work which has come under my notice. Many of us do not think that diatom structure is best revealed by light of the greatest possible obliquity. Dr. Van Heurck insists that the proper way to illuminate Amphipleura is to send the pencil of rays thus:—



The *perles* are then brought out, but those of us who have tried to photograph this object, know that the *perles* are "easier got than got rid of." Oblique illumination may be made to do anything with a diatom; but inasmuch as the general assumption is that axial illumination, with adequate aperture, is the true test of structure, some of us, on these grounds alone, are not prepared to exalt Dr. Van Heurck to the position claimed for him by "F.R.M.S." **Edward C. Bousfield.**

## THE "TRUTH" ABOUT THE COMPASS.

[31709.]—OUR American friend was quite right in his statement that all watches are compasses, and in his mode of exemplifying it. This will at once be seen if we suppose the hour hand to be directed to the sun at 6 p.m., when the sun will be west. Now, west is one quarter of the circle from south, but six is half the circle of the watch from 12, therefore, half this, which is three, will be the south line. After 6 a.m. it is the same; at 9 o'clock the sun will be south-west; half-way to 12 in one direction will be 4½, which will be south, and in the other direction it will be 10½, which will be north. Of course, these points of the compass are only approximate, as the method does not deal with the equation of time or the difference between Greenwich and local time.

Fordingbridge. **T. Westlake.**

## SAP IN TREES.

[31710.]—IN reply to "W. H. S." (letter 31699), I have to say that I prepared a glass tube having a membrane at the lower end, then poured in syrup to the depth of 1in., then fixed another membrane, and supplied another inch of syrup. The tube was suspended for a month over a vessel of water, the lower membrane being ½in. below the surface, but no water entered through the second membrane. Trees, in the spring, put forth their foliage two or three months before the slightest moisture can be obtained from the roots. In some cases I have squeezed portions of the wood in a smith's vice without a drop of water being discharged.

The formula for showing the height to which water rises by capillary attraction may be theoretically true, but is not true practically, especially in the case of trees when there is no water at the root.

If water rises in a tree by capillary attraction in the spring, perhaps "W. H. S." will explain why it does not continue to do so through the winter, when the soil is usually more wet. The same question also applies to osmosis, and all the other assumed forces. **J. A. Reeves.**

## THE THERMO-DYNAMICS OF THE VACUUM BRAKE.

[31711.]—MESSRS. ARCHBUTT AND DEELEY, p. 13 of "ours," assured your readers that in theory the vacuum brake cannot freeze. A Board of Trade Return was issued on Saturday last, giving *forty* (40) failures from ice and frost. I should like Messrs. Archbutt and Deeley to explain this.

I give below the causes of the forty failures, as recorded in the return:—

### THE AUTOMATIC VACUUM BRAKE.

*Great Northern Railway.*

Coupling-pipe of engine frozen.
Drip-valves frozen on engine.
Pipe frozen on stud.
Pipe frozen on stud.
Coupling-pipes of engine frozen.
Connecting-pipe, not fitting plug, blocked with snow.
Drip-valves frozen on engine.
Pipe frozen on plug.
Pipe not fitting on plug, through frost.
Drip-valve of engine frozen.
Drip-valve of engine frozen.

*Lancashire and Yorkshire Railway.*

Unable to release brake owing to frost.
Vacuum-piston sticking—cause, frost.

*London and North-Western Railway.*

Overran Castlethorpe; accumulation of ice in the pipe between the engine and the tender.
Overran Northampton; accumulation of ice in the pipe between the engine and the tender.
Some water in pipe of van frozen.
Ice in pipes of engine.
Quantity of water in pipes and cylinder.
Ice accumulated in vacuum-pipe on the engine.
Water in cylinder on vehicle.
Vacuum-pipes on train frozen.
Water in pipe of carriage frozen.
Water in brake-connections frozen.
Vacuum-pipe on engine frozen.
Pipe of parcels-van frozen.
Ice in pipes of the engine.
Apparatus on van frozen.
Apparatus on vehicle frozen.
Van detached at Tring: freezing of the vacuum-pipe on the van No. 35.
Ice in gear on rear van.
Apparatus on van frozen.
Pipe between engine and tender blocked up with ice.
Ice in the pipes of the engine.

*London and South-Western Railway.*

Vacuum-pipe under tender frozen.
Drip-valve and pipe between engine and tender frozen.
Tender steam-brake pipe frozen.
Ice in carriage cylinder.
Ice in van cylinder.

*Midland Railway.*

29 minutes delay: ice and water in pipes.

### SIMPLE VACUUM BRAKE.

*London and North-Western Railway.*

Water having got into the pipe and frozen.

It is highly instructive to note that on the very night of the Carlisle disaster—3rd and 4th March, 1890—the Great Northern had four failures from the automatic vacuum frozen.

The London and North-Western had runs past Castlethorpe and Northampton, and 7 other failures. The London and South-Western had three failures on 3rd March, and the Midland one case on the 3rd.

Thus, on the night of 3rd and morning of 4th March the automatic vacuum failed no less than 17 times from ice and frost.

Will Messrs. Deeley and Archbutt still call it a dry brake, not liable to freeze? **A Practical Man.**

[31712.]—ALLOW me to inform "Practical" (31670) that no men are employed at Clapham Junction or elsewhere by the L. and S.W. Railway
in drawing off water from the Autom
Brake. The men to whom he refers a
in ordinary brake repairs. I have ne
with an instance where water condens
atmosphere has been found in the cyli
part of this brake, and from long ex
certainly say that the Automatic Vac
with proper attention, is a dry and rel
But if the ejectors are allowed to get o
then steam can at the moment the
destroyed, pass in with the air and so c
water in the train pipes; this can easily b
out again with a vacuum of 22 to 24 inc
I can honestly say that with a little c
ing the ejectors and drip valve in goo
that it is impossible for the Automat
Brake to freeze up in any weather.

[31713.]—"PRACTICAL" (page 123,
attention to the fact that on the London
Western the pumps for the vacuum
obtain a higher vacuum than an ejector
been known on the Great Western for
Mr. A. W. Rendell, locomotive superi
the Eastern Bengal State Railway of
reported "that the maintenance of a
means of an ejector is not an economi
as it certainly affects the steaming of
prejudicially."
The reason for the prejudicial effect o
on steaming is not far to seek. The bl
small ejector is constant and of considera
it is not only a drain upon the boiler di
steam actually consumed, but it tends
the vacuum in the smoke-box, and to w
the top of the fire.
Mr. Webb, on the North Wester
fully 2lb. of coal a mile run by taking o
ejectors and putting on pumps. Yet s
blame him for altering or improving t
vacuum-brake system. **A Railwa**

## THE GASSNER DRY BATTE BELLS AND LAMPS.

[31714.] — IN reply to Mr. G.
(letter 31660), my dry-cell experience h
with the Gassner cell, but with cells
invention and construction. My inte
cells was first aroused about eighteen m
since which time I have spent a lot of
money) in experimenting. My first cell
cleaned out and refilled when exhausted
I now make are capable of *thorough* r
by dynamo or battery current; connect
freshly charged chromic cells for one, tw
hours, according to size of dry cell, seem
ficient. At present I make them in two dif
(using same chemicals)—one way I get
1 ampère, a high-voltage, high-resis
which I use for bell work; the other
1½ volt nearly, and 4—8 ampères, accord
of cell. This low-resistance form I fin
able for a lot of purposes, as it is very
the voltage falls very slowly. After ringin
for twelve hours continuously, it only fa
Five cells fully lights a 6-volt 2½c.p. lam
being switched on for 36 minutes, E.M.
fallen to 1 volt; in fact, one cell larger
—viz., 5½in. by 3in.—showed 1¼ volt.
to compare favourably with the Gassner
ing to Prof. Gérard. I find that a few
I was making a kind of an improved
contained one extra chemical. I got
bell-ringing out of a small cell (4½in. b
charged, taken out in about six hour
After regeneration it only gave 95 h
abandoned that composition for the pre
so far proves to be thoroughly regene
latest cell answers well for occasional
cell being ample; as the bath offers a
the E.M.F. and current remain stead
saving of time by its use, as I only gild o
and taking apart and putting together
reamalgamating plates or cylinder w
hindrance. I have also used it for small p
I have several cells in use for electric-cl
where they answer better than Leclan
zincs used to get clogged. I also find the
shocking coils, heating platinum wire,
occasionally working motors, lighting
clock-dial to see time by night by pr
within reach of bed, which I find a gr
and convenience; the same lamp throw
light around room to enable one to see t
On regenerating cell it gives 2 volts, but
voltage soon passes off, even if cell is n
believe the extra voltage to be cau
accumulation of gas at the electrodes aft
manner to the storage cell. During my e
I met with a cell that gave 3½ volts a
regenerated; but it had the fault of b
and current falling a week or so after
up. E.M.F. of its cell when made is ne
and current 7 or 8 amps; it would be
if it would only stand. I am still going
making, remaking, modifying, altering,
generating, and retesting of these c

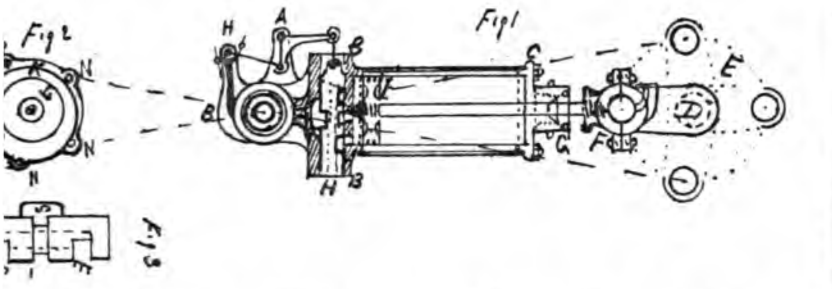
ould like to hear more about them I will in later on. I would also like to hear assner's or other dry cells.

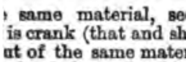
**A. E. Ball.**

## LIARY POWERS FOR TRICYCLES.

—HAVING gone as far as we can at ith manual and petro, we will next take his has its advantages. One is, we can uble-acting engine and the material for tion of power to drive can be got for next ; but these are dangerous, and, unless ned, will require a deal of attention, and, ll, such arrangements must be made to ir certain and safe action, as well as being it can be made consistent with strength; st be made instantaneous, and disposed as made; all surplus water ejected; ut filtered rain-water or distilled water as any pumps or injector is out of the as less than ⅜ cube of water is wanted at lution, I reckon upon ¼ cube to be enough. fed by gravity to be certain. Now for Fig. 1 is an oscillating cylinder, A is upon the carrier or framing, B B B is iron, Mitis metal, or steel-casting, C the same material, section throughout as is crank (that and shaft and chain wheel ut of the same material), the coupling F, gland G, and piston I, may be cast of bronze, Mitis, or Delta metal. The tube of cylinder is weldless-drawn steel tube , B). Cover as before with base. You e outer ring is eccentric; that is to cover way forward, M; the inside, L, is steel; K, brass triblet; N, N, N, N, N, steel harcoal iron. You will see the way of he valves at H A (Fig. 1), and a larger the tubular valve is shown at Fig. 3, E, E is the exhaust and S the steamway. alance valve, it will want very little power , and only a plain hole to work through. is required. Now as the cylinder is 2in., , 3·141 × 4 = 12·5, and as there are two to complete one revolution, and as a cubic am at 70 contain 5 cubic inches of water, e will require 2·2 eighths of water. The s for the revolution will want 8·8 eighths, u will see that my guesswork when I ack to what I wrote before I went into s not far out. Well, you will see what required for every stroke. There is no r pump that will work upon it, so gravity be the order of the day; if we go in for t will be = 144 strokes, or 36 revolutions foot of steam at 70lb. per square inch, or ches of water. Now put this and the p, and the diameter of wheels of tricycle, ee how far 7lb. of water will carry us; 7lb., boiler and lamp 7lb., cylinder 7lb., -tank and supply 10lb. Here we have what? Ah, that is the question. The afest boiler will be a spherical one, and ess I put down at 14 or 16 B.W. gauge, r for the best material. This and the be the next consideration, and will

**Jack of All Trades.**





## THER—MORE NONSENSE.

—IN letter 31673, E. C. Bousfield refers n occasion when a violent outburst on the the sun caused a great magnetic storm on I do not wish to enter into the controraging as to the existence of ether, but t mentioned by Dr. B. appears to coneory I have had as to the cause of the agnetism. It is this: The inequality of re at the point where the sun "rises" " sets up a current of thermal electricity e earth. The plane of the electric circuit ourse, east and west, the resultant magof force would be at right angles—viz., south. The cause of the two exciting of this great battery being the sun, it eason that if there is any sudden increase ntity of heat emitted by it, the electric hich I assume it maintains—becomes c in its behaviour owing to the opposite currents which are induced by the sudden augmentation of electric force in the primary current. Such a current as I have mentioned could be easily conducted by the salt water of the sea and the clouds. I think that this theory will explain the different phenomena mentioned by Dr. Bousfield. It may also explain the cause of thunderstorms, the "magnetic dip," &c. I should like to hear what "Sigma" or Dr. B. thinks of it.

**Abertify.**

[31717.]—IT may be worth while to draw attention to some of the statements made by those who believe in the existence of the ether in order to see how they agree, or rather to see how contradictory they are.

So far as I can learn, the ether is a fluid or not, is a jelly or not, possesses any or every property of matter or not, just according to the particular experiment under examination. Prof. Oliver Lodge tells us that it is a friction less fluid or jelly, while his theory of electricity is based on the assumption that it is not frictionless. Your correspondent, "W. C. E.," says: "It is usually supposed to have all the properties of a perfect gravitationless, material, incompressible fluid of great elasticity, which simplifies the theoretic treatment. But it is not necessarily free from an extremely small viscosity, gravitationless, or absolutely incompressible."

If we analyse these statements, we shall find that the ether has all the properties of a perfect gravitationless fluid, but it is not necessarily gravitationless; that it has all the properties of a perfect incompressible fluid, but it is not absolutely incompressible; and this simplifies the theoretic treatment! Surely those who make such statements as these would do well to study the meaning of words or a little elementary logic, as it might clear their ideas. The ether hypothesis cannot be called a novelty; but still I think the words of Prof. De Morgan in the "Budget of Paradoxes" may be fairly applied to it, and may certainly be applied to the modern developments of it:—

> "The past emergence of truths out of derided systems proves that there is a practical certainty of like occurrence to come. But, inasmuch as a hundred speculative fooleries are started for one truth, the mind is permitted to approach the examination of any one given novelty with a bias against it of a hundred to one; and this permission is given because so it will be, leave or no leave. Everyone has license not to jump over the moon."

Ordinary people, like myself, may be excused if they refuse to believe in the existence of this contradictory phantom, which eludes every attempt they can make to form any conception of it, and may come to the conclusion that whenever any scientific man assumes an existence which he cannot prove, in order to account for any natural phenomena, it is well to remember that this existence is simply a phantom of the imagination. It may be the true explanation, but is more likely not to be. In earlier stages of scientific thought the assumption may be useful and helpful; but in advanced stages, if not true, it becomes a hindrance. Hence all theories which assume such existences should be held lightly, and never be insisted on.

**J. A. H.**

## COPYING DRAWINGS TO A REDUCED SCALE.

[31718.]—THE following method of copying a drawing to a scale $\frac{1}{m}$th of the original scale by means of an easily-constructed geometrical diagram, suggested itself to me some years ago. Since then I have simplified the process, and I now offer it to your readers as one which may be found useful to mechanical and architectural draughtsmen—at any rate, in the absence of proportional compasses. Indeed, when $m$ is less than 3, working with a diagram is at least as easy as working with the clumsy instrument just named, and the results are as accurate, supposing the diagram to be carefully constructed.

In Fig. 1, let A and B be fixed points in a piece of cardboard or thick drawing paper, and A P, B P, any two lines drawn from them and meeting in P, Then, if in all cases $AP = m \, . \, BP$, the locus of P is a circle whose centre (T) is on A B produced.

To prove this, draw P N perpendicular to A B, or A B produced. Let $BN = x$, $NP = y$, and

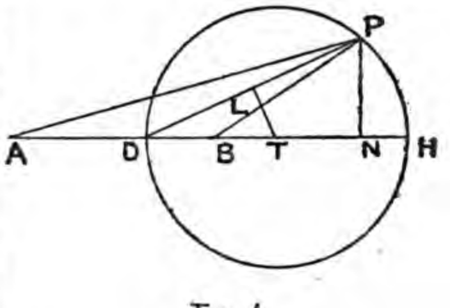


Fig. 1.

consider the length of A B (the *base*) as representing unity. Then—

$$y^2 + (x+1)^2 = m^2\,(y^2 + x^2)$$

from which we derive—

$$y^2 + \left(x - \frac{1}{m^2 - 1}\right)^2 = \frac{m^2}{(m^2 - 1)^2}.$$

This is the equation to a circle. $BT = \frac{1}{m^2 - 1}$, and the radius $TP = \frac{m}{m^2 - 1}$. By giving to $m$ different values, we can calculate the corresponding values of B T and T P. Thus, if $m = \frac{\sqrt{3}}{\sqrt{2}}$, which is the ratio used in isometric projection, it will be found that $BT = 2$, and $TB = 2{\cdot}45$. If $m = \frac{3}{2}$, $BT = 0{\cdot}8$, and $TP = 1{\cdot}2$. If $m = 2$, $BT = 0{\cdot}33$, and $TP = 0{\cdot}67$, &c. The difference between the shortest length, A D, that can be taken on the original drawing and A H, the longest, decreases as we increase $m$, and it is easily shown that the range of the instrument, in its most simple form, is expressed by the formula—

$$AH = \frac{m+1}{m-1} \, . \, AD.$$

In practice it is rarely necessary to calculate numerically the lengths B T and T P, for by a simple geometrical construction we are enabled to produce a diagram to any ratio $m$, given two lines whose lengths are in that ratio. Thus, suppose A B to be a suitable length for the base, and A P to equal $m \, . \, BP$. Bisect the angle A P B by the line P D. Then, since, by Euclid VI. 3.

$$AD : DB :: AP : BP$$
$$\therefore AD : DB :: m : 1,$$

which shows that P D is a chord of the required circle. Bisect P D in L, and draw L T perpendicular to P D. Evidently T, since it lies on both L T and A H, must be the centre, T P being the radius. Describe the circle, and the diagram is complete.

The mode of using the diagram requires little explanation. A length A P, from the original drawing, being set off with ordinary compasses from A, determines the position of the point P, and we take P B for the corresponding length in our copy. To prevent their being holed by compass points, A and B ought to be protected by horn centres.

For any measurement shorter than A D, when it cannot be taken indirectly (that is, as the difference between two longer measurements), a supplementary circle, constructed to a shorter base than A B, is required. In the diagram, Fig. 2, from A draw any line, A h = A D, the shortest of the measurements; join H h, and through T, B, and D draw lines parallel to H h, meeting A h in t, b, and d respectively. Then, A b is the new base, and t

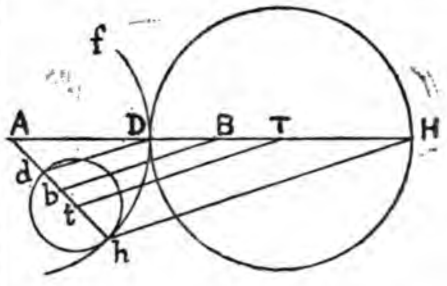


Fig. 2.

the centre of its circle, of which the radius is t d. Supposing A B to be of sufficient length, a third circle and base can be derived from the second, a fourth from the third, and so on; and it is easy to see—since the two circles in the figure are tangential to the arc f D h, described from A as a centre with the radius A D—that any measurement found on one circle cannot be found on any other, and therefore that no doubt need occur as to which base a measurement applies. When there are but two circles and bases, as in Fig. 2, since A h = A D, we have—

$$\mathrm{A\,D} = \frac{m+1}{m-1}\,.\,\mathrm{A\,d},$$

and

$$\mathrm{A\,H} = \frac{m+1}{m-1}\,.\,\mathrm{A\,D},$$

$$\therefore \quad \mathrm{A\,H} = \left(\frac{m+1}{m-1}\right)^2 .\ \mathrm{A\,d}.$$

In practice more than two circles are rarely required; but if we had *n* circles, and *l* and *s* were the greatest and least measurements within the range of the instruments, then—

$$l = \left(\frac{m+1}{m-1}\right)^n .\ s.$$

Charing, Kent. **J. R. C.**

### IMITATION IVORY.

[31719.]—Finding that my remarks (letter 31638) as to imitation ivory-xylonite, have been misunderstood by some, I desire to say that I referred to ornamental turning only, in which it is not possible to sharpen the cutter during the process of the work; for the edge is very quickly destroyed by xylonite, which, moreover, will not, with the sharpest drill, receive the finest work, and therefore is for ornamental work a failure. When, as in plain turning, you can constantly renew the edge, it cuts like hard cheese, and being homogeneous and very tough, it is excellent for many purposes.

It is unaffected by cold water, but becomes softened in hot so that its form may be considerably altered—e.g., a tube of somewhat elliptical section may be made cylindrical by being thus heated and left to dry upon a cylinder; it is not readily "moulded" and the dies are costly.

It is made in solid rods from ·06 to 1·0, in tubes (inside measure) from ·3 to 2·75, in slabs up to 47in. long by 20in. wide and in thickness from ·005 to 1·50; the price, with "grain" to counterfeit ivory, 5s. per lb.; without grain, 4s. It will thus be seen that one can get almost anything wanted, the largest tubes make good spill-pots and puff-boxes, the smaller napkin rings, &c.

The sole makers, I believe, in England are the Xylonite Co., High-street, Homerton, London, E., who have attended to my little wants with much courtesy. **C. C. Ellison.**

### DRILL-SPINDLES.

[31720.]—The writer on drill-spindles has omitted one very important point—viz., the "binding screw." In intermittent cutting—e.g., crossed spirals, recessiocator work, and especially rose-engine work—the drill is very liable to shake loose if only fitted in with a taper stem, no matter how good a fit or how well pressed home. It should have a "binding screw," the end of which bites in a file cut (upon the drill), so made that the pressure drives the drill further home. The lathe-makers know all this, and sometimes provide the screw; why not always? I can only urge my brother amateurs never to buy nor use a drill-spindle without one. **C. C. Ellison.**

**Wages.**—The average yearly wages of men, women, boys, and girls in the United Kingdom and in the United States in the following classes of mills are:

| | United States. | Great Britain. |
|---|---|---|
| Cotton | 329·33 dol. | 179·50 dol. |
| Woollen | 364·34 ,, | 165·00 ,, |
| Worsted | 361·99 ,, | 151·00 ,, |
| Linen | 305·44 ,, | 126·00 ,, |

These estimates are given by Consul Brown, of Glasgow, and Mr. Wadlin, chief of the Massachusetts Bureau of Labour Statistics, in his latest report.

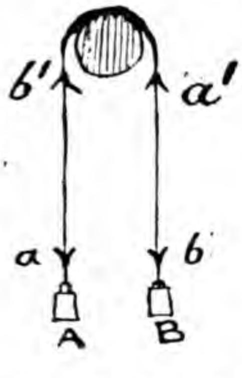
**A Line-throwing Gun.**—The shoulder line-throwing gun invented by Captain J. D'Arcy-Irvine, R.N., consists of a shoulder gun having the cop, or coil of line, suspended in a case carried under the breech of the gun. A rod is inserted in the barrel, the fore end of the rod being connected with the end of the line, which is in the centre of the cop. The line is 144 yards long, and the charge of powder used is two drachms. Upon the gun being fired at a high elevation the rod is projected upwards and forwards, carrying the line trailing away after it. The object is, of course, to land the line over the ship or other object, the rod dropping beyond it. By this means a rope can be made fast to the tail end of the line by the succouring party, and be hauled on board by those in distress.

## REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.***

[72021.]—**Telescope Stand.**—"A Fellow of the R.A.S." has answered the above query (p. 512). I would, however, like to say, for the encouragement of "A. N.," that with my glass, which has only 2½ o.g., I have spent many pleasant hours watching the changes of Jupiter's Moons, Saturn's rings, and one or two of his satellites—a few of the principal nebulæ (especially that in Orion)—the changing aspects of the moon, &c., and that I got a very satisfactory tripod stand (for such-like work) with vertical and horizontal movements, at Messrs. Watson and Sons, High Holborn, at the small cost of 15s. Astro.

[72081.]—**Statics.**—If "Sailor" puts the spar horizontally, and considers the direction and nature of pulls on rope in the following manner, I think he will be able to grasp the reason why there is no more stress on the rope at what he terms the neutral point than at any other point of the rope. Looking at the accompanying sketch, A is seen to exert a downward tendency on its own part as *a*, and an upward tendency of part B, marked $a^1$; similarly B exerts a downward tendency of its own part *b*, and an upward in the part A as $b^1$. Now it is evident that $a^1$ $b^1$ tending towards each other relieves the rope of half its apparent stress at the point where rope bears on the spar, and they counteract each other at the bend of the rope, thus leaving the sum of the two weights only as the resultant pull on the spar, which (where A and B are each equal to three tons) will be six tons. Georgius.



[72168.]—**Electric Bell and Battery.**—I did not think my comments on Mr. F. C. Allsop's criticism of another critic were so much called for as his remarks on this subject in the issue of Oct. 10 show. I should be sorry to criticise the dictum of anyone who has written a book on the subject if I were not perfectly sure of being free from any "hallucination." But Mr. Allsop says "he has been perfectly aware of my great hallucination on the subject ever since my articles appeared in the *Electrician* in 1879." Regarding the twenty-two lines following, I refuse to believe Mr. Allsop will seriously stand to his contention. If he will consider the point with the process of electro-dissolution and deposition of metals in his mind at the same time, he will, I think, withdraw his exposition of the "very simple case" which he propounds; especially as his reference to p. 113 in his book is quite inconsistent with it. In my articles, which Mr. Allsopp says he read in 1879, I anticipated his reasoning about the case of "the wiring of an hotel," where he says that "it might be preferable to put zinc to push; but this is to save a rupture of the main wire to the pushes, and consequently a break-down in the communication throughout the entire building." As a temporary expedient to patch up a bad job, this might be justifiable; not otherwise, for it would be only staving off the evil day till the *whole wiring would have to be renewed.* When I wrote in 1879, it was a common practice with some fitters, and the contractor was more sure of getting paid for the job before a break-down occurred. On reviewing my previous remarks on the query which led to this little controversy, I believe your electrical readers will see that Mr. Allsop neither has, nor can, upset my contention—viz., that "carbon to push" is the only safe rule for new work, the reason for which I claim to have clearly and concisely set forth. Walker Moseley.

[72262.]—**Guinea Fowls.**—The habits of these wandering, restless birds render them miserable and sickly in pens. They require more insect food than pheasants; in fact, it is their chief diet—grasshoppers being the favourite one. They thrive wonderfully in a few acres of rough grass land, with timber trees as a roosting-place. Look at their claws, and you will see how necessary is perchi
Try a thick bough with many branches
ground inside a shed; but they will nev
or happy without a long run. In Afr
found the wild birds in the most impene
thickets; only at roosting time could the
shot on the trees.

[72267.]—**Chemistry.**—There are s
the textbooks on the action of electric
organic substances, in the "E.M.,"
Transactions of several societies, but I
there is any book on the subject. Of co
currents would act only by way of elect
much would depend on the organic subst
the current strength (force plus quantit
result. What is the querist's object?

[72268.] — **Turning Spirals in**
"Carius" may obtain some information
to the Spiral Wood Cutting Company
street, Wharf-road, City-road, N., whic
to be the leading, if not the only, firm
spirals by specially-adapted machinery.

[72283.]—**Salt-Pans.**—The old-fash
pans cannot compete with the methods
refining the brine from the wells, and se
tains something more than chloride
which "something" has to be got ri
from sea-water is not exactly table salt.

[72285.]—**Galvanised Iron Water**
Anyone having a professional reputat
will hesitate before placing his name
"special knowledge" of this matter p
such a paper as the English Mechani
he will be quickly set right. I have
express my opinion that although some
dissolve the zinc, especially if there are
through it, so that galvanic action is set
tact with the iron, still the quantity of w
by any individual is so small that the
zinc must be infinitesimal; but many ci
majority) are lined with zinc, and litt
of any special complaint. A slate cist
haps the best; after that, the old-fashio
butt, well pitched inside; but it is alway
to boil the drinking water used in a hous
Samu

[72288.]—**Sugar-Coating Sweets.**—
is scarcely explicit. Why does she want
coat" sweets? I have heard of and s
coated pills, but not "sweets." Still
same—the articles to be covered are c
gum or gelatine, and then with what is
icing sugar, which is melted in a wat
bath, to avoid burning.

[72297.]—**Horses Running Away**
only just returned to England after an
some weeks, or would have replied to "
man." No. 1. "Unsuitable bitting" is
cause of rendering a horse unmanagea
him to an expert, who will drive him
and thereby find out the defect. No.
mouthed," the common result of
breaking-in when young, thereby ruini
for work. No. 3. "Acquired vice"—vi
the bit in the teeth and holding on to
resisting all power of pulling against hi
and 3 render an animal only fit for the ro
work of the farmer or ploughman, to
should be sold if found incurable by No.

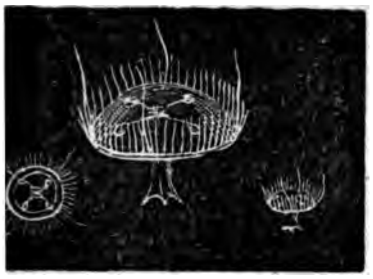
[72312.]—**Dissolving Nickel off C**
Hydrochloric acid has no action upon co
readily dissolves nickel. Immerse the art
acid until the copper appears in sight.
A

[72322.]—**Carbonic Anhydride.**—
(often erroneously termed carbonic aci
action upon any metal whilst in a dry
but a solution of the gas, which is
($H_2CO_3$) attacks iron and zinc, and as
partially composed of the latter, I shou
the acid to have some action upon
cannot store the substance (in any condi
drawer. The idea is simply ridiculous.
A

[72329.]—**Solvent for Alumina.**—
acid slowly dissolves alumina, but has
upon the metallic base. I do not expect
you mention is pure aluminum, but you
the above acid. Whatever you do, d
hydrochloric acid, as it is the best solve
metal. A

[72353.]—**Fresh - Water Medusa,**
**Gardens, Regent's Park.**—In June,
father, the Secretary of the Royal Botani
discovered, swimming about in the
Victoria lily tank, numbers of what appea
a small jelly-fish. Being unable to dete
name of the strangers, he submitted spe
Prof. Flower, P.R.Z.S., Dr. Allman,
Prof. Ray Lankester, and other well
scientific gentlemen, all of whom said
never heard of a fresh-water jelly-fish.

ade out the creature to be a medusa, and ; Limnocodium Sowerbii. Full descriptions, ures of its anatomy, were published in some ading scientific journals shortly afterwards.



irst placed among the Trachymedusæ, which directly from the egg instead of budding a fixed zoophyte; but since then a polype, cience, has been found in the same tank, generally believed to be the fixed form ich the Limnocodium buds; but although ype has been continuously watched, the n stage has never been seen. In fact, hese little jelly-fish have appeared in the tank nearly every year since 1880, where ne from and their mode of reproduction is ystery, and it is curious to note that in no rt of the world are there any medusæ living water known to science. I inclose copy of .S.L. Quarterly Record, which contains a on and figure, showing the medusa, size and magnified three diameters, and pleased to send a copy to your corre- t, "J. C. S.," if he will favour me with his

J. B. Sowerby.

ic Gardens, Regent's Park.

.]—**L. and S.W. Tank Locos.**—"North- " also makes a slight mistake in his reply, trust, he will permit me to correct, at the e thanking him for his reply, as it was in o a query of mine. Nos. 169 to 173 (except ch is a six-coupled goods), 82, 104, 125, and to 495, and 516 to 525 have all side tanks nearly to the driving-wheel splashers, as e 58 to 60, 106 and 107, which he does not Nos. 123 and 124 are Beyer Peacock's h long side-tanks completely covering the wheels, same class as 374. No. 129 I am about; I should be obliged if "North- " could give me the name of the maker of ate and maker's number. Nos. 77 and 78 of the new front coupled tanks, 61 class, s year; at all events, I do not know of rs for these numbers, except the old ldfire 77 and Hecate 78. If "North- " has seen ten-wheelers for these numbers, tell me when and where, also where 52, 4 are stationed?

Locomotive.

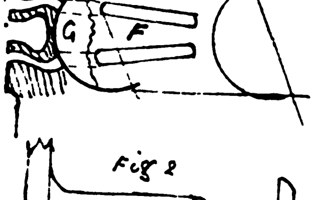
n.

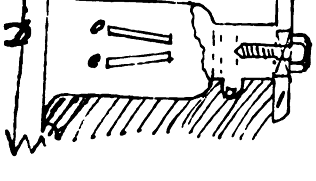
.]—**Electric Bell and Battery.**—Con- carbon pole of the battery to one of the of the bell, from the other terminal run a e push in the furthest room, and from the he battery run another wire to the same d from these wires run branch wires to es in the other two rooms. You will wo cells to get the best ringing effect.

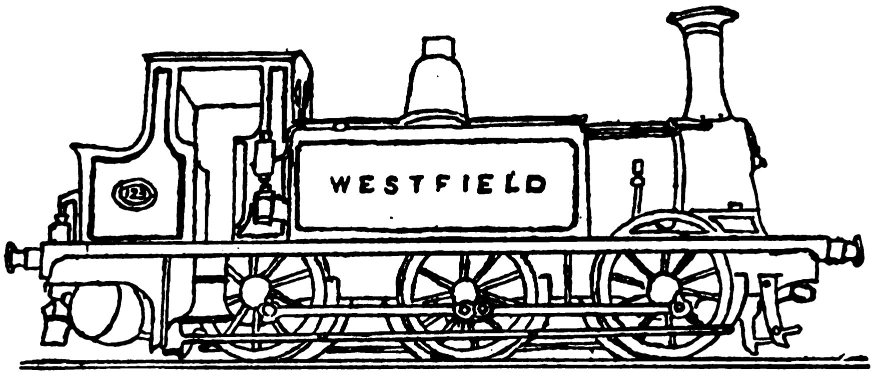
T. Hagues.

]—**Compound Oscillating Paddle** .—To "Jack of All Trades."—I am not tell you that this is how they are made, have not seen any of them; but I picked of paper in the street with something on ne, and I put this and that together, which you. The accompanying sketch will give hing like getting at proportions; but that will be got at best by putting it upon paper to scale, as all this arrangement will depend upon length of stroke, &c. You will see that, I dare say, as well as position of the trunnion, and there are several advantages got by the casting of the ports in the trunnion, and the ports are always open the same area; second, they drain out; third, the shearing action, they wear better, and are not so likely to ridge and ride; and lastly, they insure lubrication, and therefore, take all things into consideration, wear much better and more regular. In sketch to the left of Fig. 1, A is the valve face of steam-chest, and B B are steam-ports, E is the exhaust, the curve at back at G is the inside next trunnion, past the rag is F, showing the position of the ports in trunnion, and the arcs are showing position of seat of trunnion. Fig. 2 gives you what I should do—a conglomeration of section, &c., of trunnion, which will be understood, I have not the least doubt. D cylinder side, C C ports, H recess for tallow for lubrication, I washer fitted upon square to keep tight.

Jack of All Trades.







[72419.]—**Selenite.**—I may inform Mr. Bottone that my son, when residing in Portland, used to find crystals of selenite in a stratum of clay exposed in railway cutttings between that place and Weymouth.

Walter M. Hardie.

[72447.]—**Aluminium Plating.**—Mr. Bottone states there is not a trustworthy process of depositing aluminium electrolytically. Will someone please say if there is a method of obtaining aluminium electrolytically from the solutions at all, and if so, how?

Bert.

[72456.]—**Magnetic Sheet Brass.**—Since finding strong magnetism in some brass boxes, as referred to in the query of the above number, I have been put to a great deal of trouble in testing others, with the result that about 10 per cent. are, more or less, magnetic. What seems to me extraordinary is that a well-known compass-maker, who made the boxes for me, says he has never known of similar instances. The well-known liability of brass castings to contain iron filings offered very little explanation, and, since discovering the cause, there arises fresh food for wonderment. I found in one a piece of thin steel about 1in. × ⅜in., as thin as tissue paper, and in the middle of the thickness. If all were like this one, they could be tested and passed, or condemned in an instant, but others have power to deflect the needle only 2 or 3 degrees, and very much more time is occupied in proving all those that are free from such faults.

W. Moseley.

[72461.]—**Piano Played by Electricity.**—There is a description of apparently what the querist wants on p. 319, No. 1290, and I think I saw an instrument of the kind at one of the exhibitions held at the Crystal Palace. There cannot be much difficulty in devising such an arrangement; but—Cui bono?

Organon.

[72493.]—**Great Western and Great Northern of Scotland Railways.**—It may interest "Mr. Loco. No. 2" to know that No. 9 (G.W.R.) has been rebuilt, and the eccentrics that were outside are now inside, and the driving wheels have now outside bearings; altogether the engine is now exactly the same as No. 10. No. 9 was up at Paddington to-day (Oct. 6th, 1890). A capital sketch of No. 9 appeared in the issue of "Ours" for Sept. 24th, 1886 (Vol. XLIV. No. 4).

North Western.

[72506.]—**Spectroscopic.**—Besides the focussing recommended by "F.R.A.S.," the spectroscope must have an exceedingly narrow slit to show the absorption lines. "Zain" says that by a certain arrangement he gets a long bright spectrum without lines. This brightness may be due to the slit being much too wide. A narrow slit excludes light, and will not give a highly dispersed bright spectrum unless the source of the light be very intense, such as the sun. If "Zain" will direct his spectroscope point-blank towards the sun when nearing the horizon, using a slit narrow enough to reduce the light admitted to an endurable amount, he should not fail to see the absorption lines, providing the focussing is correct.

Walter M. Hardie.

[72502.]—**N. B. Railway.**—I inclose a sketch taken from a photo of "Westfield," No. 123, one of Mr. Drummond's 4ft. 6in. six-coupled tank engines for passenger traffic, but am unable to give dimensions of the loco.

J. A.

[72508.]—**Thin Enamel on Glass.**—Have you tried a wax of rouge and borax, oxide of cobalt, or oxide of tin with borax, and subjecting it to a red heat, brown, blue, white?

Jack of All Trades.

[72512.]—**Heating Shop.**—The two pipes you intend using would be sufficiently large enough to insure circulation, and could be taken either under or above doorway, which would be most convenient. If taken under door, which would cause a dip in the pipes, an air-pipe or vent should be put in the highest point of pipes immediately before and after dip. If taken above door, one air-pipe or vent would be sufficient. I have used saddle boilers with every success, fixed end upwards, with the firegrate at bottom end of boiler and the open bottom of boiler placed against a setting of bricks, with a flue left between the outside shell of boiler and brick setting, so as to allow the heat to act upon inside and outside shell of boiler before passing into chimney flues. The fire can be banked up to last from 18 to 24 hours without any attention, and keep your workshop sufficiently warm. The boiler I would recommend for all purposes of heating with water is the upright conical boiler. You need not have your cistern for feeding more than 4ft. above the highest point of your pipes.

Leeds. W. Farrar Bramley.

[72514.]—**Brazing Copper and Brass.**—There is a composition called quick, and I think you can make it thus: Take equal parts of tin, copper, and zinc. I have made it in a long tobacco pipe; put the tin in and melt, stop the hole with a little clay first, then the copper in the shape of bright small copper wire, cut up; then put into the fire again, then the zinc, and stir it up with an iron wire, put a pinch of salt into the pipe, and get a good heat; then take out, and turn it out upon a slab. Now pound it up fine; this, mixed with some calcined borax in powder, is ready for use. Make your job red hot, take out, that is when the spelter, and solder or spelter is on it, and dust a very little of this on it, and put into the fire again, and it will go off with a flash. If you put too much, your work will be brittle.

Jack of All Trades.

[72516.]—**Testing Hardness of Water.**—I omitted to mention in my reply to this query the number of cubic centimètres of soap solution used denote the degrees of hardness. You will see by the following table that soap is no use in an analytical sense, as the whole of the impurities mentioned may be contained in one single sample of water; and to produce 10° of hardness (Clark's scale) the annexed quantities of the mineral salts are necessary:—carbonate of lime 10·0 grains per gallon, sulphate of lime 13·6, nitrate of lime 16·4, chloride of calcium 11·1, carbonate of magnesia 8·5, sulphate of magnesia 12·1, chloride of magnesium 9·6. Wanklyn, in describing his method, says:—"Many years ago the late Dr. Clark brought out a simple method of measuring the degree of hardness of different waters. He ascertained, by direct trial, how many measures of a standard solution of soap were required by a gallon of water in order to form a lather. Nothing could be more simple or more direct than Dr. Clark's soap-test itself; but, unfortunately, an unhappy mode of registering the results was adopted, and a certain degree of confusion crept into this transparently simple matter. Instead of registering the degree of hardness of a water as the number of measures of standard soap solution consumed in producing a lather, he registered the degree of hardness as the number of grains of carbonate of lime (or its equivalent of other soap-destroying salts) in the gallon of water. The relative degrees of hardness of two waters are, on our scale, simply the number of soap measures consumed by a gallon of the waters in yielding a permanent lather; and the quantity of soap in one soap measure is the quantity required to precipitate one grain of carbonate of lime." Clark's table, taken from his specification, is as follows, 1,000 grains of water used, each measure of soap solution 10 grains.

| Hardness. | Measures of soap-solution used in producing a lather. | Difference for the next degree of hardness. |
|---|---|---|
| Distilled water 0 | 1·4 | 1·8 |
| 1 | 3·2 | 2·2 |
| 2 | 5·4 | 2·2 |
| 3 | 7·6 | 2·0 |
| 4 | 9·6 | 2·0 |
| 5 | 11·6 | 2·0 |
| 6 | 13·6 | 2·0 |
| 7 | 15·6 | 1·9 |
| 8 | 17·5 | 1·9 |
| 9 | 19·4 | 1·9 |
| 10 | 21·3 | 1·8 |
| 11 | 23·1 | 1·8 |
| 12 | 24·9 | 1·8 |
| 13 | 26·7 | 1·8 |
| 14 | 28·5 | 1·8 |
| 15 | 30·3 | 1·8 |
| 16 | 32·0 | 1·7 |

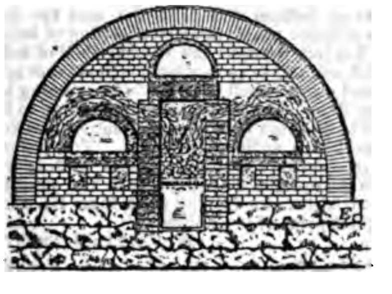
You will see many analysts using different tables, so several will give different results with the same sample of water. Wanklyn's method I think the most feasible. CHAS. E. GITTINS.

St. George's House, Eastcheap.

[72519.]—**Master Taps for Recutting Dies.**—The bottom of taps *re* threads should be a trifle larger than the size wanted, say, for 1in. 1 in $\frac{1}{24}$.

JACK OF ALL TRADES.

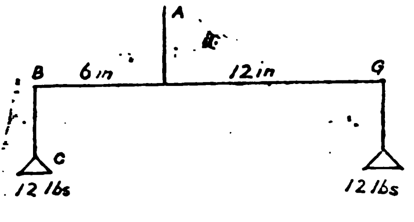
[72520.]—**Case-Hardening Oven.**—The following will suit you—cast-iron retorts or fireclay.



For case-hardening use wood charcoal-dust, wet up with two parts salt, one part yellow prussiate of potash dissolved in water.

JACK OF ALL TRADES.

[72521.]—**Leverage.**—This resolves itself into a simple question of parallel forces. You have two forces at G and B tending to pull the bar downwards, and you have the tension of the string at A tending to keep the bar in its position. In order to maintain the equilibrium, the weight or pulling force at G, multiplied by its perpendicular distance from A, must equal the weight of C at B multiplied by its perpendicular distance from A. That is, you must have F × G A = C × B A. Substituting values given, we have 6 × 12 = 12 × 6. Therefore, we shall have equilibrium because these two are equal. The weight on A will be 18lb, plus the weight of the bar. R. B. T. W. Z.



[72521.] — **Leverage.**—The arrangement in Fig. 2 (p. 131) will certainly not balance except under one or other of two conditions—(1) That the arms of the lever balance each other independently of any suspended weights; or (2) that the bar itself is entirely devoid of weight. The latter condition is impossible. Suppose, however, the bar to be of uniform thickness throughout, and that it weighs $p$ lb. per inch, the arm A G being, of course, heavier than A B. Let A G measure $x$ inches, and F = $w$ lb. Then, remembering that the moment of the arm of a lever with respect to the fulcrum is the weight of the arm multiplied by half its length, we have for the equation to equilibrium—

$$72 + 18p = \frac{p x^2}{2} + w x,$$

from which, if we know any two of the quantities $p$, $x$, and $w$, we can calculate the third. Moreover, the weight on A is always the sum of the weights C and F, plus the weight of the bar. Thus, if $p = \frac{1}{4}$ and $x = 12$, then $w = 4{\cdot}87$, and weight on A = 21·37lb. But if $p = \frac{1}{4}$, and $w = 6$, then $x$ = 10·46in., and weight on A = 22·11lb.

Charing, Kent. J. R. C.

[72530.] — **Zoology.** — Cheese - maggots, or "jumpers," are the larvæ of the cheese-fly (*Prophilus casei*), which deposits its eggs in the cheese. The common cheese-mite is the *Acarus domesticus*. R. B. T. W. Z.

[72537.]—**L.B. and S.C. Railway Singles.**—The small copper wheel is used, I believe, to drive the electric-light apparatus, carried on the tender or in the guard's break next the engine.

NORTH-WESTERN.

[72537.]—**L.B. and S.C. Ry. Singles.**—The small copper wheel on the singles is part of the apparatus to give the speed the engine is running. It is driven by the band passing around a small grooved disc fixed on the axle of the driving-wheel, and is connected with an indicator inside of the cab on the right-hand side.

Brixton. LOCOMOTIVE.

[72539.]—**Railway Punctuality Returns.**—In reply to "Traveller" (p. 132), my attention has for some time been directed to the returns which are presented to Parliament every two months relating to the arrival of trains at various London stations. I have obtained the length of journey and kind of train in each case, and the result of my dissection of the return is that, for all practical purposes, it is useless and misleading. Your correspondent calls my attention especially to the Great Eastern and Midland Companies. The Great Eastern runs a very large number of local trains into Liverpool-street. They come but a few miles, and consequently keep time. On the other hand, the Midland trains running into St. Pancras are practically all main-line trains from either Scotland, Bradford, Liverpool, Manchester, Nottingham, or Leicester. It is very easy indeed for the Great Eastern Company to work local traffic into Liverpool-street to time; but it becomes extremely difficult for such a line as the Midland to bring in its long-distance expresses punctually, more especially as they depend upon the arrival of other companies' train at Carlisle, York, Normanton, Marple, and several other stations. To make the returns presented to Parliament of practical value, they should show both up and down traffic, and distinguish between simply local trains and through express trains; and, further, the records should not refer to London only, but contain data as to arrivals in important towns such as Glasgow, Manchester, Liverpool, and Bristol.

CLEMENT E. STRETTON, C.E.

Saxe Coburg-street, Leicester, 7th Oct.

[72541.] — **Centre of Gravity of Loco.**—"Molesworth's Pocketbook" gives: Rule for the centre of gravity of locomotives:—C = horizontal distance line of centre of gravity from driving axle; L = load on leading axles; T = load on trailing axles; $l$ = distance of leading axle from driving axle; $t$ = distance of trailing axle from driving axle; W = total weight of engine. $C = \frac{L\,l - T\,t}{W}$ measured towards leading axle. If the load on the trailing axle exceeds that on the leading axle, then $C = \frac{T\,t - L\,l}{W}$ measured towards trailing axle. This rule applies to six-wheeled engines when the driving wheel is placed between the leading and trailing wheels. NORTH-WESTERN.

[72541.]—**Centre of Gravity of Loco. Engine**—The position of the centre of gravity of a six-wheeled engine is usually slightly in advance of the driving-axle; the practice seems to be varied, however, according to circumstances. The rule for finding the centre of gravity of locomotives, according to Molesworth, is:

$$C = \frac{L\,l - T\,t}{W}, \text{ or}$$

$$C = \frac{T\,t - L\,l}{W} \text{ if T t exceeds}$$

L $l$ where C = horizontal distance line of centre of gravity from driving axle.

L = load on leading-wheels.
T = load on trailing-wheels.
$l$ = distance of leading from driving-axle.
$t$ = distance of trailing from driving-axle.

In your query, taking 10ft. as the distance from the centre of bogie, the position of the centre of gravity is nearly 1ft. 3in. in advance of driving-axle.

R. J. URQUHART.

[72541.]—**Centre of Gravity of Locomotive.**—The horizontal centre of gravity of either a bogie or six-wheeled engine should be a few inches in front of the centre of the driving axle. To find this point, multiply the weight resting upon the leading wheels (or leading bogie, if one be used) by the distance in feet from the centre of the driving axle. Multiply the weight upon trailing wheels by distance in feet from driving axle. Find the difference, which divide by the total weight of the engine in tons; the quotient is the horizontal distance in feet of the centre of gravity from the driving axle in the direction of the axle carrying the greater weight. "Driver" (p. 132) tells us his engine weighs 41tons 13cwt. 2qr.; on leading wheels, 14tons 6cwt.; on trailing wheels, 12tons 16cwt.

14·3tons × 10ft. (for leading end of engine)........................ 143 ft.-tons
12·8tons × 8ft. 6in. (for trailing end of engine) ........................ 108·8ft.-tons

Difference ............... 34·2

This difference (34·2), divided by total weight of engine (41·68), = ·82 of a foot. Therefore the centre of gravity of the engine is ·82ft., or 9⅞in. in front of the driving-axle.

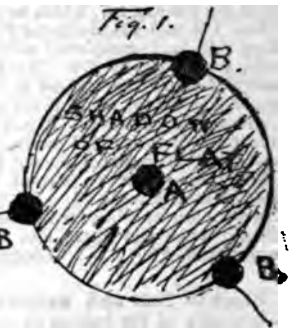
CLEMENT E. STRETTON, C.E.

[72542.]—**Weight of Engine.**—Increase of weight is mainly due to the very much higher pressure carried in the boilers now, therefore they are made heavier, the fire-boxes larger, and the frames heavier and stronger, to bear the increased strain. NORTH-WESTERN.

[72542.]—**Weight of Engine.**—The weight of the engine is mostly of the frame—that is, the frame, cylinders, wheels, motion, springs, &c. The proportion of weight of the frame and parts to the boiler varies according to the class of engine. I have not an example to hand now. The weight of engines is increasing with the power, larger boilers, cylinders, wheels at times, heavier motion.

R. J. URQUHART.

[72546.]—**Reflecting Telescopes: Adjustment of.**—Mr. Westlake's remarks in "E.M." July 3rd, 1882, as to "spot and pin-hole method," referred, I believe, to my suggestion and description of it in "E.M.," January 13th, 1882, the method being stated as follows: (1) To complete the adjustment of the silver-on-glass mirror: *a*, mark a central spot A on the mirror; *b*, ascertain the diameter of the reflected image of the flat on the mirror, and then mark three other spots B B B on the mirror, one in the direction of each of the adjusting-screws of the cell; *c*, by the adjusting-screws bring the B B B spots into position as in diagram, Fig. 1, bisected by the circumference of the reflected image of the flat when seen through the usual adjusting pin-hole eyepiece. These spots on the mirror can be of any size, such as can be clearly seen. They can be made by removing the silvering, without the least injury to the mirror, by a spill of rolled soft paper. Their exact position can be marked off from a straight-edge laid over the mirror without touching it, resting upon the metal ring, or they can be set out upon a stencil plate through which the spots can be made exactly. 2. To insure the axis of the eye tube being parallel with the axis of the reflected cone of light. In addition to the usual pin-hole adjusting eyepiece C, Fig. 2, insert at the other end of the eye-tube another disc with central hole D, rather larger, and then observe whether the reflected image E of the flat is central through both holes C and D; if not, and if a slight alteration of the flat does not correct the error, then alter the position of the support of the eye-tube until the image of the flat is central at all distances and while the eye-tube is rotated. After continued experience of the plan, since then I find that the one "central spot," about ¼in. diameter, is practically sufficient, although the spots B at the edge of the "flat" shadow insure absolute exactness in placing the central spot; the spots can be made well with dull black paint. The diameter of the flat is that of its shadow on the mirror. The base of the eyepiece tube should be mounted with three screws for adjustment, but the ordinary flat base may be adjusted by inserting thin metal wedges between it and the telescope tube. The size of the hole in the inner disc D, Fig. 2, should be ⅛in. diameter or less, just large enough to show a fine ring of light round the shadow of the flat; the appearance through both the pin-holes when the adjustment is completed should be as in Fig. 3. The effect of this method of refining upon the ordinary



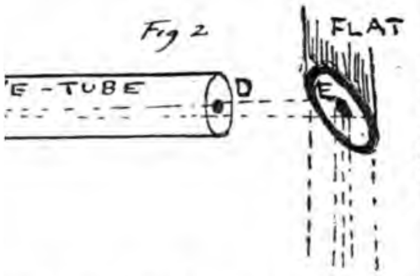


Fig 2

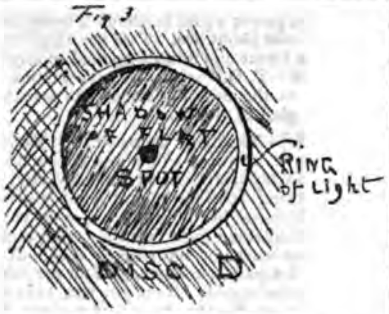


Fig 3

which should first be done, is to make ie mirror exactly coincident with the repiece—resulting in practically perfect Try it. T. A. SKELTON.

on, October 4.

**Sounds.**—Every shock received by membrane is transmitted through a s to the opposite membrane, thence to f the labyrinth, and thence to the ve. It is on its transmission to the re that the sounds are analysed, partly tles of Schutze, and partly by the ie former are so arranged that when give different pitches, the latter tend the vibrations of evanescent sound. und-vibrations strike the bristles, each ation selects the bristle which has a to its own, and in this way the sound nd passed on to the nerve.

R. B. T. W. Z.

**Steam-Boiler**—The plan which you eding steam to your coils at the lowest iot work at all satisfactorily; you would but burst pipes and broken joints. nect the return end of pipes to boiler level, and do away with your steam tead of your condensed steam running ve it returned to your boiler at boiler

W. FARRAR BRAMLEY.

**Cement for Loose False Teeth.**—hich I want to cement are mounted on t is the incisors which appear to be the vulcanite, with two wire pins, and drawn out a little. DENS.

**Coloured Lights.**—Use a coloured-y. SM.

**Vibration.**—Probably Edison's phono-thing like what "Dyfi" requires. It n the "A B C of Electricity"; but I to it just now. DIRECTOR R.R.L.

**Naples.**—Never having lived in not give you much useful advice. But t any letters of introduction to Italians vill take their advice as to placing pensione" you can, if you accustom ieir mode of living, live cheaply and ou must avoid all dealings with others ind bear in mind Bulwer's golden rule ishmen (and for that matter any other who are living out of their own country ided. S. BOTTONE.

**Chromic-Acid Battery.**—Do you le cell, or do you mean a number of single cell, make your carbon present face as you possibly can, keeping the s thin as you can, to leave as much ble for chromic solution. The nearer to each other, the less internal resist-o the sooner polarisation sets in, unless requently agitated. In my best cells I on plates 3½in. wide by 7in. long, and Between these lies a plate of zinc of the ons, separated by a space of $\frac{3}{16}$in. on om the carbon plates. If you refer to nany cells, then the most effective size, on whether a high or low resistance is n circuit. If the former, the exact size is not material; if the latter, the larger id the elements must be so connected nd series that the internal resistance early as possible the external.

S. BOTTONE.

**Dynamo Output.**—No, the statement ie highest voltage is 300 volts, and that output is 10 ampères. But the shunt reaches its highest E.M.F. when the circuit is at its highest point, and then current is at its lowest. Supposing the e in circuit be 300 ohms, then as the its highest, viz., 300 volts, the current père. Now let us suppose the total be reduced to 30 ohms. A current of will now flow, but it will be evident at terminals will immediately fall. he resistance in circuit is less, less round the F.M., and the E.M.F. of alls in proportion. S. BOTTONE.

[72581.]—**False Notes in Piano.**—Are you quite sure the complaint is "false notes"? It seems to me, from your description, that either your sounding-board is split, or else one of the bridges has become detached from the sounding-board. I never yet heard of the uncovered treble strings of a piano giving "false notes," though I have had 30 years' experience. S. BOTTONE.

[72582.]—**Tempering Skates.**—Take off the parts you want tempering, heat them to a cherry red, plunge them in limpid water, they will come out white; heat a large piece of iron red, and then lay the tempered parts on it until they turn grey, then plunge them until cool in oil. CYMRY.

[72583.]—**Polaris.**—The *comes* is 9th magnitude at a distance of 18—19 seconds. Perhaps it is too small for your telescope. The two principal components of Castor are 3 and 3½ mags., and 4—5sec. apart. However, you ought to see a 9th if your glass is any good at all. SM.

[72583.]—"**Comes**" **Polaris.**—Like "Astro-Stargazer," I had a great difficulty with the *comes* to Polaris at first, though in my case it was less to be surprised at, as my glass is only 1⅞in.; but happening to turn the telescope on the star in strong twilight during the present summer, I saw the companion very distinctly, as the flare of the larger star was toned down by the twilight. Perhaps your correspondent might try this method if he fails during the night hours; but surely 180 on 3in. ought to do it easily at any time. As Polaris souths about 10 or 11 p.m., and the position angle is 210·1°, he will find the *comes* just a little to the left of directly above the larger star in an inverting telescope about the time named. The distance is 18·6″.

W. J. PAYNE.

[72584.]—**Fountain.**—If I understand the query aright, I am afraid that the law of conservation of energy would stand in the way of carrying the scheme out exactly as described. There are, I believe, one or two devices which approxionate to it, the unavoidable loss of power being minimised.

DIRECTOR R.R.L.

[72584.]—**Fountain.**—This querist, judging by the terms of his query, seems to want a sort of perpetual motion, which, it is needless to say, he cannot get. He must raise the water by some means outside of his fountain, unless he uses one of the reversible fountains—that is, one of those which are turned over when they cease to play in one direction of the containing vessels. If he can refer to Nos. 402, 405, 459, 582, 801, 967, 973 and 974, he will find a variety of designs from which he can select one that suits him. NUN. DOR.

[72585.]—**Vacuum Gauge.**—To begin with, the difference between the two gauges is that the one you use now is numbered by the ½lb., and your previous one numbered by 1lb. So that you see 30 half-pounds is equal to 15 whole pounds. Your employer expects too much. The atmospheric pressure is constantly changing, as you can see with a barometer. Even with the best possible means, you cannot have a perfect vacuum. With the barometer at 30in. you could have no more than 14·7lb. of vacuum, and to obtain 15lb. (or 30 half-pounds) the barometer must stand 30·6in. I consider you have good vacuum with the gauge indicating 27.

ALLTFAR.

[72586.]—**Vacuum.**—Procure a filter pump from any apparatus-maker, for about half-a-crown; attach to high-pressure water supply, and preferably attach a long ½in. bore pipe to take away the water. SM.

[72586.]—**Vacuum.**—To produce anything like a real vacuum a Sprengel pump is necessary. To do it by aspirators a 40ft. fall would be required, so that it is impracticable. A good filter pump (such as can be purchased of most dealers in chemical apparatus) with a 15ft. fall of water will readily reduce pressure to about 6in. of mercury. There are, however, filter pumps and filter pumps, and one has to pay a good price for one that is really efficient. DIRECTOR R.R.L.

[72587.]—**Making Gold Band Ring.**—If by "pewter" this querist means a mixture of lead he has mixed with his gold, he has spoilt it for further use without it is refined again, as the lead that is in it will make it brittle and render it unworkable. If he means an ordinary plain band ring, the best way to make it would be to turn it from a flat piece the required width and solder it. If he will write again with more particulars as to kind of ring, shall be pleased to help him. WORKING JEWELLER.

[72589.]—**G.W.R. Engines.**—The date of No. 153 G.W.R. is 1875. It was built at Wolverhampton. CAUCASUS.

[72589.]—**Locomotives.**—L. and N. W. R. No. 1840 Sefton, is one of Trevithick's 6ft. singles, built at Wolverton in 1856. Cylinders 15in. and 20in. originally. All of this class were enlarged and rebuilt by Mr. Ramsbottom in and about 1868. No. 2030, built in 1871, from the designs of Mr. Ramsbottom, at Crewe: Diam. of wheels, 5ft. 2in., cylinders, 17in. by 24in. G. W. R., No. 153, built by G. England and Co., London, in 1862, rebuilt at Wolverhampton, June, 1882, from the designs of Mr. Armstrong, diam. of driving wheels, 6ft. 6in., cylinders (since rebuilt), 17in. by 24in. NORTH WESTERN.

[72589.]—**Locomotives.**—L. and N.W.R. Sefton No. 1840 was designed by Mr. Allan about 1847, and was originally named Pegasus, with 7ft. driving wheels. L. and N.W. No. 2030 is one of Ramsbottom's six-coupled goods engines, built at Crewe Works in 1871; cylinders, 17in. diam. by 24in. stroke; wheels 5ft. 2in. N.E.R No. 1160. Am sorry I can give no particulars. G.W.R. No. 153. This engine was built originally by G. England and Co. in 1862, and was rebuilt at Wolverhampton Works in 1882. Her cylinders are 17in. diam. by 24in. stroke, and driving wheels 6ft. 6in., inside. C. F. DENDY MARSHALL.

[72590.]—**Lathe Carriage.**—The easiest way to find distance would be to gear your wheels for those threads, start your carriage and measure on the lathe bed; wheels will be for 1¾:

$$\begin{matrix}\text{Drivers } 80, \text{ or} \\ \text{Driven } 35 \;\; .. \end{matrix} \left\{ \begin{matrix} \frac{20}{35} & \frac{100}{25} \end{matrix} \right\}$$

for $3\frac{3}{8}$, $\frac{32}{27}$; for $\frac{1}{8}$ double thread, $\frac{20}{45}$. CYMRY.

[72592.]—**Medical Battery.**—Couple up the cells in five sets of four in series. Bring out the terminals on to a switch-board, with four plugs and corresponding binding screws. When all the plugs are in, you will get the current from all 20; when three plugs are in, from 16; when two, from 12; when one is in, from 8; and when all plugs are out, from 4 cells only. Of course, you will have to shift the connecting wire; or you can use a sliding contact running on a split disc. A Faradaic coil can be used with one, or at most two, cells, if they are bichromates, or four or five if Leclanché's.

S. BOTTONE.

[72594.]—**Aquarium.**—Some years ago I had an aquarium with ¼in. plate-glass sides a few inches smaller than your correspondent's. It stood on some rock-work in the garden (Kent), and, when the winter came on, I wrapped round the sides two or three folds of drugget, leaving the top open, breaking the top ice every day. One night there came a very sharp frost; in the morning I could not readily break the top ice, and, unwinding the drugget, I found one or two of the fish (carp) in the centre, where there were a few inches of free water. The others were frozen round the sides, and the front glass was split across. I then removed the aquarium to a greenhouse, where it remained all the winter safely. The fish gradually thawed out all right. I had, of course, to replace the glass. If the framing of the glass is metal, the glass is pretty sure to go in a frost if the water be left in. B. HARCOURT, Solr.

118, Palmerstone-buildings, E.C.

[72597.]—**Dynamo.**—If your castings are hard, throw them away: it will be cheaper in the long-run. If it is only the armature that is hard, get a set of 1½in. punchings for armature, and file them down, or turn them up to 1¼in. But the shape of your carcase is simply awful. The nearest size and amount of wire I can recommend is—armature 4oz. No. 22 silk-covered wire, field magnets, 1lb. of the same gauge, cotton-covered. Connect up in shunt. You should certainly read my book "The Dynamo" before attempting to wind such a machine.

S. BOTTONE.

[72598.]—**Sails, to Dye.**—Boil in water with oak bark. SM.

[72598.]—**Sails, to Dye.**—This is done with the liquor from a tan pit at a leather manufactory. If possible, dip the sail; if not, apply with brush as paint until you have the desired shade of colour.

W. P. W.

[72602.]—**Thymol Disinfectant.**—Thymol is soluble in alcohol, oils, and fats, also in 1,000 parts of water. SM.

[72602.]—**Thymol Disinfectant.**—"C. L." does not say for what purpose he wants a thymol disinfectant. For drains or household purposes the high price stands in the way, and even in surgical operations this has barred its general adoption. In summer its attractive odour brings on a plague of flies. Volkmann's formula in surgical operations is:—Thymol, 1; alcohol, 10; glycerine, 20; water, 1,000 parts. Spencer Wells' is:—Thymol, 1; warm water, 1,000 parts. As a detergent antiseptic for the mouth, its pleasant taste and smell are pre-eminently suitable. B.Sc.

Plymouth.

[72602.]—**Thymol Disinfectant.**—Thymol is a stearoptene contained in oil of thyme (Thymus vulgaris). It is, however, more often obtained from the oil of the fruit of Ptychotis Ajowan. It has an aromatic taste, and an odour of thyme. Applied to the skin thymol acts as a caustic, and is a powerful irritant to all mucous surfaces. It is soluble 1 in 800 parts of water, and fats and oils absorb it freely. Solutions can also be made with alcohol, ether, acetic acid, and some alkaline salts. This drug is both antiseptic and antiputrefactive, and is used in consequence for many surgical dressings. For the sick-room the 1 in 800 solution in warm water forms an agreeable antiseptic lotion which may be sprinkled about the apartment or atomised in the air. Thymol has been largely used associated with vaseline, &c., as a preventive to the bites and stings of many insects.

J. West, L.D.S., F.P.S., G.

[72604.]—**Plaster of Paris Appliances.**—I speak from experience gained from observing the benefit derived from them by a friend of mine, who was troubled with spinal weakness. He made a very good recovery, and told me that he found the plaster of Paris both absorbent and warm. He never complained of any inconvenience, except the natural uneasiness of first wearing an uncommon appliance, which soon wore off. No corset could ever be made to fit so exactly, and yet not compress or injure. S. Bottone.

[72604.]—**Plaster of Paris Appliances.**—As you have had no experience with them, don't attempt to make one or apply it, but take your friend to an hospital for spinal disease, and the surgeon in charge will tell you if it is a case where it can be usefully employed. The plaster of Paris jackets are seldom used in spinal cases, but, rather, those of a felty nature, which are fitted on soft, and harden very quickly. During the fitting-on the patient is suspended, chiefly from the head, receiving a little support under the armpits; by this means the spine is straight at the moment of application. Another form in use now is Cocking's (of Plymouth) patent poro-plastic jackets. They are made to measure, and strapped on.

Plymouth. B.Sc.

[72604.]—**Plaster of Paris Appliances.**—I hope that "Z. A." has not determined to treat a case of spinal curvature on his own responsibility; unless he is competent to discover whether the disease of the vetebræ is, or is not, still in progress; spinal appliances, whether they be of the plaster jacket kind, of the felt jacket, or the metal and bandage type, are all capable of increasing the deformity, or preventing the spine from regaining the erect position, if unskilfully applied; the plaster (or, as is now used, the poro-plastic felt, jackets) are applied under extension to restore the proper curve whilst applying the jacket; this process of extension requires special knowledge, and without extension, a diseased spine may be seriously cramped by the jacket, and the threatened deformity confirmed. The felt jacket can be removed for purposes of cleanliness, and is in every way preferable to the old plaster case, which gave rise to much suffering and ill health; but, let me drop the warning that this is a department of orthopædic surgery which needs great caution and a full experience. No untrained person should risk using these appliances. Gerard Smith.

Craigholm, Upper Clapton, Oct. 10th.

[72605.]—**Pressure.**—It does not matter how the tube is bent. If filled with fluid under pressure, the pressure is the same in all directions.

Nun. Dor.

[72607.]—**Emeralds.**—The emerald, or beryl, consists of silica 66·9, alumina 19, glucina 14·1, with chromium oxide as colouring medium. It has a sp.gr. of 2·7, and a hardness of 7½—8. It is brittle.

Sm.

[72607.]—**Testing Emeralds.**—The emerald crystallises in forms belonging to the hexagonal system, and will therefore act on polarised light. To apply the test, the gem must be unmounted.

Director R.R.L.

[72607.]—**Testing Emeralds.**—If this is a "paste" emerald, you can cut it with a sharp file; but perhaps it is a "doublet"—that is, it has got a scale of the real stone back and front with a false centre, and if it is mounted in a setting, it will be rather difficult to tell, if you cannot see the edges.

Working Jeweller.

[72607.]—**Polishing German-Silver Plate.**—There is no way of getting a polish on German silver otherwise than by friction, and the only way of applying such friction effectively is by means of a proper polishing machine; to do the work by manual process is out of the question; such a machine to be driven at the necessary speed would require a power equal to about 2-horse to drive it, and the cost about 30s. This would give a brilliant polish in about one minute applied to any particular part. If "T. D." wishes to have further information as to the construction of the machine, &c., I shall be glad to give it. G. G.

[72607.]—**Testing Emeralds.**—Your jeweller must have a queer education in his trade! He was probably not inclined to assist you. It is the easiest thing possible to test your emerald. The first and easiest test is to touch it with your tongue, when a real stone feels intensely cold, and all paste imitations warm, or but slightly cool. If you try a stone and a paste once, you will never mistake one for the other again. Next you can take a file, and try if you can file the stone. If you can, it is paste. No stone that I know of, except some specimens of Bobrowska garnets, comes up to the intense green of a good emerald; but if you wish to try further experiments get a pair of medicine scales, and take the specific gravity, which is easily done. An emerald's will lie between 2·6 and 2·75. It should scratch quartz, and, by the way, you may try this first of all, if you have a quartz crystal, as it will set the question of genuineness at rest at once. I have not mentioned the green corundum, or Oriental emerald, as that is so rare as to be out of the question. One thing more, your stone might be, namely, a doublet. I have seen some fine emerald doublets. Steep it in chloroform, and it will resolve itself into its constituent parts if so. In the dichroiscope the emerald shows two colours, a yellowish and bluish green. But, briefly, if your stone scratches quartz, and is a rich grass-green, it is either an emerald or green corundum, and the chances are about 10,000 to 1 in favour of the former.

T. Preston Battersby, Capt. R.A., F.R.A.S.

[72608.]—**German Silver, to Polish.**—Dip in cleaning acid or rub over with fine emery. Then polish with rouge or jeweller's chalk, using a piece of soft chamois leather. The acid liquor must be swilled off with water, and if the plates have anything like a planished surface, the emery need not be used. Nun. Dor.

[72610.]—**Lithanode.**—To Mr. Bottone or Mr. Fitzgerald.—1st. Because it is not generally known, and because it is more expensive than carbon. 2nd. Certainly, it gradually gives up its oxygen, and acts as a perfect depolariser. 3rd. A plain single-fluid battery with dilute sulphuric acid (like the old Walker). With this arrangement it gives really 2·5 volts per cell, or nearly double a plain zinc carbon element. S. Bottone.

[72611.]—**Coch-y-Bondhu.**—That is the correct spelling in Welsh of the name given to the bracken clock, or June bug (Phyllopertha horticola), used by anglers as bait. It is commonly called "cocker-bundy," is about ½in. in length, has reddish-coloured elytra and dark green head and thorax, can be found in many orchards in abundance, and I should think any owner of an orchard would allow the intending angler to capture as many as he could, and would not say anything if the latter did eat some of the fruit, provided he made a good "bag" of coch-y-bondhu. Nun. Dor.

[72614.]—**To Find a Person's Age.**—The following is, I think, the simplest way of finding a person's age. Let any person under 64 years of age point out the columns in which his age is found. Add together the numbers at the top of these columns, and the sum will be his or her age.

| 1 | 2 | 4 | 8 | 16 | 32 |
|---|---|---|---|---|---|
| 3 | 3 | 5 | 9 | 17 | 33 |
| 5 | 6 | 6 | 10 | 18 | 34 |
| 7 | 7 | 7 | 11 | 19 | 35 |
| 9 | 10 | 12 | 12 | 20 | 36 |
| 11 | 11 | 13 | 13 | 21 | 37 |
| 13 | 14 | 14 | 14 | 22 | 38 |
| 15 | 15 | 15 | 15 | 23 | 39 |
| 17 | 18 | 20 | 24 | 24 | 40 |
| 19 | 19 | 21 | 25 | 25 | 41 |
| 21 | 22 | 22 | 26 | 26 | 42 |
| 23 | 23 | 23 | 27 | 27 | 43 |
| 25 | 26 | 28 | 28 | 28 | 44 |
| 27 | 27 | 29 | 29 | 29 | 45 |
| 29 | 30 | 30 | 30 | 30 | 46 |
| 31 | 31 | 31 | 31 | 31 | 47 |
| 33 | 34 | 36 | 40 | 48 | 48 |
| 35 | 35 | 37 | 41 | 49 | 49 |
| 37 | 38 | 38 | 42 | 50 | 50 |
| 39 | 39 | 39 | 43 | 51 | 51 |
| 41 | 42 | 44 | 44 | 52 | 52 |
| 43 | 43 | 45 | 45 | 53 | 53 |
| 45 | 46 | 46 | 46 | 54 | 54 |
| 47 | 47 | 47 | 47 | 55 | 55 |
| 49 | 50 | 52 | 56 | 56 | 56 |
| 51 | 51 | 53 | 57 | 57 | 57 |
| 53 | 54 | 54 | 58 | 58 | 58 |
| 55 | 55 | 55 | 59 | 59 | 59 |
| 57 | 58 | 60 | 60 | 60 | 60 |
| 59 | 59 | 61 | 61 | 61 | 61 |
| 61 | 62 | 62 | 62 | 62 | 62 |
| 63 | 63 | 63 | 63 | 63 | 63 |

Thus, suppose a person's age to be 29, it is in the first, the third, the fourth, and the fifth columns; now the numbers at the top of these are 1,
which, added together, will give 29, the
age.

Dublin. Phillip She

[72614.]—**Guessing a Person's A**
the person add 1 to his age, multiply by
add his age, and tell you the number.
you substract 4, and divide by 4, which
the age required. There are plenty of oth
methods.

[72614.]—**Person's Age.**—This is
method, but the persons whose age you requ
calculate it themselves. Multiply the nu
the month of the year by 2, add 5, multi
product by 50, add their age, subtract f
365, add 115, strike off the first figure of
this obtained, you will get your answer.

C

[72618.]—**Winding Armature of Dyn**
It is well not to exceed five layers as a ma
In large machines two layers are sufficient, in
ones three to four. The addition of mor
increases the "extra" current, which is p
every time the brush passes from one colle
to the other, and also removes the inner l
wire farther from the magnetic field. Thi
loss is nearly inversely as the square of the
to which the inner layers are removed.
loss from this cause is not so great as one
first imagine, provided the armature is o
soft punchings, and of a fair size. S. Bor

[72619.]—**Marine Glue.**—The easiest
solve the question is to try. Marine glue wi
stand the action of water and many other li

[72619.]—**Producing Darkness.**—F
apparatus for showing the interference
is described in most books of physics—Ga
example. The querist must understand
darkness is meant that the beam of light, in
producing a continuous band on the screen,
band of alternations of light and darkness,
that monochromatic light must be employe
the full effect. Director R

[72619.]—**Producing Darkness.**—By
conclude you mean observing the bands p
by interference of light. To do this, take a
lantern, arrange it to throw a parallel be
cause the light to pass through a very nar
such as may be made out of tinfoil.
through a telescope placed at a distance, w
slit of light will be seen to be accompanie
interference bands.

Nearly 3,000 persons now find employ
the Edison Electric Works at Schenectady,
company is so extending its plant that ma
will soon be employed. In the new power
now being built will be located monster d
which will furnish electricity for the many
which are to supplant the steam-engines
use.

The largest gold coin in circulation in th
is stated to be the gold "loof" of Au
French colony in Eastern Asia. It is a fla
piece worth about £65 sterling. The next i
this unwieldy coin is the Japanese "obang,
weighs rather more than two ounces and
about equal to ten English sovereigns.

**Obtaining Prints to Scale at the Or**
**Survey Office.**—Capt. C. E. Haynes, R.E
that the large-scale maps of the Ordnance
are printed on double elephant machi
drawing paper, the expansion of which,
humidity, is greatest in its length. Being
paper, it is necessary to print from the zinc
damp sheets, which contract on drying, i
chiefly; consequently, the form on the plat
have a similar elongation. The negative
true to scale, and a photographic transfer p
after the Southampton method, on Evans
elephant thin paper, which likewise has its
expansion in length. Previous to transfer
the transfer is damped until it has expan
certain convenient length—in practice,
quarter of an inch beyond its correct s
quickly passed through the zincographic pr
scraping action of the press increases the l
the transfer by a slight variable amount, w
be determined by experiment. The prin
obtains a stock of paper for printing that
damped to such a degree of expansion as
tract on drying to the correct scale. In th
damping department a stock of printing
kept sorted in various degrees of expansio
the variable sizes of form on the zinc plates.
sheet of paper used for printing is measure
being damped, after being damped, and ag
being printed. Prints with over $\frac{1}{600}$ or ·16
of error in scale are cancelled. It is found
elasticity of paper—i.e., its capability of r
its original form on drying after being dam
pends on its maturity, and that the matu
sheet depends on its age, and to a certain e
its position in the ream.

## NANSWERED QUERIES.

*numbers and titles of queries which remain unan-
for five weeks are inserted in this list, and if still
wered are repeated four weeks afterwards. We trust
ders will look over the list, and send what information
m for the benefit of their fellow contributors.*

Paper-making, p. 520.
Hinge Joint, 520.
L. and Y.R. Locos., 520.
Weather Forecasting, 520.
Cutting Tissue-paper, 520.
Eccentric, 520.
Goathland Mile Incline, 520.

Guinea Fowls, p. 42.
Grandfather's Clock, 43.
Troughton's Reflecting Circle, 43.
Electroline, 43.
Direct Vision Prism, 43.
G.W.R. Locomotives, 43.

## QUERIES.

620.]—**Compound Distillers.**—I should be glad
meone would give me a formula for the cooling sur-
required for a distiller, when T = temperature of
in tubes, and *t* that of the water outside of the tubes
oling purposes?—B. I. S.

621.]—**Giffard's Carbonic-Acid Gun.**—Can
ubscriber oblige with information as to meaning of
pansion of liquid carbonic acid which is injected
all quantities behind the cartridge and immediately
nto gas"? (See page 115 of last number.) I am no
ist and do not understand how the carbonic acid
" into gas; but I can use such a means of power on a
extensive scale if safe, noiseless, and free from
r in handling and manipulating.—Jay Bee.

622.]—**Blue Pipeclay.**—What kind of blue is
for colouring pipeclay squares?—Gossamer.

623.]—**Tramcar with Gas-Engine.**—Will any
r kindly advise as to the probable success of an en-
ent? I am anxious to try by the construction of a
way car to be propelled by a gas-engine? Hitherto a
t obstacle to this scheme has been the ponderous fly-
l indispensable to gas-engines. This I propose to
e right under the car bottom, lying flat similar to the
ce wheel of a watch, while I would store up sufficient
pressed gas in cylinders underneath the car seats.—
eer.

624.]—**Brazing Iron.**—Will any reader please
his experience in brazing sheet iron or steel?—
.Z.

625.]—**Goldbeater's Skin.**—I want to manu-
re the above. Can any reader of "Ours" say from
part of the animal it is obtained, and how manu-
red?—Gut Scraper.

626.]—**Electric Boat.**—To Mr. Bottone.—I have
, weighing 10lb. 7oz., and measuring 3ft. 4in. long
. wide (in the middle) and 6½in. deep, which I am
us of driving by electricity. The space for the
r measures 4¾in. long—i.e., looking from the bows to
ern—and 6in. broad, and 4½in. high. The battery
is divided into six partitions, each partition or cell
ring 2in. long by 2¾in. broad by 3½in. in height.
are made of wood, coated over with some water-
material. The propeller has two blades, each
ring 1in. long and 6-8in. broad at the end. The
of the screw shaft is 6in., and it has at its other
cog-wheel, 6-8in. long, and ½in. in diameter, which
e driven from a cog-wheel on the motor. Is it
le to buy or make a motor which would fit the space
ble for it, and which at the same time would be
ful enough to move the boat along? If so, would
ttery space be large enough to drive such a motor?
kind of battery would be the best?—H. T. E.

27.]—**Sheep-Dip.**—Will any reader inform me
od recipe for a non-poisonous sheep-dip?—Alkali.

28.]—**Electric Signalling Lamp.**—What
be the best kind of electric lamp and secondary
y, and the way to construct the same for using in
inary bull's-eye army signalling lamp, say, for
g up to a distance of seven miles?—the signals to be
hrough a telescope.—Limelight.

29.]—**Painting Lantern-Slides.**—Will some-
ndly give me a few hints how to paint lantern-slides
or colours? I have tried sketching little pictures
ian ink on glass, but get the outlines thick and
l. Are special brushes and colours used? Is the
prepared in any way, &c.?—Janette.

30.]—**Locomotive Becoming Disabled
e Railway.**—Can any reader tell me what to do
broken gland stud or both studs breaking? What
steadyment of the links or any other things that
ely to break, and which is the quickest way to take
o get out of the way?—Young Fireman.

31.]—**Revolver.**—I have a revolver which I use
get practice in my garden. I have also a license,
m told that I do not require one. Can any reader
whether I require one or not?—The Law.

32.]—**German and Italian Locomotives.**—
any reader kindly give me sketch and particulars
ess locos. on the Alsace-Lorraine and Adriatic Rys.

3.]—**N.E.Ry. Locos.**—Would "St. Aubyn" or
arshall kindly give me a few leading dimensions of
at was given last week? A rough sketch of tank
s loco. of above railway would oblige.—A. F.

4.]—**Talc and Spinning Metal.**—Will some
please tell me if talc can be made into any shape,
s), where it is done? Also how should I fix a
tin or copper in the lathe to spin it into shape?—
Bo m.

[72635.]—**Water Regulator.**—Being a sufferer from water-pipes bursting during the night owing to the great increase of pressure from the main supply, would some of your readers kindly inform me if they know of any regulator that can be attached to the pipes, so as to prevent this great strain?—Glasgow.

[72636.]—**Striking Force.**—With what force will a weight of 1 ton falling a distance of 1ft. strike the ground? How is the same proved?—H. W. Jackson.

[72637.]—**Gap Lathe-Bed.**—Can any reader kindly give me information and sketch showing how to make pattern for gap lathe-bed suitable for 5in. or 6in. centre, calculated for strong work? The shears of the bed must be bonded together in the casting by cross webs to insure rigidity. An early reply will oblige. I have searched all back numbers I possess, but can obtain no information.—T. J. Hawes.

[72638.]—**Lathe Gut Band.**—A hook has come off the above; would some fellow-reader be kind enough to tell me how to put it on again? The hook has an internal thread. Also can the gut be stretched or shortened?—W. C.

[72639.]—**Brake upon the L. and N.W.**—The L. and N.W. last week turned out from Wolverton a number of fish-trucks, horse-boxes, and carriage-trucks fitted with a new arrangement of vacuum brake, having a large double-piston vacuum cylinder; the first of its kind. Wanted, a sketch and details thereof; also of the new pump the company is putting on the engines in place of a pump.—Brake.

[72640.]—**Midland Engines—1913, 1976.**—Will any reader oblige me with details or a sketch of engines 1913 and 1976 just put to work on the Midland line?—Loco. No. 1.

[72641.]—**Old Locomotives.**—Can one of "ours" furnish us with sketch of Agenoria 1829, now at South Kensington Museum? Also of the Vulcan for the Swannington line 1835.—Historian.

[72642.]—**Stomata.**—Can any of your readers inform me what is the best method of removing the epidermis of leaves to show the stomata? I find a difficulty in getting specimens nice and clean for mounting.—Lavant.

[72643.] — **Angular Measurement of the Planets.**—Will "F.R.A.S." be so kind as to tell me the true angular diameter of all the planets at the earth's mean distance from the sun, as I shall be able to ascertain their real linear diameter in miles? I find that those given in the *Nautical Almanac* are far from right. Will "F.R.A.S." explain how it is that they still continue the old table of Leverrier in the *Nautical Almanac*, the "E. M.," *Whitaker's Almanack*, &c.? And *Knowledge* gave the same until last May, and then there was a great alteration in some of them. For instance:

| | Apparent diameter. | |
|---|---|---|
| *Knowledge* | April 30th, | May 1st. |
| Mercury | 7″ | 7″ |
| Venus | 10¼″ | 10½″ |
| Mars | 18½″ | 16″ |
| Jupiter | 36¼″ | 39″ |
| Saturn | 18¼″ | 18¼″ |

According to Jupiter's measurement 39″, he must have a far greater linear diameter than I have ever seen in any astronomical work—viz., 93,000 miles. Hor. par. 8·848″. I shall be thankful for any information "F.R.A.S." can give me on the subject.—Tom Moore.

[72644.]—**To Mr. Bottone.**—I wish to make a dynamo, Manchester type, compound wound, with Gramme laminated armature. Will you kindly give me dimensions of F.M. castings, wrought-iron cores, and Gramme ring? Also size and quantities of wire for F.M. and armature. I want the machine to light 20 E.S. 16c.p. lamps, and please inform me how to connect up when wound, E.M.F., &c., the machine will give, and number of revolutions.—Manchester Gramme.

[72645.]—**Engine Governors.**—I made an engine 3in. bore, 5in. stroke. Will any reader kindly give me sketch and size of a pair of governors to suit it? It is to run 200 revolutions a minute.—Monte Christo.

[72646.]—**Charging Primary Battery.**—I have a small battery which I wish to charge up. There are four glass jars, each holding half-pint arranged in square box, with arrangement for lifting the glasses up to elements which are zinc and carbon. The size of carbons is 2in. by ⅞in. by ⅛in., and the zinc the same size. What is the best solution to charge with, and what volt lamp should I have? I have used it only once before with a solution of powdered bichromate potash 3oz., cold water 20oz., and 4½ fluid oz. of pure sulphuric acid; but it would only last a few minutes, and then gradually die away. If this is not the right solution, kindly say what is.—Engine-Driver.

[72647.] — **Electrical Resistance.** — Will Mr. Bottone say what are the relative diameters of two wires each of the same metal and of the same length, having resistances of 2,000w. and 3,000w. respectively, and kindly show the working?—Motor.

[72648.]—**Aries and Libra.**—Would "F.R.A.S." be so kind as to tell me how our globe can be unilluminated when above the horizon, as stated by Keith on the globes (problem 22)? I fixed my terrestrial globe to the position there stated, but cannot solve it any how.—H. J. Hook.

[72649.]—**L. and S.W. Tank Locos.**—Many thanks to C. F. Dendy Marshall for his sketch, but there are two items in his reply which I hope he will not mind me correcting. In his sketch, he has made the side tanks short, which is like those numbered 45, 47, to 57, 427 to 432 Stephenson's, and 415 to 426 by Beyer Peacock; whereas 479 to 489 Neilson's, and 490 to 495, 516 to 525 Dübs', 58 to 60, 82, 104, 106, 107, 125, and 126 Stephenson's, have all side-tanks reaching nearly to the driving-wheel splashers. The 123 class have 10 wheels, same as the above. He must be thinking of the old 318 class which have 8 wheels. Speaking of 318, could C. F. Dendy Marshall inform me what has become of them all? 318 and 320 were running on the Netley to Portsmouth line about a month or so ago; but I saw the side-tanks of 322, and also side plates of 446 large bogie in trucks in the yard of the works when passing by a few days since. What is the reason?—does it mean they are broken up? I saw 446 running the day after, so cannot quite understand it. Can C. F. D. Marshall tell me if there is any means of getting shown over the works at Nine Elms, Brixton?—Locomotive.

[72650.]—**Pianoforte Keys, Colouring.**—I have a piano with celluloid keys, and some of them are turning a yellowish colour. Could some reader inform me what may be the cause, and how to restore them to their original whiteness?—P. C.

[72651.]—**Gas Blowpipe.**—Will any reader kindly give me instructions for making a gas blowpipe, powerful enough to braze a plug in a 3-16in. or ¼in. tube? The gas and also air-supply to be ⅜in. A diagram will oblige.—Conway.

[72652.]—**Problem.**—I attend a science class in metallurgic chemistry where there are 18 students, myself included. We are seated on 3 benches, each of which holds 6. Each student takes whatever seat he pleases at each lecture. What are the chances against the occurrence of finding myself seated between two particular students on the same bench? The condition that the three of us should be on the same bench of course makes it more improbable than if all the 18 were placed on one long bench.—Vehmoericht.

[72653.]—**Propelling Boat.**—I should be much obliged if some reader of the "E. M." would inform me as to somewhere about the H.P. required to propel a boat 15ft. long by 4ft. 6in. beam, carrying a load of 4cwt., at the rate of 6 knots per hour?—Anxious.

[72654.]—**Diffraction Gratings.**—I have been using a direct-vision spectroscope, and also a home-made three-prism spectroscope for photo-spectroscopy, but am anxious to try a diffraction grating, either plane or concave, so as to avoid the contraction of the less refrangible rays and the absorption of the violet, my three prisms being heavy flint glass. Can any reader inform me where to obtain a grating and the probable price, or whether it would be possible to rule one with a dividing engine, such as is used for graduating thermometer tubes. The action of any prism exerts so much influence on the maximum and minimum action on the silver salts as to require constant correction, which is a source of great inconvenience.—Foto File.

[72655.]—**Railway Curves.**—When a railway line goes round a curve the inner rail is generally slightly depressed, and is at a lower level than the outer rail of the curve. Is this inner rail laid so at first, or does the extra stress upon it when a train is going round the curve depress it to a lower position?—Merlin.

[72656.]—**N.W.R. Condor.**—Will one of my fellow-readers kindly send a sketch and dimensions of the above engine, with particulars of colour, &c.? Also is the number of it 686 or 868?—Caucasus.

[72657.]—**S.W.R. Tank Engines.**—Will some one kindly send sketch and particulars of the new trailing bogie tanks on this line, Nos. 177—180, built at Nine Elms this year? How many of them are there?—Caucasus.

[72658.]—**Electric Gas-Lighter.**—Can any reader kindly inform me as to the cause of failure in the "Matchless" electric gas-lighter? I have some that will readily give short sparks, but not strong enough to ignite gas. All contacts are perfect, and sectors insulated and varnished round the edges. Should the plates and sectors be quite smooth and polished?—Hathaway.

[72659.]—**Slide-Rule.**—Will any correspondent enlighten me (1) as to the working of the two rows of figures on the opposite leg to that carrying the slide on an ordinary carpenter's slide rule (Rabone's); (2) the two rows on reverse side of rule 8-square line; (3) the set of figures on the extreme edge, with simple workings to illustrate? May add, am able to work certain calculations by means of A, B, C, and D lines.—Apprentice.

[72660.]—**Dynamo.**—Will Mr. Bottone kindly inform me if the following is right for a dynamo giving 25 ampères at 75 volts? F.M.'s 25lb. No. 18 B.W.G., armature 80yds. No. 10 B.W.G. The dynamo to be Manchester type with Pacinotti armature. Also what size will F.M.'s and armature require to be, and how many sections on armature?—L. E. R.

[72661.]—**Crookes' Tubes.**—Will some reader who has experimented with these tell me at what distance the phenomena can be made visible? Can they be shown to 150 persons at once? Crookes, in his lecture before Royal Institution in April, 1879, speaks of the difficulty of showing experiments not visible more than 3ft. off, and yet many lectures with the same experiments have since been given to large audiences Crookes also attributes any success in showing them at a distance to Mr. Spottiswoode's large coil; but I thought that a small coil was quite sufficient, and would therefore be as effective as a large one. Will someone kindly help me to understand, and give me any hints as to the successful management of the experiments?—R. M.

[72662.]—**Dynamo.**—I have got a set of castings for a small dynamo. The space for wire on the field-magnets is 3½in. high, by 4in. wide. The armature is 4in. by 1½in., laminated, Siemens pattern. Will Mr. Allsop kindly inform me how much 22 B.W.G. wire shall I need on the field-magnets, and what current shall I get in volts and ampères?—Leo.

[72663.]—**Nitrate of Soda Battery.**—Can I make a nitrate of soda battery, with all particulars for working same?—Leo.

[72664.]—**Neatsfoot Oil.**—Will "Jack of All Trades" kindly inform me his method of obtaining the above, so that it is entirely free from sediment and cloudiness?—Apprentice.

[72665.]—**Rope and Drum.**—Will some kind reader help me in the following:—Supposing I had a steel wire round rope 1¼in. diameter, and 600ft. in length, and a small drum 12in. diameter, and I want that rope to wind upon itself; how often will that drum go round to wind the 600ft. of rope on?—Collier.

[72666.]—**South Eastern Engines.**—What has become of the South Eastern engines (similar to the Metropolitan) with outside cylinders? When the S.E. first ran trains on the Gt.N.Ry. (about 11 years ago), they were used for this traffic; but I have not seen them for 7 or 8 years.—Sekon.

[72667.]—**Charging Accumulators.**—To Mr. Bottone.—I have charge of a dynamo which is used for charging 28 Elwell-Parker accumulators for house lighting. Can you tell me if there are any means of telling when the accumulators are fully charged, as I understand it is useless to run the machine after the cells are charged up to a certain degree of saturation? There is a cut-out on the main which disconnects dynamo and cells when the current diminishes, owing to slow running of engine or accident to machine, and thus prevents the cells emptying themselves in driving engine. There is also an ammeter and volt-meter.—A. P. Swinton.

[72668.]—**Armourer.**—Will some kind reader give full information as regards the duties of an armourer in the Royal Navy?—if they are required to work in the rigging or go aloft, or do they work at their trades only? —Sail.

[72669.]—**Gassner Battery.**—Made up, I believe, of zinc oxide and gypsum moistened with solution of chloride of zinc. Would Mr. Bottone or some correspondent please tell me in what proportions these are mixed? Further, if it is material whether the positive element is a thick sheet of zinc or, say, a preserve-jar lined with sheet zinc; the whole being sealed with melted rosin.—A. B.

[72670.]—**Incandescent Lamps.**—Will Mr. Bottone kindly explain what is the advantage and disadvantage of having a lamp of low voltage over one with high voltage? Say, for instance, I have a 5c.p. lamp of 8 volts, so that I can light it by means of 4 cells of 2 volts each (theoretically), and another 5c.p. lamp of 16 volts that requires 8 cells of 2 volts each.—Alltfab.

[72671.]—**Boiler.**—I am about making a new boiler for my 4ft. yacht, which has a pair of ¾in. by 1½in. slide valve cylinders. I wish to know gauge of metal (brass), and if safe at working pressure of 50lb. square inch. It is to be 12in. long, by 6in. wide, by 7in. deep, flat top and side, but rounded at bottom, which will fit boat without any further fixing. Firebox will be made to go through entire length of boiler 4in. high, rounded at crown; but sides and bottom will follow external shell leaving ½in. space all round for water; also beyond half-way will have 3 cross tubes in firebox, smoke-box at end. This being a simple way to make a boiler, I wish to know also if it will be a quick steam generator? I thought a stay to every 1½sq.in. would do?—Billy Hooks.

[72672.]—**Silent Steam Jet.**—Can any of your readers kindly describe a good and efficient silent steam jet for a water heater? A sketch of same would greatly oblige.—Ajax.

[72673.]—**Pump.**—The force-pump I have does not act at all when boiler is under steam. It seems to me to throw the water back, although the valves are conical shape, and well ground in, all of brass, solid plunger ⅝in. dia., by ¾in. stroke. What is this caused by? I fancy the suction valve floats being small, about ⅜in. dia. I have tried the suction from side of boat, as well as from bottom. Can balls be recommended? Any hint or advice will be esteemed.—Billy Hooks.

[72674.]—**Proper Motion of the Stars.**—Would "F.R.A.S." kindly say if there is an accepted theory giving order to the proper motion of the stars? Also in what path a planet would revolve round one of the stars of a close binary, say, Zeta Ursæ?—W. J. Payne.

[72675.]—**55 Piscium.**—Can anyone give me the present magnitude of the companion to this star? I see it with 50 on 1⅞in. Does this show good eyesight, or is the star brightening?—W. J. Payne.

[72676.]—**To Mr. Allsop or Mr. Bottone.**—Could I get sufficient power from a water-motor attached to ⅜in. pipe (ordinary waterworks pressure) to work a dynamo that would charge an accumulator for two good lights? If so, kindly advise as to the cheapest way in which it can be done, or could it be done by hand machine and manual labour?—A. L.

[72677.]—**Force.**—In transmitting force through liquid contained in a short bent tube, does the pressure tend to move the tube bodily in any direction? If so, which direction?—W. R.

[72678.]—**Pellets.**—How are best, and most recently, manufactured the pellets for shooting?—Etimomachos.

[72679.]—**To Mr. Bottone.**—I wish to fit one of the girder form of armatures mentioned in your book ("Electrical Instrument Making for Amateurs") to a dynamo instead of a permanent magnet; but I do not know what form to give the electro-magnets, so as to insure efficient working. I saw your answer a few weeks back to a similar question, so that I know the amount of wire to wind on, but I could not understand the diagram for the electro-magnets at all. Please give sketch and mark the different diameters, so that I cannot mistake.—Puzzled.

[72680.]—**Electro-Motor, Wrought Iron for.**—To Mr. Bottone.—With reference to your reply to query No. 72478, supposing two carcases to be obtained exactly alike as to dimensions, weight, &c., but one made of best wrought iron and the other of ordinary cast iron, and both wound with the same amount of wire, would the wrought iron motor give its full power with 40 per cent. less watts than the cast iron one? If not, what would be about the difference in the number of watts? A little information on this point will greatly oblige.—A Mechanic.

[72681.]—**Dynamo.**—Having made a small Manchester type, with malleable cast ring armature and c. iron field-magnets, the former wound with 173yds. d.c.c. No. 18 copper wire in 20 sections, and the latter wound with 5½lb. each of the same wire, and when run at 2,200 revolutions per minute the output is 3½ ampères, 33 volts, whereas I had expected to get 6 ampères and 50 volts,—will some of "ours" who have had experience say where the fault may be?—K. N. A.

[72682.]—**The Polygon of 17 Sides.**—To "E. L. G."—I have lately been trying to draw this polygon by a graphic method founded on your reply to query 72151 (p. 39). Getting the side considerably too short, I have calculated it numerical value according to your formula, and find that (if my figures are correct) your expression for 2 sin. $\frac{\pi}{34}$ would make the angle $\frac{\pi}{34}$ nearly $= 4^\circ 41'$, instead of about $5^\circ 17\frac{1}{2}'$ as it should be: Suspecting some slight typographical error (besides that corrected on p. 65), I have tried several guesses at the correct expression without success, and should, therefore, be greatly obliged if you could tell me where the mistake is, as I cannot discover any in my figures. I make $a = 1{\cdot}5616$, $b = 2{\cdot}2705$, and $c = {\cdot}3442$, taking $\sqrt{17} = 4{\cdot}12315$. (For my graphic $\sqrt{17}$, I took the hypothenuse of a right-angled triangle having one of the sides four times the other side, as I confess I do not quite see why $\sqrt{3}$ is required as you direct.) —Mu Nu.

[72683.]—**Electric Motor.**—What proportions of field-magnets, what gauge, and length of wire would be proper for high-speed motors, to give respectively ½-man and 1 man-power? A drum armature would be preferred. It is intended to be run with current from incandescent mains. Full particulars with a drawing, if possible, will greatly oblige. The information has appeared before, but times have changed since then.—Simplex.

[72684.]—**Conductivity of Wire.**—I cannot find particulars of the resistance of common brass or tinned iron wire. Are they given anywhere?—Simplex.

[72685.]—**Yew.**—What is the value per cubic foot of yew timber in the log, and how much seasoning it requires for furniture, before and after cutting up?—F. W. Elliott.

[72686.]—**Tool Steel.**—What kind of steel is self-hardening steel? How is it worked, and how can it be self-hardening? Also what is chrome steel? Information on this subject is apparently confined to a very few, and is not easily obtained.—Simplex.

## ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

### HINTS TO CORRESPONDENTS.

**1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.**

**⁂ Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

**The following are the initials, &c., of letters to hand up to Wednesday evening, Oct. 15, and unacknowledged elsewhere:—**

H. W. Scriven.—T. W. McClelland.—Jay.—R. C.—London Lathe Co.—E. J. L.—E. A. B.—E. Sang.—Dexter.—J. S. C.—Boiler.—John Dormer.—A. B. T.—Working Jeweller—S. E. Peal.—Douglas Leitch.—F. G. Willatt.—Jack of All Trades.—Georgius.—W. S.—L. L. W.—Assoc. N. S.

J. W. Frankland. (We have not yet received any further particulars, and therefore cannot say what the cost would be; but information can be obtained from the Vaughan-Sherrin Co., 48, Eagle Wharf-road, E.C. The running expense depends on the consumption of zinc and the cost of the special exciting fluid, which can be readily estimated from many replies in back numbers.)—Lady Electric. (You can use a coil with a battery for the purpose; but the "figure" must be insulated, and so must the "persons" who are to receive the shock. They stand on a concealed metal plate, and complete the circuit when they shake hands. You had better consult some electrician, who will see that there is no risk of the shocks being too strong; but the principles are given in the textbooks and in the back volumes.)—Inquirer. (You must please yourself. If you have motive power available the dynamo will be cheaper than a battery, especially if the dynamo is run by waste power and employed to charge an accumulator during the daytime for use at night. Electric light from a primary battery is rather expensive; but see many replies in the last half-dozen or so volumes.)—Ignorant. (The license is to "use or carry," and we believe it has been decided that a revolver is a gun; but you can easily ascertain by applying to the Excise officer in your district, or by referring to 33 and 34 Vict. c. 57, section 7. We think a license is not required when used only in a house or the curtilage thereof.)—Toothsome. (Precipitated chalk, sold by all druggists, is a simple and good dentrifice; charcoal of areca nut is another; but to remove mere stain from smoking, a weak solution of chloride of lime is in common use—washing out the mouth well afterwards. A little tannin rubbed on the gums will tighten the teeth; or a solution of alum or of borax.)—Chemic. (We think we answered you recently. The particulars of the B.A. examination can be obtained from the Calendars of the respective universities granting the degree, and as to the F.I.C., apply to the secretary of the Institute, 9, Adelphi-terrace, London.)—W. T. (See answer to "St. Clair," p. 156, last week, or apply to the Secretary of the Chemical Society, Burlington House, London, W.)—D. R. (It can be done with the sandblast, protecting the other parts of the glass with a stencil, or with a little emery wheel running in the lathe. Several methods have been described in back volumes.)—A. Eastgate. (As a rule American papers of the kind are not sold by single copies in this country, but are sent to those who subscribe for a year or a quarter, according to the terms of the publisher. You can try the International News Company, Bream's Buildin
lane, E.C.; they may have specimen copie
G. W. Patterson. (A peculiar "manual.'
the stamps demanded by the Patent Office is
tion, £3 on filing the complete specification
for four years; then £50, for what is termed
which carries the patent over seven yea
£100, which carries it to the fourteen yea
last two items may be paid in annual sun
find the amounts set out in *Whitaker's Aln*
of Stamps. Cannot answer the other que
to say that you must distinctly specify wh
as the invention. If you have anything
you would act wisely by going to an age
work for you.)—New Reader. (Scarcely
you. It is only necessary to put in the re
ber of stoves, or one with a wick la
What temperature do you require? See
*Times and Echo* last week (Oct. 12).
an expensive way of heating a greenho
Hemmans. (If you tell us what yo
"general purposes," we can possibly answer
but so much depends on the conditions. If
can be placed out of doors, use a Bunsen
indoor work, try the chromic acid cell. Ple
has been said so many times in back n
Chappell. (The only way is to apply for
tion; but if you have not had any exp
engines and boilers, there are few who will c
you.)—J. P. (Names have nothing to do w
can be changed as often as people like; but
C, his first wife B being still alive, he comm
—Pompey. (Butter is made by churning cre
small scale, you can do it by whipping up c
fork. 2. Blackberry wine is made by crush
and preferably boiling with water in the p
about a gallon to 3lb. of fruit. Strain, a
the liquor with sugar; ferment with yea
spirit to keep it.)—Despair. (The best cure
is a strict bread-and-fruit diet and scrup
nence from alcoholic drinks and tobacco.
to ten ounces of brown bread and half a po
fruit three times a day, or some stewed
No drink at all is needed with this diet, bu
of milk *may* be taken if needed, and two or
of any nuts in season. Tobacco *must* b
Whatever other good or harm tobacco does,
after a careful observation extending th
years, that its use makes recovery from
disease impossible.)—J. Webb. (Each of
hearing, and there the matter must rest.)

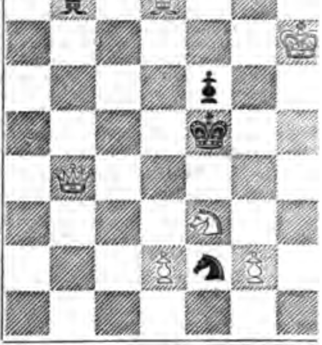
**Mr. Wm. Gunn**, the celebrated
Cricketer, writing from the County Cricket Warehouse,
street, Nottingham, says:—"You will be glad to hea
Electropathic Belt has quite cured the rheumatism tha
from playing football last winter, and it has been of
sustaining strength of nerve and endurance, which qual
great importance to cricketers." The marvellous invig
restoring properties of this genuine Electric Belt are n
They give wonderful support to the spine and inter
light and comfortable to wear, and are invaluable
nervous, muscular, or organic weakness. Descriptive
of testimonials, and consultation free of charge, eithe
by letter, on application to the Medical Battery Com
52, Oxford-street, London, W. Those who cannot call
once.

## CHESS.

All communications for this departmen
addressed to "J. Pierce, Knollside, Yawl,
Dorset."

PROBLEM MCCXXIV.—(Tourney proble

*Black.*



*White.*

**White to play and mate in two mo**

Solution to 1222.

| *White.* | *Black.* |
|---|---|
| 1. Q-Kt 3. | 1. Any |
| 2. Q or Kt mates. | |

(Five variations.)

NOTICES TO CORRESPONDENT

Correct solutions to 1222 by W. Sangst
Kistruck, W. L. Martin, H. Fellows, A. Fe
D. Mackay, M. Kelly (excellent for such a
Biene, W. Gleave, J. H. Eastwood, C. P. P.,
W. Jay, T. H. Billington, A. A., G. W. M
F. Moon, J. B., and Fr. Fernando; to 12
Ryan, M. Kelly, T. H. Billington, J. B., G. W
W. Jay, White Knight, Donald Mackay,
Lambert, Link, and J. Y. Rogers.

Entrance fees received with thanks from G.
ton, J. B., and Link.

J. F. Moon.—No. 1221 cannot be done by Q-
at it again.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
*FRIDAY, OCTOBER* 24, 1890.

# TELEPHONES: THEIR CONSTRUCTION AND FITTING.—IX.

By F. C. Allsop.

Author of "Practical Electric Bell Fitting," "Electric Bell Construction," "Practical Electric Light Fitting," &c.

### Connecting-Up.

In the diagrams of connections that will now be given, it has been the aim of the writer to include all the most important cases hat are likely to be presented to the fitter; ut it must be borne in mind that special equirements are very often required in telephony, and that to get at these special requirements one diagram requires to be read in conjunction with another. In the connections of the instruments also, the different parts of the telephones are arranged with a view to increase the clearness of the diagrams; thus the relative position of one part to another must not be taken as a guide to the arrangement of parts that would be found in actual practice. The main principle governing the connections of one instrument will be found to underlie the connections of all other instruments of the same class, the difference being generally merely in the mechanical arrangement to effect certain operations.

*Simple Telephone Circuit.*—Fig. 48 shows a simple circuit consisting of two magnetic receivers connected together, but without any arrangement for signalling between them. For E.M. or membrane receivers a battery of two or three cells requires to be interposed in the circuit. The earth, or return wire, is shown darker than the line-wire, a method that will be adhered to throughout the diagrams.

*Two Magnetic Receivers with Switch-Bells and Batteries.*—Fig. 49 shows the connections for two instruments having magnetic receivers with switch-bells and batteries. In the figure, *a* is the switch-bell, *b* the receiver, *c* the automatic switch, *d* the ringing key (in this case a double contact, or key-push), and *f* the batteries on instrument No. 1; *a*′, *b*′, *c*′, *d*′, *f*′ being the corresponding parts of instrument No. 2. When the receiver *b* is on the spring-hook of the automatic switch *c*, the hook is in contact with the

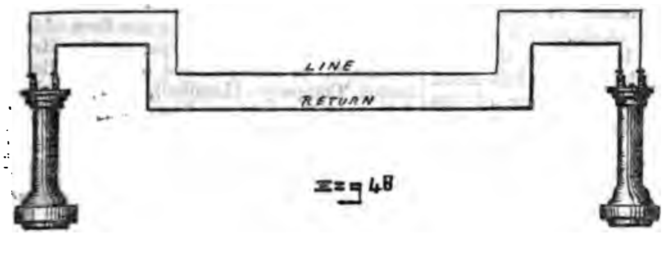


Fig 48

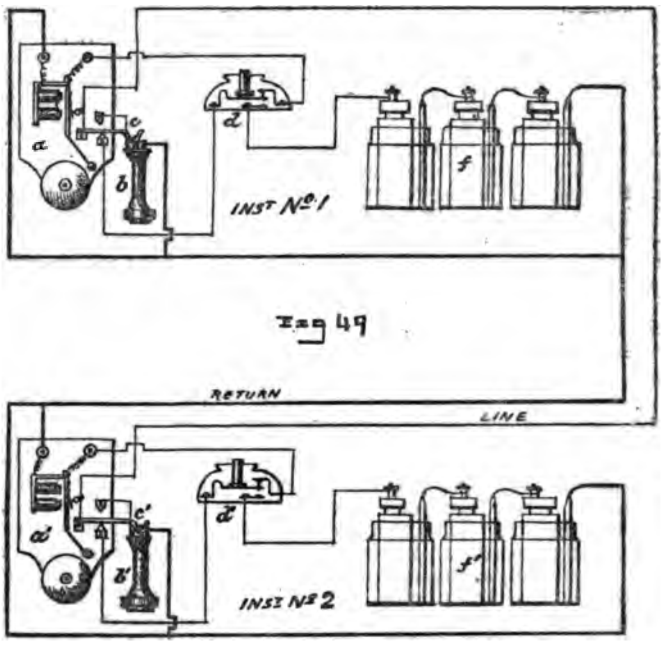


Fig 49

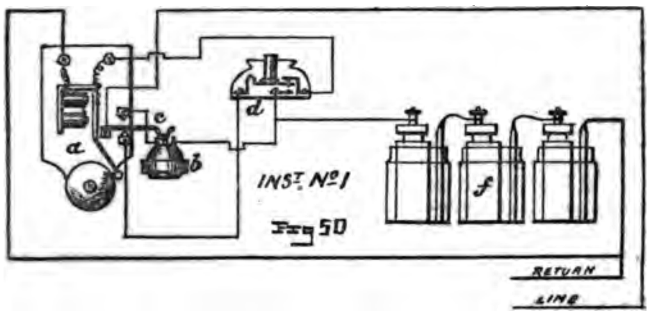


Fig 50

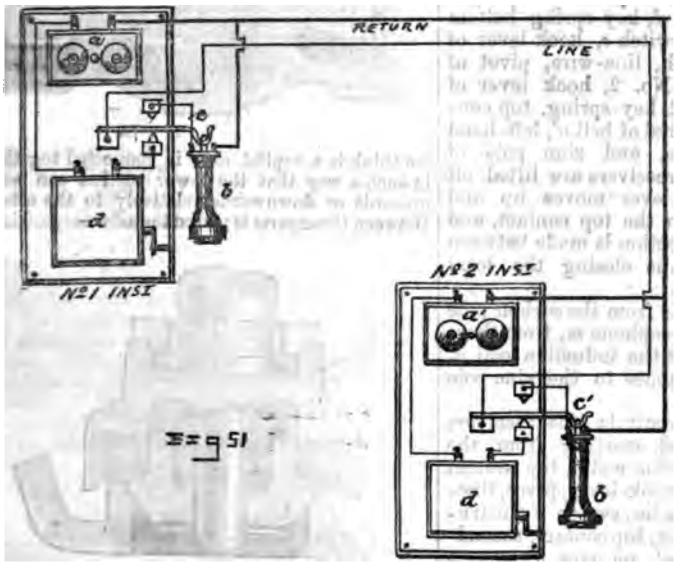


Fig 51

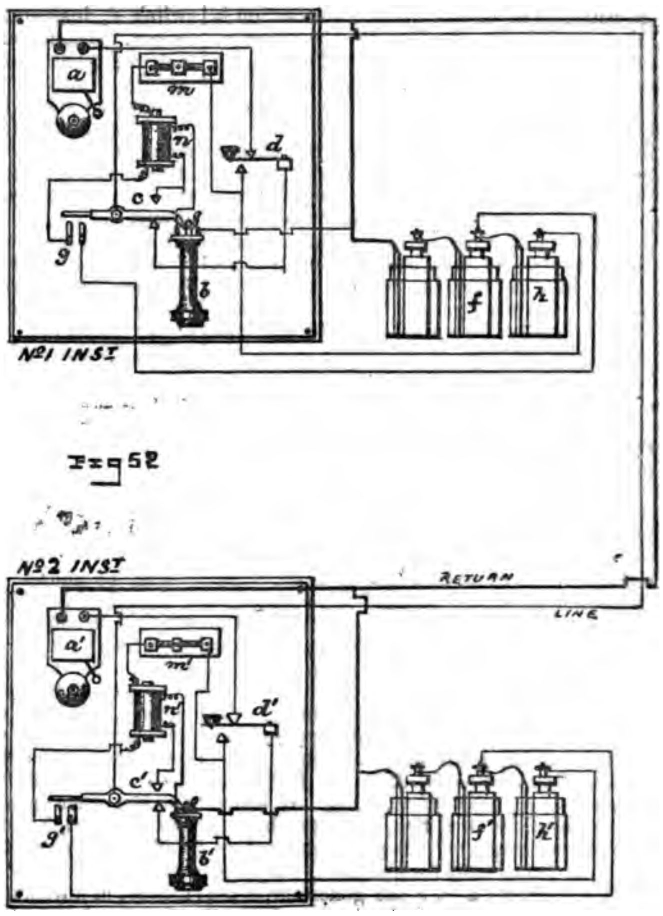


Fig 52

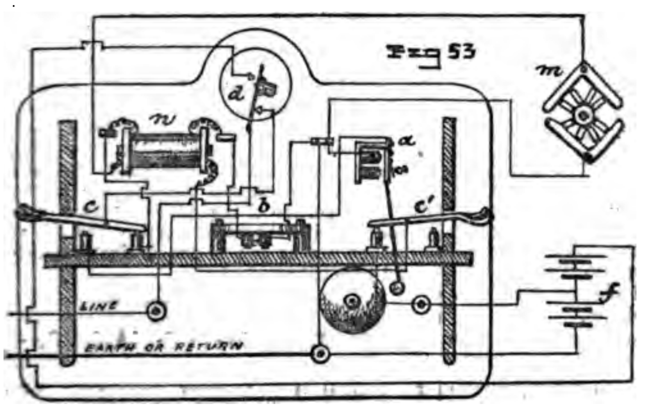


Fig 53

bottom contact; but when the weight of the receiver is taken off, the hook moves up, and is in connection with the top contact. When the push *d* of instrument No. 1 is pressed, the current flows from the carbon pole of the battery *f* to the bottom contact of the push, thence to the push-spring and bottom contact of the automatic switch *c*, from there to the spring-hook, line-wire, spring-hook of the automatic switch belonging to instrument No. 2, bottom contact of switch, spring of push *d'*, top contact of push, right-hand terminal of bell *a'*, through the bell to return wire, and from thence to zinc pole of battery *f*. This causes the bell of instrument No. 2 to ring, calling the attention of the person at that end, who presses the button of his push, causing the bell at instrument No. 1 to ring in reply. The receivers are now taken off the switch-hooks, and conversation is carried on. The "speaking" circuit is, starting, let us say, from receiver *b*—receiver *b*, top contact of automatic switch *c*, spring-hook of switch (the circuit being now closed owing to the receiver being removed), line-wire, spring-hook of automatic switch of instrument No. 2, top contact of switch, receiver *b'* return wire, and from thence back to receiver *b*. Thus there is, when the receivers are off the hooks, a complete circuit without the batteries, the batteries not being required owing to the receivers having permanent magnets.

*Two English Mechanic or Membrane Receivers, with Switch-Bells and Batteries.*—Fig. 50 shows the connections for two telephones having "English Mechanic" or membrane receivers with switch-bells, batteries, &c. Only one instrument is shown; but the connections for the other are exactly the same. As in Fig. 49, *a* is the switch-bell, *b* the receiver, *c* the automatic switch, *d* the ringing key, and *f* the batteries. The connections, it will be noticed, are somewhat different to those of Fig. 49, owing to its being necessary to have the batteries in circuit while conversation is being carried on. In Fig. 49, the receivers have permanent magnets, but in Fig. 50, the receivers being of the E.M. type, have an electro-magnet, and require the battery to be in circuit. When the button of the push *d* is pressed, the current flows from the carbon pole of the battery *f*, to bottom contact of push, from there to push-spring, bottom contact of automatic switch *c*, spring-hook of switch, line-wire, spring-hook of automatic switch of instrument No. 2 (not shown in the figure), bottom contact of switch, push-spring, top contact of push, bell, and thence by return-wire to the zinc pole of battery *f*.

When the receivers are off the switch-hooks the circuit is as follows:—Carbon pole of battery *f*, receiver *b* of No. 1 instrument, top contact of automatic switch *c*, spring-hook, line-wire, spring-hook of automatic switch of instrument No. 2, top contact, receiver *b'*, zinc pole of battery *f'*, belonging to No. 2 instrument, carbon pole, return-wire, and thence to zinc pole of battery *f*. It must be borne in mind, when connecting up instruments of this class, that at one end of the line the *carbon pole* of the battery belonging to that instrument must be put to bottom contact of push, while, at the other end, the *zinc pole* must be used; otherwise, when the receivers are off the hooks, the two batteries will oppose one another and there will be no current.

*Two Receivers with Magneto Bells and Generators for Signalling.*—Fig. 51 shows the connections for two receivers having permanent magnets, magneto generators, and bells being used for signalling purposes. *a* is the magneto bell, *d* the generator, *c* the automatic switch, and *b* the receiver of instrument No. 1, *a'*, *b'*, *c'*, *d'* representing similar parts of instrument No. 2. The "ringing" circuit is as follows:—When the handle of the generator *d* is turned, the current flows, let us say, from the right-hand terminal of the generator to bottom contact of automatic switch *c*, spring-hook of switch, line-wire, spring-hook of automatic switch *c'* (instrument No. 2), bottom contact, generator *d'*, bell *a'*, return wire, bell *a* (instrument No. 1), and thence to left-hand terminal of generator *d*. Ringing from the other end a similar action takes place. The "speaking" circuit, when the receivers are off the hooks, is as follows:—Starting from receiver *b*, the circuit runs to top contact of automatic switch *c*, spring-hook of switch, line-wire, spring-hook of switch *c'* (instrument No. 2), top contact of switch, receiver *b'*, return wire, and thence back to receiver *b*.

If the E.M. or membrane receivers are used instead of the Bell as shown, it will be necessary to insert a battery of three or four Leclanché cells between the left-hand terminal of the receiver of either of the instruments and the top contact of the automatic switch.

*Two Instruments with Microphones, Receivers, and Battery Switch-Bells.*—Fig. 52 shows the connections for two telephones with microphone transmitters, receivers, and battery switch-bells. In the figure *a* is the bell, *b* the receiver, *c* the automatic switch, *d* the ringing key, *m* the microphone, *n* the induction coil, *g* the two contact springs (connected across by the back part of the automatic switch when the receiver is off the hook), by means of which the local circuit through the microphone is opened and closed, *f* the ringing battery, one cell *h* of which is the local cell for the microphone. The corresponding parts in instrument No. 2 are designated by *a'*, *b'*, *c'*, *d'*, etc., similar letters denoting similar parts.

The "ringing" circuit, when the ringing key *d* of instrument No. 1 is pressed, is, starting from the carbon pole of battery *f*, bottom contact of key *d*, key-spring bottom contact of automatic switch *c*, hook-lever of switch, pivot of switch, line-wire, pivot of switch *c'*, instrument No. 2, hook lever of switch, bottom contact key-spring, top contact, right-hand terminal of bell *a'*, left-hand terminal, return wire, and zinc pole of battery *f*. When the receivers are lifted off the hooks, the hook-lever moves up and makes connection with the top contact, and at the same time connection is made between the two hooks *g*, thus closing the local circuit.

The local circuit runs from the carbon pole of the cell *h* to the microphone *m*, from there through the primary of the induction coil *n*, springs *g*, and from thence to the zinc pole of the battery.

The "speaking" circuit is (the receivers being off the hooks), starting from the secondary of the induction coil *n*, top contact of automatic switch *c*, hook-lever, pivot, line-wire, pivot of automatic switch *c'* (instrument No. 2), hook-lever, top contact, secondary winding of coil *n'*, receiver *b'*, return wire, receiver *b*, and from there back to secondary of induction coil *n*.

*Connections for the Gower-Bell Telephone,*—Fig. 53 shows the connections for the Gower-Bell instrument. In the figure *a* is the bell, *b* the receiver (the listening tubes of which are not shown), *c* and *c'* the automatic switches, *d* the ringing key, *m* the microphone, *n* the induction coil, and *f* the battery, two cells of which are used for the microphone. It will be noticed there are two automatic switches, the one, *c*, making the changes from "ringing" to "speaking," and the other opening and closing the local circuit through the microphone.

The local circuit runs from the carbon pole of two of the cells of the battery *f* to back-contact of automatic switch *c'*, switch-hook, primary of induction coil *n*, microphone *m*, and then to zinc pole of battery.

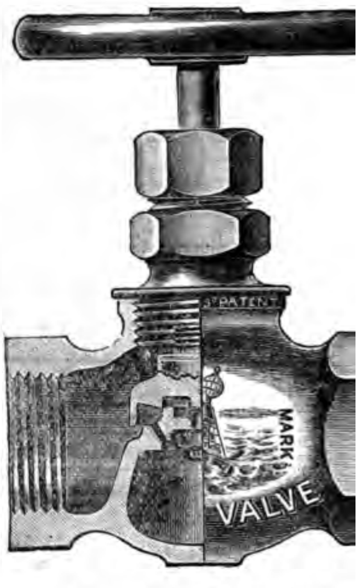
The "ringing" circuit is from carbon-pole of battery to bottom contact of ringing key *a*, key-spring, line-wire, instrument No. 2 (not shown in the figure), return wire, a
of the battery.

The "speaking" circuit is from se
windings of induction coil *n*, back-co
automatic switch *c*, switch-hook, ba
tact of ringing key, key-spring, lin
instrument No. 2, return wire, receiv
from there back to secondary of in
coil. If a relay is required the bell r
cut out and the two wires going to
taken to the relay.

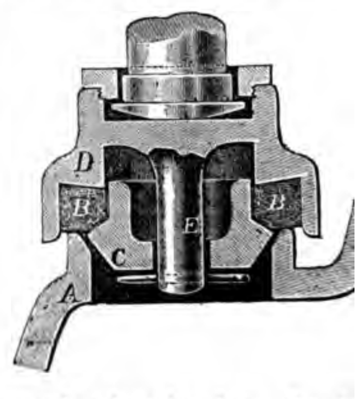
(*To be continued.*)

## A NEW ASBESTOS-PACKED VALVE.

WE illustrate herewith a new form of a
packed stop-valve, patented by Mr
Robinson, of Penryn, and of which Be
bestos Company (Limited), Southwark
S.E., are the sole vendors. The valve,



we think is a capital one, is connected t
in such a way that the lower portion ca
upwards or downwards relatively to th
Between these parts is placed the asbestos p



On screwing the valve down, the ch
portion first comes in contact with its s
on continuing the motion the asbestos p
is also brought hard down on the outer
the seat, and completes the joint. Sh
any chance the asbestos packing be blo
the lower portion of the valve will come
in contact with the upper portion, and th
will then act as one of the ordinary m
metal type till repaired.

## MODEL LOCOMOTIVE-MAKING

I WILL now give a series of sectio
general views to show the various
their relative positions, showing also so
not hitherto described.

Fig. 54 gives a back view of the engi
the fittings belonging to the foot-plate a
box. A is the door with its hinges an

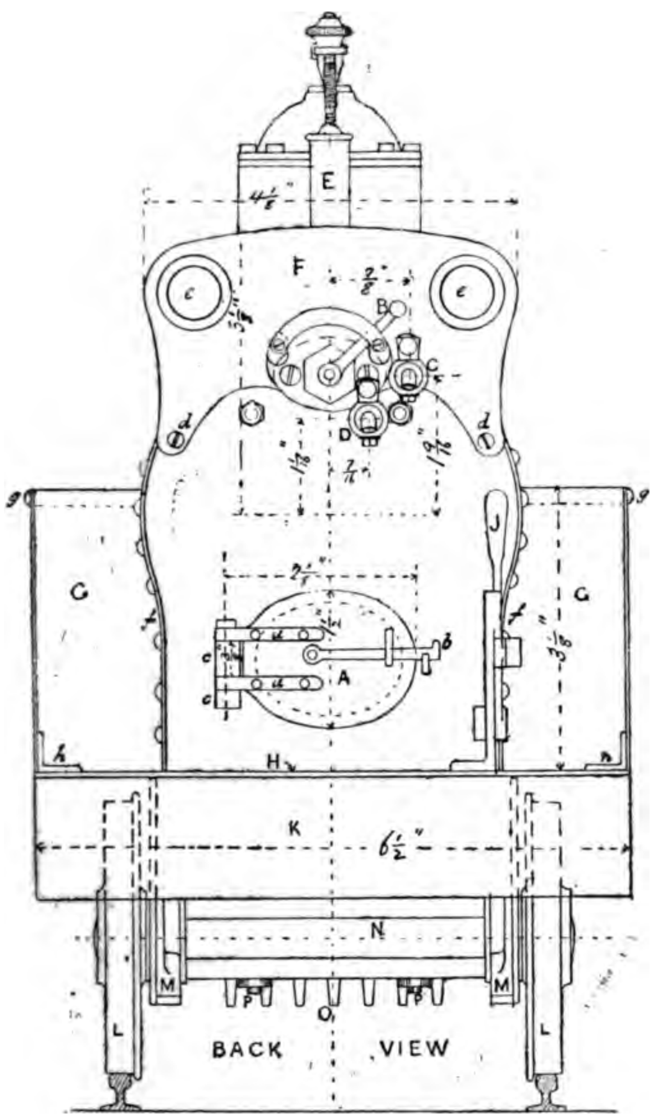


FIG 54

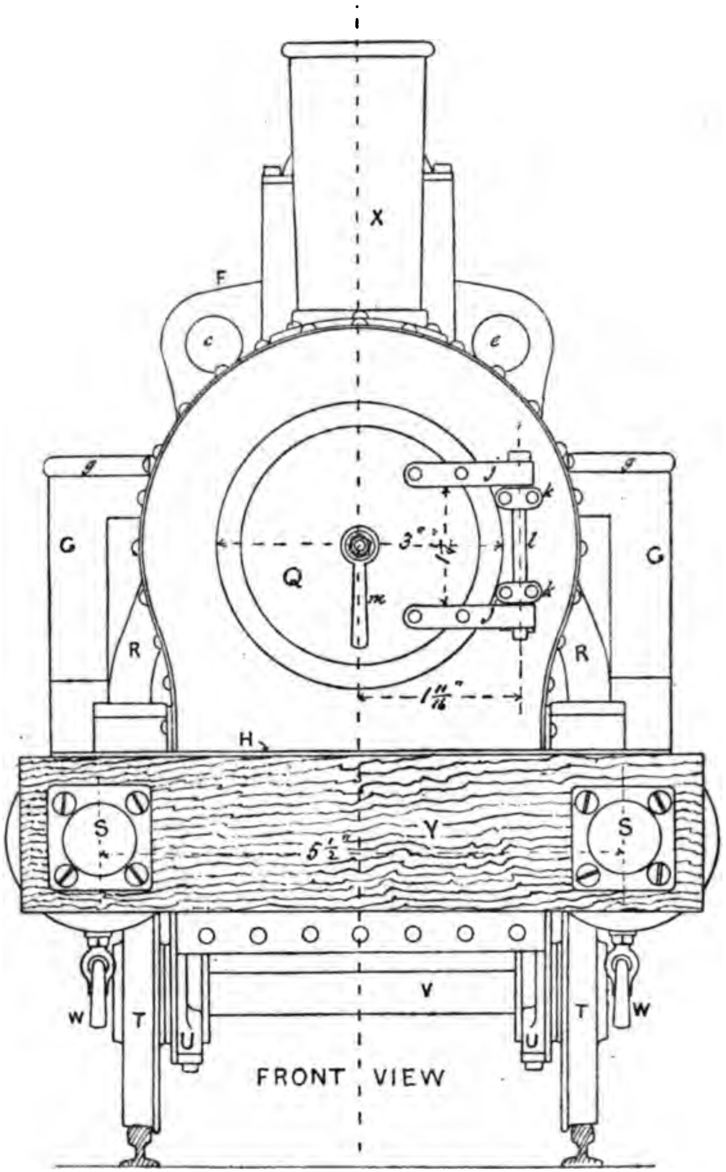


FIG 56

B the regulator handle and parts described in our last, C the steam-cock, D the water-cock, E the safety-valve, F the wind-guard, G the wing-guards, H the foot-plate, J the reversing handle and bracket, K the framing, L the trailing-wheels, M their axle-bearings, N their axle, O the fire-bars, P their supports.

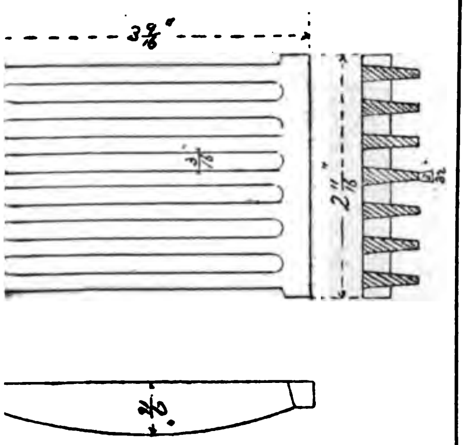


FIG 55

The fire-door A is cut from a bit of sheet-iron, or brass 1/16in. thick, the hinges *a*, *a*, and latch *b* attached to it, and hinge blocks *c*, *c*, either tapped and riveted into the plate of the fire-box, or fitted with square shanks into square holes and riveted; or the door itself with its hinges may be cast in brass.

Instead of a gauge glass, it is better to insert steam and water taps, C and D, in the positions shown. There is not room to put on the smallest gauge-glass made, nor is such necessary. These cocks will be purchased.

We will avoid the work involved in cab, and only put up a weather-guard, F, in front, and two side guards, G. The wind-guard F should be properly fitted around the curve of the outer fire-box sheet, and secured with angles to the top sheet. As involving a little less trouble, I show the sheet fitted directly in front, and held with two screws, *d*, *d*, only. The sheet is cut to a curved form to clear the regulator casting. Two holes are cut at *e*, *e*, and may be left open, or an annular recess made by punching to receive glass discs, which may be covered with rings screwed to the wind sheet. Or a plain beading may be made to encircle the hole, and glass be omitted.

The side guards G G are cut from sheet-metal. The elevation and plan views to follow in the next article will show the guards complete. They are curved round in plan, and abut against the fire-box at *f f*. The bit of half-round wire, *g*, *g*, soldered or riveted to the sheets, improves their appearance, and affords a means of attachment to the sides of the fire-box. The wire is continued beyond the end of the sheets, the free end turned round sharp, and screwed to the fire-box sides. The guards are fastened to the foot-plate below with small angles, *h*, *h*.

The neatest arrangement for the fire-grate is that shown in Fig. 55. Seven properly shaped fire-bars are cast together with connecting bars at their ends. This casting is thrust up through the bottom of the fire-box, and rests on the four supports P (Fig. 54), each of which is pivoted on a screw so as to be turned round to pass underneath, and support the bars. When the ashes have to be cleared from the fire-box, the supports P are turned to one side, and the bars fall out bodily. A piece of sheet-iron perforated with slots will also answer the same purpose.

In Fig. 56, which is a front view of the engine, some few of the parts seen are identical with those in Fig. 54, and are lettered similarly. Other parts are: Q smoke-box door, R exhaust-pipes, S buffers, T leading wheels, U their axle bearings, V their axle, W pet-cocks to cylinders, X chimney, Y buffer beam.

The smoke-box door Q is dished or spun from sheet-metal, or may be readily cast with its hinges *j*, and the trouble of dishing and soldering on the hinges thereby saved. The blocks *k* may be riveted to the smoke-box plate, or fastened with screws, or even soldered on. The hole should be drilled through both *j* and *k* together to insure good fitting of the pin *l*.

The door will be secured with a bar and Tee-headed bolt moved by the handle *m*. The section of this will be shown in the next article. A slotted pin and cottar may be adopted as an alternative.

Fig. 57 shows the smoke-box in section viewed from the front of the engine. The section is carried on the left hand through the steam-pipe, on the other side through the exhaust. As the two cylinders are fixed apart from each other, there are necessarily a separate steam and exhaust pipe to each cylinder.

In this view, Z Z are the tubes opening out into the smoke-box A A, B B are the steam-

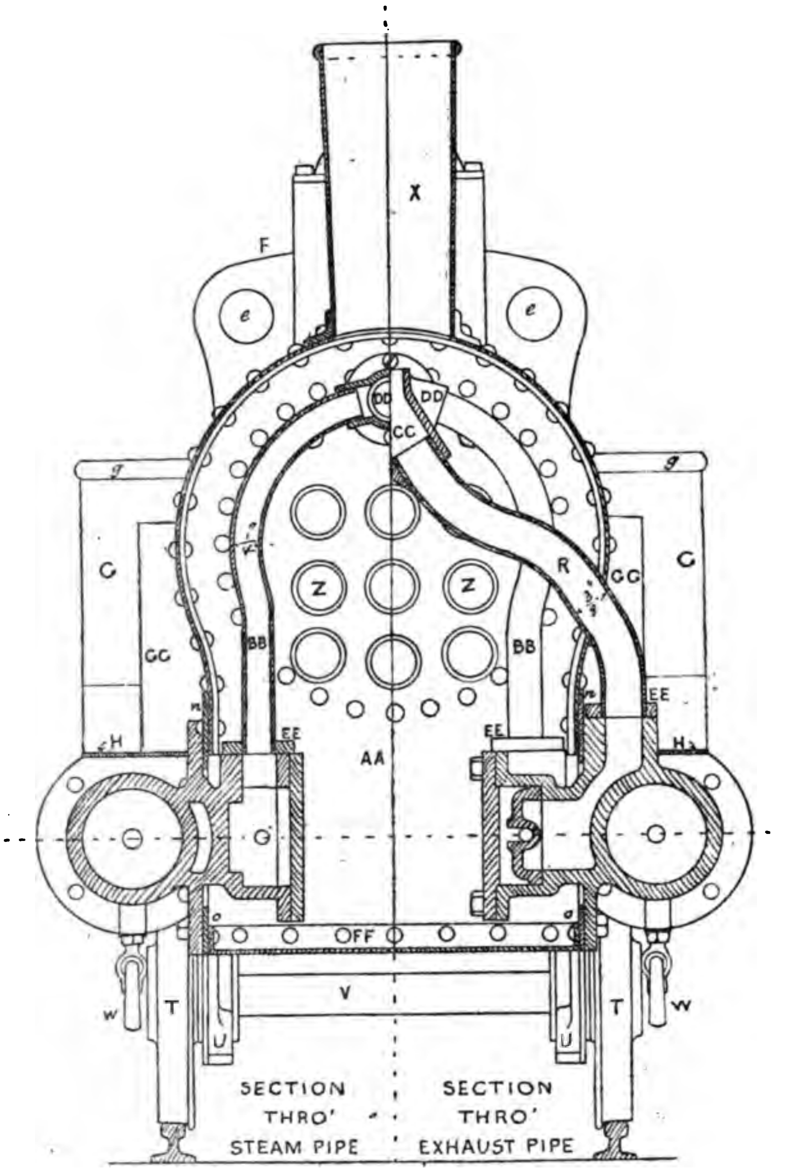


FIG 57

pipes, R the exhaust ditto, C C the blast-pipe nozzle, D D the steam-pipe union, E E pipe flanges, F F the bottom of the smoke-box, G G splashers; other references as in previous figures.

Taking the steam-pipes B B first, D D is a three-way piece cast in gunmetal, which receives the main steam-pipe coming from the regulator, and the smaller steam-pipes passing to the cylinders. This casting is bored at each of the three openings to receive the pipes B B—of copper—which are either soldered or brazed into the bored emds. It is also furnished with a flange to screw to the front tube plate.

On the right-hand side of Fig. 57, the steam-pipe B B, and the corresponding branch of D D, are seen in outside view, standing nearer to the tube-plate than the exhaust-pipe R does. The exact longitudinal positions of the pipe and the longitudinal sections of the castings C C and D D will be seen in the next article.

At the cylinder end the gland-shaped flanges E E are bored out to receive the pipes, which are brazed or soldered into the bored holes. The flanges are then screwed to the steam-chests.

The exhaust-pipes R are provided at the cylinder end with bored flanges, E E, into which they are brazed or soldered, and the flanges are screwed to the facings of similar shape provided on the cylinders.

The two pipes R are brazed into the blast nozzle C C, which is a gunmetal casting, cored out, and bored to receive the pipes. The pipes pass from the cylinders into the smoke-box through the holes cut at *f f* (Figs. 38 and 48, pp. 94 and 95).

The boiler is fastened rigidly at the smoke-box end by means of the arched sheet at *n*, and the bottom sheet at *o*, to the frame-plates. At the fire-box end it merely rests upon the foot-plate by angles riveted to the outside of the outer fire-box sheet.

The smoke-box must be inclosed in order to allow the blast to draw the flame and smoke through the tubes. But we need not have a plate above the steam-chests, but below only. The easiest way to effect this without bothering with angles is simply to turn up the edges or flange the bottom plate F F itself. This is easily done on all four sides by cutting out pieces at the corners first. The back and front flanges will then be riveted to the tube-plate and front-plate, and the side flanges riveted to the frame-plates. As the arched sheet is fastened to the frame-plates above at *n*, and as the tube-plate and front smoke-box plate (Figs. 46 and 47, p. 95) are fitted closely within the frame-plates, there should be little escape of air. If the fit of these last plates is not good between the framing, then angles had better be soldered down inside edges.

In Fig. 58 the half-sections are seen by observer standing at the back or foot-plate of the engine. H H is the driving-wheel, the eccentrics, K K the connecting-rod, cylinders, M M handrails, N N regulator cas and other references as in previous figures.

The description of foot-plates and splas shown in section must be deferred for elucidation of the longitudinal views of next article. J. 1

## GENT AND CO.'S ROTARY INDICATOR.

THE indicator, patented by Messrs. Slater Newman, and represented above, is enti different to any other indicator. It is conta within a walnut case, with black glass f having the names of rooms upon it in dist letters; there is a diamond-shaped ope opposite each name of room, and behind glass a white pointer revolves, and stops opp the named opening corresponding with the r in which the button is pressed; the pointer remains in sight until the button in ano room is pressed, when it instantly passes opp the opening corresponding with the roor which the button was last pressed.

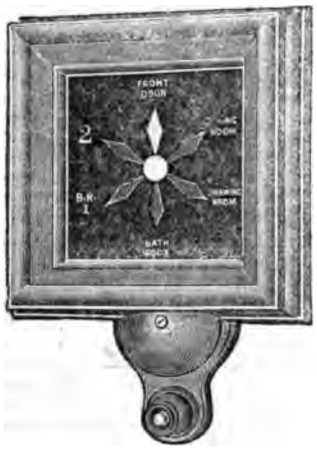


FIG. 1.

If required, it may be provided with a stu shown at the bottom of engraving), in pres which, the pointer will pass out of sight. bell is fixed in the same case.

It is fixed and the wires run exactly as indicators, no special directions being necess

It is specially clear in indicating the room there can never be two in sight on the same c at the same time. The action is as fol (Fig. 2).

The revolving pointer is actuated by an ele magnet vibrator operating upon a milled wh the spindle which carries the pointer also ca a cam and an insulated ring; as many spring provided as there are divisions on the dial, division representing a room to be indicated; of the springs rests on the edge of the revo cam. The cam is connected through the sp with the vibrator, so that when a current is along any one of the springs, it can pass the cam to the vibrator, causing the spin revolve. The cam is provided with a notch which each spring faces in succession a spindle revolves. The insulated ring whi

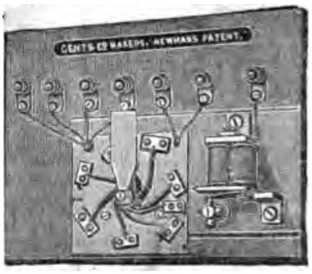


FIG. 2.

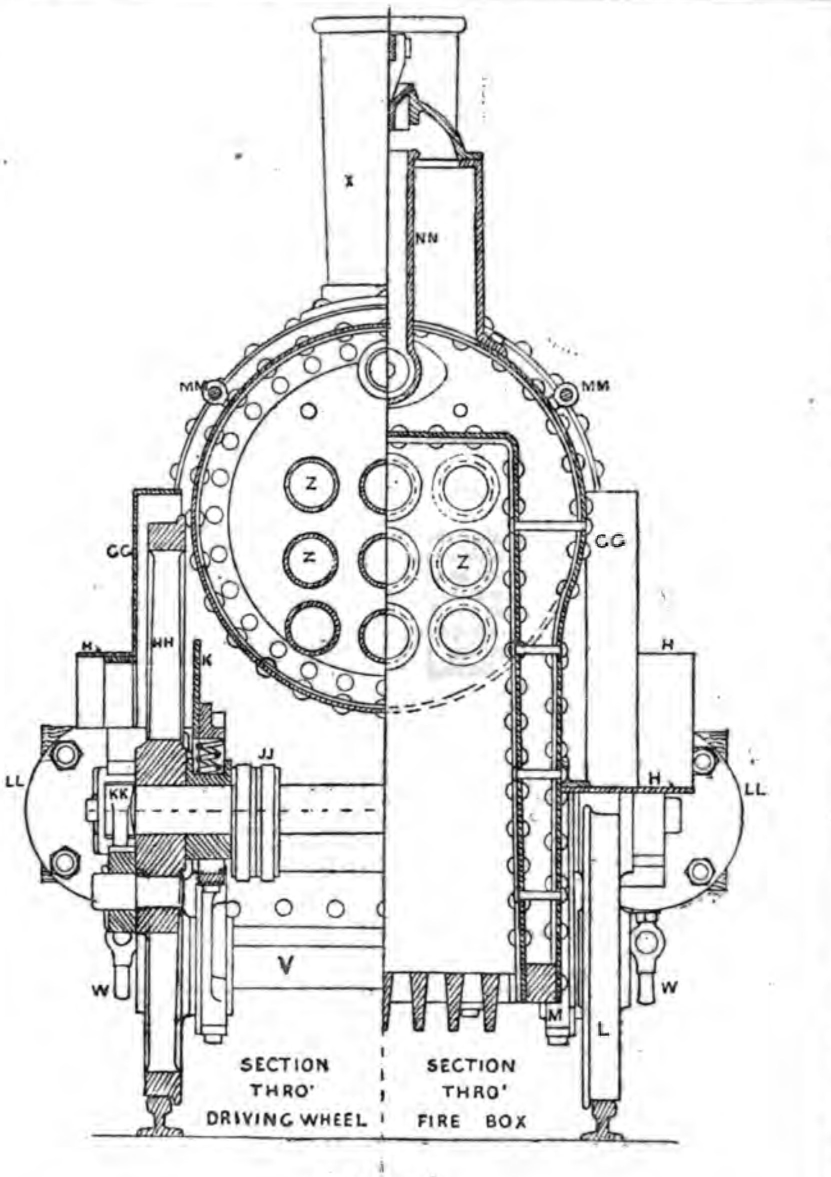


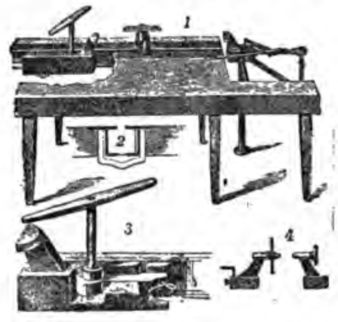
FIG 58

close to the cam, and moves with connected with the electric bell, springs as they fall into the notch fall nd make contact with the insulated ring. ference to Fig. 2, suppose the current at the left hand or No. 1 binding screw, s over No. 1 spring, through the cam and to the electro-magnetic vibrator, and on nd or right-hand binding screw, and so the battery, The vibrator being thus set on, the spindle rotates, carrying the cam ntil No. 1 spring drops into the notch, he current is shunted from the cam and r to the insulated ring, so setting the bell in motion—the bell ringing as long button is pressed in, and the current ined. It will be seen that No. 1 spring nain out of contact with the vibrator until it is sent throngh one of the other springs, the cam to rotate, when No. 1 spring ain be lifted into contact with the cam, or use. The indicator, as sketched above, e pointer always in sight opposite the last used. A press button is arranged as in Fig. 1, which causes the pointer to stop at a space between the openings and of sight. The indicators are usually cted for any number up to 10 signals on rd; if more than 10 signals are required, ller dials are recommended.

atent has been assigned to Messrs. Gent , of Faraday works, Leicester, who are makers.

## SQUIER'S VICE.

annexed engraving illustrates a new vice ently patented in the United States by Mr. H. Squier, of Trempealeau, Wisconsin, which is adapted to a large range of work, and is also convertible into an efficient lathe. In the work bench to which this improvement is applied is formed a longitudinal slot, the sides of which are lined with channelled iron bars, as shown in Figs. 1 and 2. The bar at the front of the bench is serrated, and to the space between and within the channelled bars is fitted a sliding block carrying one of the jaws of the vice. In the block is journalled a cam or eccentric, adapted to reciprocate a serrated jaw which engages the inner surface of the serrated channel bar. To the eccentric is fitted a key with a cross arm which may be inserted whenever it is desired to revolve the eccentric and thus move forward the jaw. In this movable block is inserted one of the jaws of a vice. The other jaw of the vice is supported by a standard at the end of the bench, and is adjustable by a screw. The jaws are both removable, and may be replaced by jaws of other forms and by other attachments. The inventor has provided a lathe head and tail block, shown in Fig. 4, which may be used in place of the jaws, and the tool-rest shown in Fig. 1 may be used in connection with the head tail block, for turning wood or metal, or for boring or light sawing.



## THE ELECTRO-MAGNET.—IV.*

### Methods of Measuring Permeability.

THERE are four sorts of experimental methods of measuring permeability.

1. *Magnetometric Methods.*—These are due to Müller, and consist in surrounding a bar of the iron in question by a magnetising coil, and observing the deflection its magnetisation produces in a magnetometer.

2. *Balance Methods.*—These methods are a variety of the preceding, a compensating magnet being employed to balance the effect produced by the magnetised iron on the magnetometric needle. Von Feilitzsch used this method, and it has received a more definite application in the magnetic balance of Prof. Hughes.

3. *Inductive Methods.*—There are several varieties of these, but all depend on the generation of a transient induction-current in an exploring coil which surrounds the specimen of iron, the integral current being proportional to the number of magnetic lines introduced into, or withdrawn from, the circuit of the exploring coil. Three varieties may be mentioned.

(A) *Ring Method.* — In this method, due to Kirchhoff, the iron under examination is made up into a ring, which is wound with a primary, or exciting coil, and with a secondary, or exploring coil. Determinations on this plan have been made by Stoletow, Rowland, Bosanquet, and Ewing; also by Hopkinson. Rowland's arrangement of the experiment is shown in Fig. 12, in which B is the exciting battery; S, the switch for turning on or reversing the current; R, an adjustable resistance; A, an ampère-meter; and B G the ballistic galvanometer, the first swing of which measures the integral induced current. R C is an earth-inductor or reversing coil wherewith to calibrate the readings of the galvanometer; and above is an arrangement of a coil and a magnet to assist in bringing the swinging needle to rest between the observations. The exciting coil and the exploring coil are both wound upon the ring; the former is distinguished by being drawn with a thicker line. The usual mode of procedure is to begin with a feeble exciting current, which is suddenly reversed, and then reversed back. The current is then increased, reversed, and re-reversed; and so on, until the strongest available points are reached. The values of the magnetising force H are calculated from the observed value of the current by the following rule. If the strength of the current, as measured by the ampère-meter, be $i$, the number of spires of the exciting coil S, and the length, in centimètres, of the coil (i.e. the mean circumference of the ring) be $l$, then H is given by the formula—

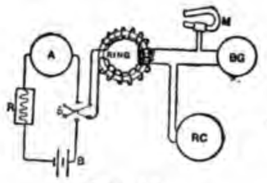


FIG. 12.

$$H = \frac{4\pi}{10} \times \frac{S\,i}{l} = 1{\cdot}2566 \times \frac{S\,i}{l}$$

(B) *Bar Method.*—This method consists in employing a long bar of iron instead of a ring. It is covered from end to end with the exciting coil; but the exploring coil consists of but a few turns of wire situated just over the middle part of the bar. Rowland, Bosanquet, and Ewing have all employed this variety of method; and Ewing specially used bars the length of which was more than 100 times their diameter, in order to get rid of errors arising from end-effects.

(C) *Divided Bar Method.*—This method, due to Dr. Hopkinson, is illustrated by Fig. 13.

The apparatus consists of a block of annealed wrought iron about 18in. long, 6½in. wide, and 2in. deep, out of the middle of which is cut a rectangular space to receive the magnetising coils.

The test samples of iron consist of two rods, each 12·65 millimètres in diameter, turned carefully true, and slide in through holes bored in the ends of the iron blocks. These two rods meet in the middle, their ends being faced true so as to make a good contact. One of them is secured firmly, and the other has a handle fixed to it, by means of which it can be withdrawn. The two large magnetising coils do not meet, a space being left between them. Into this space is introduced the little exploring coil, wound upon an ivory bobbin, through the eye of which passes the end of the movable rod. The exploring coil is connected to the ballistic galvanometer, B G, and is attached to an indiarubber spring (not shown in the Fig.), which, when the rod is suddenly pulled back, causes it to leap entirely out of the magnetic field. The exploring coil had 350 turns of fine wire; the

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* Extracted from the Cantor Lectures delivered by Prof. SILVANUS P. THOMPSON, B.Sc., before the Society of Arts.

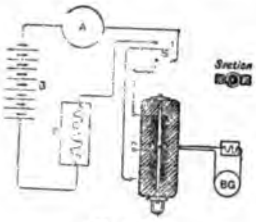

Fig. 13.

two magnetising coils had 2,008 effective turns. The magnetising current, generated by a battery, B, of eight Grove cells, was regulated by a variable liquid resistance, R, and by a shunt resistance. A reversing switch, and an ampère-meter, A, were included in the magnetising circuit. By means of this apparatus the sample rods to be experimented upon could be submitted to any magnetising forces, small or large, and the actual magnetic condition could be examined at any time by breaking the circuit and simultaneously withdrawing the movable rod. This apparatus, therefore, permitted the observation separately of a series of increasing (or decreasing) magnetisations without any intermediate reversals of the entire current. Thirty-five samples of various irons of known chemical composition were examined by Hopkinson, the two most important for present purposes being an annealed wrought iron and a grey cast iron, such as are used by Messrs. Mather and Platt in the construction of dynamo machines.

### Traction Methods.

Another group of methods of measuring permeability is based upon the law of magnetic traction. Of these there are several varieties.

(D) *Divided Ring Method.*—Mr. Shelford Bidwell has kindly lent me the apparatus with which he carried out this method. It consists of a ring of very soft charcoal iron rod 6·4 millimètres in thickness, the external diameter being 8 centimètres, sawn into two half-rings, and then each half carefully wound over with an exciting coil of insulated copper wire of 1,929 convolutions in total. The two halves fit neatly together, and in this position it constitutes practically a continuous ring. When an exciting current is passed round the coils both halves become magnetised and attract one another. The force required to pull them asunder is then measured. According to the law of traction, which will occupy us in the second lecture, the tractive force (over a given area of contact) is proportional to the square of the number of magnetic lines that pass from one surface to the other through the contact joint. Hence the force of traction may be used to determine $\mathsf{B}$; and on calculating $\mathsf{H}$ as before, we can determine the permeability.

(E) *Divided Rod Method.*—In this method, also used by Mr. Bidwell, an iron rod hooked at both ends was divided across the middle, and placed within a vertical surrounding magnetising coil. One hook was hung up to an overhead support; to the lower hook was hung a scale-pan. Currents of gradually increasing strength were sent around the magnetising coil from a battery of cells, and note was taken of the greatest weight which could in each be placed in the scale-pan without tearing asunder the ends of the rods.

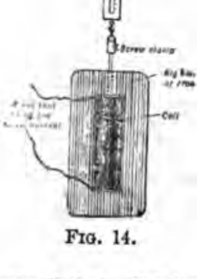

Fig. 14.

(*F*) *Permeameter Method.*—This is a method which I have myself devised for the purpose of testing specimens of iron. It is essentially a workshop method, as distinguished from a laboratory method. It requires no ballistic galvanometer, and the iron does not need to be forged into a ring or wound with a coil. For carrying it out a simple instrument is needed, which I venture to denominate as a *permeameter*. Outwardly, it has a general resemblance to Dr. Hopkinson's apparatus, and consists (Fig. 14) of a rectangular piece of soft wrought-iron, slotted out to receive a magnetising coil, down the axis of which passes a brass tube. The block is 12in. long, and 6½in. wide, and 3in. thickness. At one end the block is bored to receive the sample of iron that is to be tested. This consists simply of a thin rod about a foot long, one end of which must be carefully surfaced up. When it is placed inside the magnetising coil, and the exciting current is turned on, the rod sticks tightly at its lower end to the surface of the iron block; and the force required to attach it (or, rather, the square root of that force), is a measure of the permeation of the megnetic lines through its end-face.

### Curves of Magnetisation and Permeability.

In reviewing the results obtained, we note that the curves of magnetisation all possess the same general features, all tending towards a practical maximum, which, however, is different for different materials. Joule expressed the opinion that "no force of current could give an attraction equal to 200lb. per square inch," the greatest he actually attained being only 175lb. per square inch. Rowland was of opinion that the limit was about 177lb. per square inch for an ordinary good quality of iron, even with infinitely great exciting power. This would correspond roughly to a limiting value of $\mathsf{B}$ of about 17,500 lines to the square centimètre. This value has, however, been often surpassed. Bidwell obtained 19,820, or possibly a trifle more, as in Bidwell's calculation the value of $\mathsf{H}$ has been needlessly discounted. Hopkinson gives 18,250 for wrought iron, and 19,840 for mild Whitworth steel. Kapp gives 16,740 for wrought iron, 20,460 for charcoal iron in sheet, and 23,250 for charcoal iron in wire. Bosanquet found the highest value in the middle bit of a long bar to run up in one specimen to 21,428, in another to 29,388, in a third to 27,688. Ewing, working with extraordinary magnetic power, forced up the value of $\mathsf{B}$ in Lowmoor iron to 31,560 (when $\mu$ came down to 3), and subsequently to 45,350. This last figure corresponds to a traction exceeding 1,000lb. to the square inch.

Cast iron falls far below these figures. Hopkinson, using a magnetising force of 240, found the values of $\mathsf{B}$ to be 10,783 in grey cast iron, 12,408 in malleable cast iron, and 10,546 in mottled cast iron. Ewing with a magnetising force nearly fifty times as great, forced up the value of $\mathsf{B}$ in cast iron to 31,760. Mitis metal, which is a sort of cast wrought iron, being a wrought iron rendered fluid by addition of a small percentage of aluminium, is, as I have found, more magnetisable than cast iron, and not inferior to wrought iron. It should form an excellent material for the cores of electro-magnets for many purposes where a cheap manufacture is wanted.

### Hysteresis.

I have already drawn attention to the difference between the ascending and descending curves of magnetisation, and may now point out that this is a part of a set of general phenomena of residual effects. The best known of these effects is, of course, the existence in some kinds of iron, and notably in steel, of a remnant of sub-permanent magnetisation after the magnetising force has been entirely removed. To this retardation of effects behind the causes that produce them the name of "hysteresis" has been given by Prof. Ewing.

Another kind of after-effect was discovered by Ewing, and named by him "viscous hysteresis." This is the name given to the gradual creeping up of the magnetisation when a magnetic force is applied with absolute steadiness to a piece of iron. This gradual creeping up may go on for half an hour or more, and amount to several per cent. of the total magnetisation.

Another important matter is that all such actions as hammering, rolling, twisting, and the like, impair the magnetic quality of the annealed soft iron. Annealed wrought-iron which has never been touched by a tool shows hardly any trace of residual magnetisation, even after the application of magnetic forces. But the touch of the file will at once spoil it. Sturgeon pointed out the great importance of this point. In the specification for tenders for instruments for the British Postal Telegraphs, it is laid down as a condition to be observed by the constructor, that the cores must not be filed after being annealed. The continual hammering of the armature of an electro-magnet against the poles may in time produce a similar effect.

### Fallacies and Facts about Electro-Magnets.

I will conclude this lecture by stating a few of the fallacies that are current about electro-magnets, and will add to them a few facts, some of which seem paradoxical. The refutation of the fallacies and the explanation of the facts will come in due course.

*Fallacies.*—The attraction of an electro-
for its armature varies inversely as the squar
distance from the poles.

The outer windings of an electro-mag
necessarily less effective than those that are
the iron.

Hollow iron cores are as good as solid core
same size.

Pole-pieces add to the lifting power of an
magnet.

It hurts an electro-magnet (or, for that
a steel magnet) to pull off the keeper su
[It is the sudden slamming on that in realit
it.]

The resistance of the coil of an electro-
ought to be equal to the resistance of the bat

A coil wound left-handedly magnetises a
differently from a coil wound right-handedl
is not a question of winding of coil, but of
tion of current.]

Thick-wire electro-magnets are less powerf
thin-wire electro-magnets.

A badly insulated electro-magnet is more
ful than one that is well insulated.

A square iron core is less powerful (as Dal
says, eighteen-fold!) than a round core of
weight.

The attraction of an electro-magnet for its
is necessarily less strong (one-third accord
Du Moncel) sideways than when the keepe
front of the poles.

Putting a tube of iron outside the coil
electro-magnet makes it attract a distant ar
more powerfully.

*Facts.*—A bar electro-magnet with a conv
holds on tighter to a flat-ended armature th
with a flat pole does.

A thin round disc of iron laid upon the fla
end of an electro-magnet (the pole end
slightly larger than the disc) the disc
attracted, and will not stick on, even if lai
quite centrally.

If a flat armature of iron be presented
poles of a horse-shoe electro-magnet the att
at a short distance is greater, if the arma
presented flankways, than if it is presented edg
On the contrary, the tractive force in con
greater edgeways than flankways.

Electro-magnets with long limbs are pra
no better than those with short limbs for s
on to masses of iron.

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## ODONTICS, OR THE THEORY PRACTICE OF THE TEETH GEARS.—XII.*

### Circular Pitch Worm Teeth.

THE old and clumsy circular pitch syste
universal use for worm teeth, for the
that worms are generally made in the lath
lathes are never provided with the proper
gears for cutting diametral pitches. The err
firmly rooted, that it is useless to attempt
lodge it.

It is, therefore, necessary to figure the dia
of worm gears as if their throat sections w

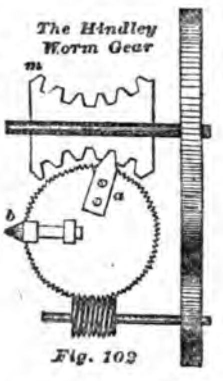


Fig. 102

same as those of common spur gears and ra
the circular pitch system. The table of dia
will be of great assistance.

One great objection to the use of the c
pitch system for spur gears does not apply to
gears, that the centre distance between the
will always be an inconvenient fraction, unl
pitch is as inconvenient. The worm can be
of any diameter, and can therefore be
to suit the pitch diameter of the gear and the
distance at the same time.

The sides of the tool for circular pitches
come together at an angle of 30°, and the w
the point, as well as the depth to be cut in th
or in the hob, should be taken from the fol

---

* By Geo. B. Grant, in *American Machinis*

The diameter of the hob should be greater ɩt of the worm by the "increase" given.

LE FOR CIRCULAR PITCH WORM TOOLS.

| r pitch.. | 2 | 1¾ | 1½ | 1¼ | 1⅛ |
|---|---|---|---|---|---|
| f hob tool | ·644 | ·564 | ·483 | ·402 | ·362 |
| f worm ........ | ·620 | ·542 | ·466 | ·388 | ·349 |
| of cut in or hob.. | 1·416 | 1·240 | 1·062 | ·886 | ·797 |
| e ...... | ·166 | ·146 | 1·249 | ·104 | ·094 |
| r pitch.. | 1 | ⅞ | ¾ | ⅝ | ½ |
| f hob tool | ·322 | ·282 | ·241 | ·201 | ·161 |
| f worm ........ | ·310 | ·271 | ·233 | ·194 | ·155 |
| of cut in or hob.. | ·708 | ·620 | ·531 | ·443 | ·354 |
| e ...... | ·083 | ·073 | ·062 | ·052 | ·042 |
| r pitch.. | 7/16 | ⅜ | 5/16 | ¼ | 3/16 |
| f hob tool | ·141 | ·121 | ·100 | ·080 | ·060 |
| f worm ........ | ·135 | ·116 | ·097 | ·078 | ·058 |
| of cut in or hob.. | ·310 | ·265 | ·222 | ·177 | ·133 |
| e ...... | ·036 | ·031 | ·026 | ·021 | ·016 |

the tool with the proper width at the point ɩd the worm, and then, after making the grind off half the "increase" from the f the tool, and use it to thread the hob.

### Diametral Pitch Worm Teeth.

proper change gears are provided, it is as cut diametral pitch worm teeth as any. The gears can always be easily calculated by the ɩt the screw gear is to the stud gear as two times the pitch of the lead screw of the to seven times the diametral pitch of the be cut.

xample, it is required to cut a worm of liametral pitch, on a lathe having a leading ɩt six to the inch. We have—

$$\frac{\text{screw gear}}{\text{stud gear}} = \frac{22 \times 6}{7 \times 12} = \frac{11}{7};$$

y change gears in the proportion of 11 will answer the purpose with an error of

of an inch to the thread of the worm.

and 7 give inconvenient numbers of teeth, bers 69 and 22 can be used with sufficient y, and 47 and 5, or even 25 and 8 may do in ses.

ve calculation and study, the table of change r diametral pitches is provided, and it will proportion of screw gear to stud gear to be all ordinary cases.

air on the left will give the proper pitch ess than a thousandth of an inch, and that ight will serve with an error always less undreth of an inch, and sometimes less than hree thousandths of an inch.

g the change gears, figure the pitch diameter of the gear as if the throat section is a spur the diametral pitch system.

des of the tool should come together at an thirty degrees, and the width of the point ool, as well as the depth to be cut in the r in the hob, should be taken from the following able. The diameter of the hob should be than that of the worm by the "increase"

E FOR DIAMETRAL PITCH WORM TOOLS.

| al pitch ...... | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| hob tool...... | 1·035 | ·517 | ·345 | ·258 |
| worm tool .... | ·968 | ·484 | ·323 | ·242 |
| f cut in worm or ............... | 2·125 | 1·063 | ·708 | ·532 |
| ............... | ·250 | ·125 | ·083 | ·063 |
| al pitch ...... | 5 | 6 | 7 | 8 |
| hob tool ...... | ·207 | ·173 | ·148 | ·129 |
| worm tool.... | ·194 | ·162 | ·138 | ·121 |
| f cut in worm or ............... | ·425 | ·354 | ·304 | ·266 |
| ............... | ·050 | ·042 | ·036 | ·032 |
| al pitch ...... | 10 | 12 | 14 | 16 |
| hob tool...... | ·104 | ·086 | ·074 | ·065 |
| worm tool.... | ·097 | ·081 | ·069 | ·060 |
| f cut in worm or ............... | ·213 | ·177 | ·152 | ·133 |
| ............... | ·025 | ·021 | ·018 | ·016 |

the tool with the proper width at the point d the worm; and then, after making the worm, grind off half the "increase" from the length of the tool, and use it to thread the hob.

TABLE OF CHANGE GEARS FOR DIAMETRAL PITCH WORMS.

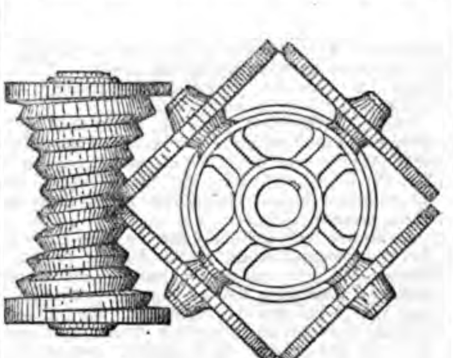
Pitch of Leading Screw.

| Diametral Pitch to be Cut. | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 10 |
|---|---|---|---|---|---|---|---|---|
| 3 | $\frac{44}{21} \cdot \frac{23}{11}$ | $\frac{22}{7}$. | $\frac{88}{21} \cdot \frac{46}{11}$ | $\frac{110}{21}$. | $\frac{44}{7} \cdot \frac{69}{11}$ | $\frac{21}{3}$. | $\frac{176}{21} \cdot \frac{92}{11}$ | $\frac{220}{21}$. |
| 4 | $\frac{11}{7}$. | $\frac{33}{14}$. | $\frac{22}{7}$. | $\frac{55}{14}$. | $\frac{33}{7}$. | $\frac{11}{2}$. | $\frac{44}{7}$. | $\frac{55}{7}$. |
| 5 | $\frac{44}{35} \cdot \frac{5}{4}$ | $\frac{66}{35} \cdot \frac{15}{8}$ | $\frac{88}{35} \cdot \frac{5}{2}$ | $\frac{22}{7} \cdot \frac{25}{8}$ | $\frac{132}{35} \cdot \frac{15}{4}$ | $\frac{22}{5} \cdot \frac{35}{8}$ | $\frac{176}{35} \cdot \frac{5}{1}$ | $\frac{44}{7} \cdot \frac{25}{4}$ |
| 6 | $\frac{22}{21}$. | $\frac{11}{7} \cdot \frac{30}{19}$ | $\frac{44}{21} \cdot \frac{40}{19}$ | $\frac{55}{21} \cdot \frac{50}{19}$ | $\frac{22}{7} \cdot \frac{60}{19}$ | $\frac{11}{3} \cdot \frac{70}{19}$ | $\frac{88}{21} \cdot \frac{80}{19}$ | $\frac{110}{21} \cdot \frac{100}{19}$ |
| 7 | $\frac{44}{49} \cdot \frac{9}{10}$ | $\frac{66}{49} \cdot \frac{27}{20}$ | $\frac{88}{49} \cdot \frac{9}{5}$ | $\frac{110}{49} \cdot \frac{9}{4}$ | $\frac{132}{49} \cdot \frac{27}{10}$ | $\frac{22}{7} \cdot \frac{63}{20}$ | $\frac{176}{49} \cdot \frac{18}{5}$ | $\frac{220}{49} \cdot \frac{9}{2}$ |
| 8 | $\frac{11}{14} \cdot \frac{4}{5}$ | $\frac{33}{28} \cdot \frac{6}{5}$ | $\frac{11}{7} \cdot \frac{8}{5}$ | $\frac{55}{28} \cdot \frac{2}{1}$ | $\frac{33}{14} \cdot \frac{12}{5}$ | $\frac{11}{4} \cdot \frac{14}{5}$ | $\frac{22}{7} \cdot \frac{16}{5}$ | $\frac{55}{14} \cdot \frac{4}{1}$ |
| 10 | $\frac{22}{35} \cdot \frac{5}{8}$ | $\frac{33}{35} \cdot \frac{15}{16}$ | $\frac{44}{35} \cdot \frac{5}{4}$ | $\frac{11}{7} \cdot \frac{25}{16}$ | $\frac{66}{35} \cdot \frac{15}{8}$ | $\frac{11}{5} \cdot \frac{35}{16}$ | $\frac{86}{35} \cdot \frac{5}{4}$ | $\frac{22}{7} \cdot \frac{25}{8}$ |
| 12 | $\frac{11}{21} \cdot \frac{10}{19}$ | $\frac{11}{14} \cdot \frac{15}{19}$ | $\frac{22}{21} \cdot \frac{20}{19}$ | $\frac{55}{42} \cdot \frac{25}{19}$ | $\frac{11}{7} \cdot \frac{30}{19}$ | $\frac{11}{6} \cdot \frac{35}{19}$ | $\frac{44}{21} \cdot \frac{40}{19}$ | $\frac{55}{21} \cdot \frac{50}{19}$ |
| 14 | $\frac{22}{49} \cdot \frac{4}{9}$ | $\frac{33}{49} \cdot \frac{2}{3}$ | $\frac{44}{49} \cdot \frac{8}{9}$ | $\frac{55}{49} \cdot \frac{10}{9}$ | $\frac{66}{49} \cdot \frac{4}{3}$ | $\frac{11}{7} \cdot \frac{14}{9}$ | $\frac{88}{49} \cdot \frac{16}{9}$ | $\frac{110}{49} \cdot \frac{20}{9}$ |
| 16 | $\frac{11}{28} \cdot \frac{2}{5}$ | $\frac{33}{56} \cdot \frac{3}{5}$ | $\frac{22}{28} \cdot \frac{4}{5}$ | $\frac{55}{56} \cdot \frac{1}{1}$ | $\frac{33}{28} \cdot \frac{6}{5}$ | $\frac{77}{56} \cdot \frac{7}{5}$ | $\frac{11}{7} \cdot \frac{8}{5}$ | $\frac{55}{28} \cdot \frac{2}{1}$ |

Exact numbers on the left. Approximate on the right.

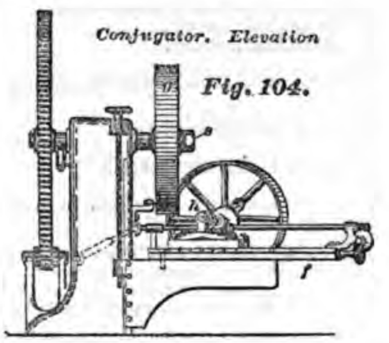
### Width of Worm Gear Face.

The bearing between the tooth of the worm and that of the gear is near the centre of the gear, and it is quite small. It is, therefore, useless to make the gear with a wide face. If the face is half the diameter of the worm it will have all the bearing that can be obtained, and any extra width will simply add to the weight and cost of the gear.



Pin worm gear.
Fig. 103.

The length of the worm need be no more than three times the circular pitch, for there are seldom more than two teeth in contact at once. If, however, the worm is made long, it can be shifted when it becomes worn, so as to bring fresh teeth into working position. This provision is wise, for the reason that the worm is always worn more than the gear.



Conjugator. Elevation

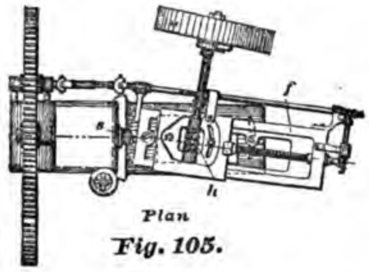
Fig. 104.

### The Hindley Worm and Gear.

If the cutting hob and the worm is shaped by the tool, *a*, and the process indicated by Fig. 102, the resulting pair of gears is known as the Hindley worm gear. The worm is often called the "hourglass" worm.

It is commonly but erroneously stated that this worm fits and fills its gear on the axial section, the section that is made by a plane through the axis of the worm and normal to the axis of the gear. It has even been stated that the contact is between surfaces, the worm filling the whole gear tooth.

The real contact is not yet certain, but it is certain that it is not a surface contact. It is also certain that it is on the normal and not on the axial section, and that the Hindley worm hob will not cut a tooth that will fill any section of it. The contact may be linear, along some line of no great length, but it is probably a point contact on the normal section. The order of the contact is certainly very close, resembling that of two surfaces.



Plan

Fig. 105.

The worm is limited in length, for the sides of the teeth cannot slant inward from the normal to the axis. The end tooth *m* in Fig. 102 cannot be used, for it will destroy the teeth of the gear as it is fed towards this axis in the operation of hobbing.

It has the one great defect that it is not adjustable in any direction, and, therefore, cannot change its position when the shaft bearings wear, unless it is itself worn the same amount. It is doubtful if this form of gearing has any advantage over the plain spiral gearing, except when new and in perfect adjustment.

### The Pin Worm and Gear.

If the hob and the worm are shaped by the pin-shaped revolving milling tool *b* of Fig. 102, the gearing produced will have linear bearing between the teeth.

The action will be the same as between a series of pin teeth like the milling tool, each pin being in the axial section of the worm, but having a linear bearing on the normal section of its teeth.

This form of gearing, which is a modification of the Hindley form, may take the shape of pin gearing, the teeth being round pins like the milling tool. If the pins are mounted on studs, so as to revolve, a roller pin worm gear will be produced. Fig. 103 shows a form of roller pin gearing in which the pins have been enlarged.

### The Whitworth Hobbing Machine.

When the amount of work to be done will warrant the use of a special machine, the hobbing machine of Sir Joseph Whitworth may be used. It was invented in 1835, and has not been materially improved since then, although there are numerous patents relating to it. The worm gear to be hobbed is fixed upon the same spindle with a master worm-wheel. A driving worm runs in the master wheel, and it is connected by a train of gearing with a hob that is so mounted on a carriage that it can be fed towards the gear blank. The hob is slowly forced into the blank, while both are revolving with the proper speeds, and the gear is cut without the assistance of previously made nicks. See British patent 6,850 of 1835.

### The Conjugator.

This is a machine for cutting spur or spiral gears by means of a hob, and its principle is an extension of that of the Whitworth worm-gear hobbing machine.

If, when the hob in the Whitworth machine has reached the full depth of the tooth, it receives a new motion in the direction of the tangent to its pitch spiral, it will continue the tooth to the edge of the gear, and form the plain spiral gear of Fig. 91.

Fig. 104 is an elevation of the machine, and Fig. 105 is a plan. The hob *h* is mounted upon an arbor that is connected by a train of gearing with the spindle *s* that carries the blank gear *g* to be cut, so that the hob and blank revolve together with any definite proportionate speed. The hob is carried upon a carriage that is fed on a frame *f*. The hob swivels upon the carriage, so that the tangent to its pitch spiral can be set parallel with the direction of the feed, and the frame swivels so that the tooth can be cut at any angle with the gear spindle.

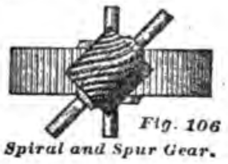


*Fig. 106*

*Spiral and Spur Gear.*

As the blank and the hob are revolving, the latter is fed into the former, and it will cut a perfect tooth in the direction that the frame is set at. As the frame can be set in any direction, the machine will cut the common straight tooth. All gears cut by the same cutter will run together interchangeably, and if two gears are cut at the same angle in opposite directions, they will run together on parallel shafts. See U.S. patent number 405,030, June 11th, 1889.

## A PRACTICAL METHOD FOR REDUCING THE INTERNAL WASTES OF THE STEAM-ENGINE.*

By Robert H. Thurston, M.Am.Soc.C.E.

In the operation of the steam-engine, experiment and observation show that the great losses of heat, steam, and fuel which distinguished the real from the ideal engine, and which constitute the greater part of the discrepancy between the computed thermo-dynamic efficiency and the efficiency of the engine in actual working, are due to waste of heat internally by the alternate absorption of heat by the metallic surfaces of the cylinder-heads and piston and the ejection of that heat later to the condenser, if it be a condensing engine, or in non-condensing engines into the atmosphere. Many attempts have been made to reduce this loss, as by rendering the internal surfaces less perfect conductors and absorbers of heat, by superheating the entering steam, and by "compounding" the engine. All of these methods are familiar to the engineer and have been more or less successful. The steam jacket has also been employed, and the internal surfaces have been covered with non-conductors of heat by various inventors; but no device of this kind yet introduced or tested experimentally has been efficient and permanent.

The object of an invention of the writer is to provide an effective non-conducting surface for the internal surfaces of the steam-engine cylinder, formed integrally with the castings of which the engine is composed.

It is well known that ordinary cast iron is largely graphitic, the carbon contained by the iron amounting to from 2 to 3 per cent. of the whole up to 5 or 6 per cent., accordingly as the iron has been exposed to a higher or lower temperature in the blast furnace, and as a greater or less amount of fuel is burned in its reduction from the ore. It is also well known that a process of slow oxidation will remove the iron, in part, from the surface so exposed and leave the carbon in a somewhat compact form, which is held in place by a honeycombed mass of unoxidised iron. This mixture covers the surface of the solid iron to a depth depending upon the method and duration of the action of the oxidising medium.

One of the best methods of securing the oxidation of the iron is to subject it to a dilute acid—say, for example, a solution of sulphuric acid in water in the proportion of one part of acid to ten or more of water. The writer has found that a piece of iron submitted to a very weak solution of acid for ten days produced good results, the graphitic surface being fairly dense and compact.

The idea is to expose the internal parts of the engine (such as the heads of the cylinder, the two sides of the piston, the internal surfaces of the ports, and the clearance space) to the action of such a solvent for a suitable length of time, thus converting those surfaces into highly carbonised material, which is a comparatively poor conductor of, and has a low capacity for, heat. It is impracticable to so treat the rubbing surfaces; but, as they are kept in a high state of polish, their capacity for taking up heat is thus greatly lessened, and it is therefore not so necessary to treat the surfaces subjected to friction.

In modern engines, especially those of the "high-speed" type, the cylinders are of large diameter and small length, and the stroke of the piston is short, thus exposing large areas of piston and cylinder-head, which are effective in condensing the steam and reducing the efficiency of the engine. These large areas I propose to treat in the manner described.

Referring to the drawing, the interior surfaces of the heads *a* and the interior surfaces of the ports and passages of the cylinder A are provided with a coating, *b*, of graphite produced in the manner above described. Opposite sides of the piston, B, are treated in like manner.

In addition to rendering the surfaces graphitic in the manner described, we may fill the spongy surfaces so prepared with a substance which is a non-conductor of heat—such as drying oils, shellac, or other adhesive non-conducting materials—which will decrease the conducting and heat-storing properties of the surfaces, and at the same time aid in giving them permanence in the presence of variations of temperature, pressure, and humidity, such as inevitably occur in all engines.

The effectiveness of this plan, as devised by the writer, was studied, and its influence on the efficacy of the engine was investigated, at his request, by Mr. P. M. Chamberlain, in the Sibley College laboratories, Cornell University, in the early part of the present year.

An engine built especially for the laboratory and for experimental work by the Messrs. Payne, of Elmira, N.Y., was employed, and the process consisted in measuring the flow of heat through its head into a calibrated calorimeter. Several series of trials were made at various times, and under differing conditions, each usually lasting forty minutes.

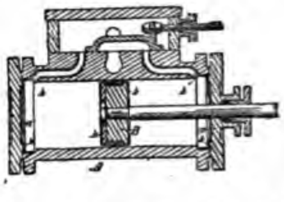
In the first trial a head was made for the steam cylinder of what is familiar in the foundries of Western New York under the name of "Tuscarora" iron. Its thickness was 1in. The outer face was smoothly polished, as is usual; the inside was simply smoothly faced-off in the lathe with the ordinary finishing cut. The inner face was tested under conditions described as follows:—

| No. Test. | Condition of Inner Surface. |
|---|---|
| 1. | As finished; greasy. |
| 2. | As finished; greasy. |
| 3. | Same; washed clean with benzine and dried. |
| 4. | |
| 5. | |
| 6. | Oiled with lubricating oil. |
| 7. | |
| 8. | Washed clean with benzine. |
| 9. | |
| 10. | After exposure to nitric acid 16 hours; then oiled with linseed oil. |
| 11. | |
| 12. | |
| 13. | Similarly treated with hydrochloric acid, and oiled after 12 hours' exposure. |
| 14. | |
| 15. | Sulphuric acid, 1; water, 2; for 48 hours; then oiled, and allowed to dry 24 hours. |
| 16. | |

Rankine's formula was employed in making comparisons:

$$q = \frac{t' - t}{\sigma' + \sigma + \rho x};$$

in which $t'$ and $t$ are the temperatures of fluid on each side the plate, $\sigma'$ and $\sigma$ are the resist heat-transmission through those surfaces, the co-efficient of internal thermal resistan which may be neglected as insensible her



equation gives $q$ the quantity of heat, in transmitted per square foot per hour.

Let Q = total heat transmitted, then for t in hand,

$$q = \frac{3}{2}\frac{Q}{0{\cdot}171} = 8{\cdot}772\,Q$$

The value of Q varied from about 5550 B cases 1 and 2 to 3000 and 3100 in cases 15 as shown in the table which follows:

Table.

| No. Test. | Q. | $t' - t$ | $\sigma' +$ |
|---|---|---|---|
| 1 | 5550·9 | 236·0 | 0·004 |
| 2 | 5566·4 | 238·0 | 4 |
| 3 | 5444·2 | 238·8 | 4 |
| 4 | 5139·3 | 239·1 | 5 |
| 5 | 5055·8 | 239·8 | 5 |
| 6 | 5523·9 | 236·4 | 4 |
| 7 | 5444·3 | 236·9 | 4 |
| 8 | 5620·4 | 233·7 | 4 |
| 9 | 5515·6 | 234·7 | 4 |
| 10 | 5101·9 | 236·6 | 5 |
| 11 | 5439·7 | 235·7 | 4 |
| 12 | 5581·8 | 235·6 | 4 |
| 13 | 5347·5 | 234·3 | 4 |
| 14 | 5741·1 | 233·5 | 4 |
| 15 | 3020·4 | 225·3 | 8 |
| 16 | 3104·9 | 225·5 | 8 |

In the first four runs the gradual incr resistance noted was attributed to the gath rust on the exterior surface, no oil being protect it from the water, and to the grad of greasiness on the interior. In Nos. 3, sensible change appears other than the alteration just noted; nor is any notable attained until the last pair of data are reach then becomes evident that treatment with oil, even after so short a period of exposure and so short a time allowed for drying, has ceedingly important effect in reducing cond and preventing heat storage and transmissio

By even a superficial treatment with a oil, the saving of heat is 40 per cent.

$$\frac{8500 - 5000}{8500} = 0{\cdot}40\text{, nearly,}$$

and this, it would seem, should measure the tion by which internal cylinder condens diminished. With more prolonged treatme acid and a more efficient absorption of oil a complete drying, the gain would be cons greater than here appears, and as will be h shown. The writer has estimated that thi treatment may reduce cylinder-waste by half: which, in ordinary practice, means fr 20 per cent. of all steam used, the figur greatest with smallest sizes of engine.

A professor in the Lehigh University h several experiments on the pressure req drill through cast iron. A cylinder was fill oil and provided with a pump piston 10 inches in area, to which was attached t to be drilled. The cylinder was also fit pressure gauge and indicator, by means o diagrams could be obtained showing the of the pressure transmitted to the oil. ¼in. diameter were found to exercise a pr 181 kilos., while for drills of ½in., ¾in., a diameter the corresponding pressures ros 498, 656, and 815 kilos. An American pa this, but does not say anything as to the the drills or the character of the cast iron.

An American paper says: "Hair felt p the foundations of the steam-engines o dynamo stations will effectively remedy t and vibration now so often complained of station is operated in a private neighbourho electric company recently had one of its power engines removed from its foundation were taken up to the depth of 4ft. A laye 5in. thick was then placed on the foundati run up 2ft. on all sides, and on the top of brickwork was built up. The cost of the alt was about 300 dols."

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[*] A paper contributed to the *Transactions* of the American Society of Civil Engineers.

# ENTIFIC SOCIETIES.

## ETT MICROSCOPICAL CLUB.

286th ordinary meeting of this club, held
ber 17th, at 20, Hanover-square, W.,
I. Dallinger, F.R.S., president, in the

utes of the preceding meeting were read
med. Proposals for membership were
uspended for ballot at the next meeting.
the books and periodicals presented or
for the library since the last meeting
y the secretary, who also announced the
f twelve slides of selected diatoms for the
om Mr. H. Morland, and also twelve
tly of Bacteria, from Mr. Pound. The
se gentlemen in their own line was well
every member attending the meetings,
lonations could not but prove valuable
to the club's collection. A vote of thanks
Morland and Pound was put from the
arried unanimously.
op exhibited and described a superior
microscope made by Messrs. Swift, of
Court-road, W. He said it had long
ter of surprise and regret with him, and
ral times expressed this at their meetings,
tter class of students' instruments should
be provided with something more scien-
actical than the common sub-stage fitting
plication, particularly of an achromatic
or such other apparatus as required
ntring to the optic axis. No doubt if a
was purchased *at the same time* as the
ould be sent out fairly centred; but if
ubsequently the chances were it would
considerably out of truth. On talking
with Messrs. Swift, it was suggested
em that the tail-piece of the microscope,
being merely a tube, should be made
vetail groove to receive a sliding bar,
he upper end a simple sub-stage with
justments, and at the lower end a slot to
g for the mirror, so that this could be
rtically independently of the main bar.
nent was now before them for criticism,
ld only point out such other features as
ecial remark. The body-tube was made
same size eyepieces as the larger instru-
is firm—viz., $\frac{3}{16}$in. in diameter, and short
vork with objectives adjusted to the Con-
be-length. A draw-tube was provided
tion to the English standard of 10in.
g carrying the body was made longer
in students' instruments, so as to be
from shake with low-power objectives.
djustment consisted of a very carefully
rential screw motion, capable of very
ussing, and the milled heads were large
firm grasp. The stage was big enough
ture-plates, and the Nelson horse-shoe
adopted both for lightness and for the
gave in feeling the working distance of
ve. Instead of those abominable clips
equently damage the specimen, it had a
e with sprung guides moving in grooves
of the stage; small clips, however, were
r use in the horizontal position. The
hanical stage can, of course, be applied
The sliding-bar carrying the substage
fitted that there was not the slightest
fficulty in focussing a fairly high-angled
and a clamping screw was provided for
ough not really necessary. The mirror
e, in case it was desired to work with
from the lamp. Messrs. Swift's price
, including two eyepieces and a superior
case.

Western read a short paper on a new
Lacinularia, which at first sight bore a
superficial likeness to Conochilus volvox.
d the provisional title of *natans* for this
because, so far as his own observations
as never attached to pond-weed, &c.,
free-swimming. He also described a
r, for which no name at present had been
d he was in communication with Dr.
the subject. It somewhat resembled
, but the winter eggs were different,
r species, moreover, possessed intestine
anus. Drawings on the black board to
r. Western's paper were made by Mr. W.

ing a vote of thanks to Mr. Western,
nt remarked that the paper they had
to was a practical proof of the value
g Society such as the Quekett Club.

. Buffham read a paper on "The Re-
Organs, especially the Antheridia of
ideæ," illustrated by coloured diagrams
ns under the microscope.

thanks was passed to the author for
ing paper, and announcement having
f the fixtures for the ensuing month,
ings terminated with the usual con-

# SCIENTIFIC NEWS.

IT appears probable—it is almost certain—that the comet observed by Mr. Barnard on the 6th inst. was D'Arrest's periodical comet, which, it seems, has been detected from the Lick Observatory some weeks after perihelion.

Another small planet (No. 299) was discovered by Dr. J. Palisa, of Vienna, on the 6th inst.

Dr. H. Struve, of Pulkowa Observatory, has been making micrometer measures of the satellites of Saturn with the 30in. equatoreal, and contributes to *Astronomische Nachrichten* a note on the subject, in which he says that the changes in the elements and mean motions of Mimas and Tethys may increase indefinitely. Those who make a study of Saturn will find much to interest them in the paper. Dr. Struve's determination of the spheroidal constant of Saturn is 0·0258, and the ring-system may be disregarded as a sensible "mass" in the calculations.

Both Mr. Barnard and Mr. Burnham have observed the remarkable appearances of the first satellite of Jupiter during the last month or so, and they conclude that, unless there was a white belt on the satellite parallel to the belts of Jupiter, there is no alternative but to consider the satellite actually double.

The ordinary general meeting of the Institution of Mechanical Engineers will be held on the evenings of Oct. 29 and 30, at 25, Gt. George-street, by permission of the Council of the Institution of Civil Engineers, when some rather important papers will be read—notably one by Mr. R. Jefferds, on "Tube-frame Goods Waggons of light weight and large capacity, and their effect upon the working expenses of railways." In connection with this paper the members are invited to inspect a waggon which will be on view during daylight on October 29 and 30, at the Victoria passenger station of the L. C. and D. Railway, where it will be standing in the siding behind the main arrival platform, by permission of the railway company. On "Milling Cutters," by Mr. George Addy, of Sheffield; on "The Mechanical Treatment of Moulding Sand," by Mr. Walter Bagshaw, of Batley, are other papers treating on interesting subjects.

In his Harveian Oration, delivered before the Royal College of Physicians, Dr. Andrew, preliminary to the more technical part of his discourse, referred to the fact that a man may be a first-rate practitioner, and yet have no title whatever to be ranked among scientific physiologists, as a sailor may be a first-rate navigator without being in any proper sense of the words a scientific astronomer, or mathematician, or physicist. One of the best, if not the best, definitions of "medicine" is that which describes it as "applied physiology." If we fail to attain to that ideal, if we are compelled daily to act upon probabilities in place of scientific certainties, then the blame must rest at least as much on the physiologist as on ourselves. He fails to supply us with the knowledge which we require, and which he alone can give us. Medicine is thus but one of many instances of an art stunted by the insufficient development of the science with which it is connected and on which it rests. Physiology by slow degrees has come to rely more and more on purely scientific modes and instruments of research, and to apply them by preference to matters which can be brought to the test of direct experiment. Medicine, on the other hand, has no choice but to remain, so far as it has a scientific side, a science of observation; for anything like effective investigation of the matters with which it deals by direct experiment is impossible.

The Geologists' Association commences the winter session on Nov. 7, when a conversazione will be held in the Library of University College, London.

The annual general meeting of the Mineralogical Society will be held in the apartments of the Geological Society, Burlington House, on Tuesday, Nov. 11.

The Decimal Association, which was formed last year for the purpose of promoting the adoption of the decimal system in this country, has lately been actively engaged in distributing information on the advantages to be gained by such a change. The question has specially been prominently brought under the notice of School Boards throughout the country. Twenty Boards have already passed resolutions favouring the object of the association, and have assisted in bringing the matter under public notice. Trade Unions are also taking the subject up, meetings having been held to discuss it from a working man's point of view—so, at least, we read; but has the carpenter or the engineer—the mechanic generally—any desire to get rid of his foot-rule?

A correspondent has sent us a "cutting" containing an account of a meeting of the Windsor and Eton Scientific Society, from which we learn that, "In one of the upstairs committee-rooms, Mr. H. Middleton, of Slough, exhibited to public view a steam-driven tricycle, which was guided round the room with the greatest facility. It is calculated that the tricycle will travel at the rate of 10 or 12 miles an hour, and the boiler, small as it is, will hold sufficient water to last an hour and a half."

The Berlin police have issued a "caution against the indiscriminate consumption of dried mushrooms, which are commonly used on the "Continent" in soups, stews, &c. The assertion is made that packets of these dried mushrooms frequently contain poisonous fungi, and it is also asserted that edible mushrooms when dried remain white, whereas poisonous species acquire a bluish tint.

Accounts received by Atlantic steamers during the present season give a remarkable description of the icebergs seen this year; the *Fulda*, which has recently arrived, for instance, reporting an iceberg about 400ft. long and 150ft. high in lat. 45° 35′ N., long. 48° 7′ W. The longitude does not matter, but icebergs in such latitudes are rather dangerous in seasons when they are unexpected.

The development of what we term electric tramways seems to have introduced a new word to American papers. As a rule, what we call a railway they call a railroad; but "over there" they are certainly going ahead, Mr. Lowry, for instance, of the St. Paul and Minneapolis Railway systems, having recently ordered 15 Edison dynamos of 200H.P. each and 20 cars. They are required to run at 25 miles an hour. Early this year Mr. Lowry ordered about 7,000H.P. of electrical apparatus.

**How Flies Die.**—Like many other insects, house-flies are subject to the attacks of a parasitic fungus which destroys great numbers of them, especially towards the end of autumn. We sometimes see the corpses of such as have met this fate glued to the window-panes in the attitude of life, with legs widely spread and wings raised as if in preparation for flight, but with a white halo on the glass all around them, and with bodies pale, unhealthy-looking, and distended. The spores of the fungus, which are excessively minute and are present in the air, are carried against the fly's body, and such as strike its under surface may become adherent, when each spore sends out a long tubular projection, which penetrates the skin and enters the body. Once here its host's doom is certain, for it meets with suitable nourishment in the shape of the fluids of the fly's body, by aid of which it will speedily propagate itself until its victim, drained of its life support, finally succumbs. The thread-like tube first produces a series of detached, rounded bodies, something like the cells of the yeast plant. These cells, which have an indefinite power of self multiplication, are carried by the blood to all parts of the body, and thus the disease spreads. They, in their turn, give rise to a number of branching tubular threads, similar to those of the earlier stage, which, in process of time, penetrate the skin. Each thread which thus makes its appearance outside gives rise to a sort of head, which contains spores like those with which the series started. These are cast off with considerable force, and multitudes of them no doubt perish, while others are ultimately wafted against the bodies of other flies, to deal destruction among them as among their predecessors. The particular species of fungus which makes havoc with the house-flies is called *Empusa muscæ*, and is one of a group which are distinguished by their habit of subsisting upon living insects. The maturation of the fungus involves the death of the fly, the fluids of whose body serve as food for the parasite. Under its attack the fly becomes gradually feebler, and finally quite unable to move, and then the viscid secretion from the pads on the feet hardens and glues the insect to the surface to which it is clinging, while the fungus spreads round it and leaves some of its spores adhering to form the halo above described.—*Knowledge*

# LETTERS TO THE EDITOR.

*[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]*

*All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

*All Cheques and Post-office Orders to be made payable to* J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

## THE LUNAR RAYS, CLEFTS, &c.

[31721.]—I am not surprised at the difficulties experienced in understanding the "Theory of Glaciation" by those who have not read the work. Even after its perusal, I find that few get hold of it all at once.

Most of the letters which I have lately written in regard to hot air on the moon, rays, colour, &c., have been to elucidate, as far as I can do so, parts of the subject which were misunderstood by correspondents from several quarters.

A very general mistake is to suppose that I look on the moon's surface as generally formed of *ice*, instead of its being mainly *snow* covering an irregular ice crust. In a few cases only do I think we should see a partially clean ice surface (covered with meteoric dust)—i.e., as in Plato, Grimaldi, Riccioli, the dark spots in Alphonsus, &c. On all the bright elevated portions, I take it, the real glaciated crust is very deeply snowed, all the raised features, such as rings, peaks, and mountains even being of that material.

But on sunk floors and *maria* the surface is less heavily snowed, the last paragraph, page 22, of my theory indicating how the long and short maritime ridges or banks arose. In letter 31475, I see Mr. H. G. Dixon asks our "F.R.A.S." to pass sentence on my work, and I hope he will do so eventually; as yet, however, he has not quite understood it all, I can see, notably in regard to the rays. Might I therefore, as the subject I know interests others as well, point out that the solution suggested for them by the editor of *Knowledge* presents some difficulties. It had been urged by Mr. Ranyard that the lunar rays are due to snow deposited from aqueous vapour given out through long radial fissures, which are so far nowhere visible to us, and that the vapour has been carried out by air.

In the first place, as far as I know, there are no visible fissures or clefts along any of the rays; and secondly, as I indicated in letter 31444, "in such a view the rays would (at least, in many cases) be ridges, and easily seen as such at the terminator on *maria*." I also pointed out that the truth of this is demonstrated by a careful study of so-called "clefts." In these latter we see the actual fissure, and at times bordered by faint, irregular ridges and rows of *confluent* craters, which I assume to be due to snow deposit. The study of "clefts" in regard to this feature seems to me instructive, a large percentage being so-called "crater rills," in many cases with confluent openings. Webb, in his "Celestial Objects," page 100, when referring to the cleft of Hyginus, says: "Beer and Mädler once saw in the wane its edges bridging the black cavity (of the crater) as two narrow bright lines, and Schmidt's large map represents it so." Neison, on page 384 of his "Moon," refers to the large cleft Hippalus $\phi$ (s. 268) thus: "Its central position is Madler's Hippalus $\delta$, and, according to Schmidt, it is in places a crater rill." Again, on page 385: "The third cleft, rill 3 (s. 173), $\chi$ breaks through the ridges Campanus $\rho$ and $\beta$, being in this portion a crater rill." On page 392, referring to the rills of Mersinus, he says: "On the border of this terrace is a very anomalous rill, $\phi$ (s. 248), that often appears not entirely as a rill but as a ridge (which Schmidt thinks it is in part)." On page 200, referring to the rill Bond $\varepsilon$, he says: "This is the great rill of Römer (s. 11), which, according to Schmidt, is in part a crater rill." Lastly, in the lowest diagram of plate 6, in my "Theory of Lunar Surfacing by Glaciation," I have drawn from Neison's "Moon," map VIII., the ridge, cleft, ridge, cleft, and crater row, which passes through Wollaston C, and is a good instance of the way these very distinct features at times *alternate on one line.* There is, in fact, ample evidence in connection with the lunar "clefts" of deposit along their borders, which I take to be snow; they seem to be vast crevasses or cracks in the solid glaciated crust of the globe, and necessarily to be more or less filled in by the snow of the outer layer. Where these fissures pass down to the warmer, unfrozen substrata, aqueous vapour may occasionally be given off at low temperature, and would tend to pass to the outer void, where it must fall as snow.

At first this would pile irregularly along the margin of the fissure, and eventually might appear as the string of *confluent* craters. Still later, as the narrow places became bridged over by accumulation of snow, it would appear as the "crater rill."

Lastly, and more rarely, as the crater orifices became smaller, or filled in, we should see the "ridge." Without some explanation of this nature, I cannot see how we can possibly account, not only for the above peculiar features in regard to clefts, but that in so many cases all are absent, and we see the cleft as a simple crevasse. But I do not see that air is needful as a means of transporting the "aqueous vapour"; this could exist, and move out in the absence of all gas. As a medium by which heat could be carried out, vapour of water is indeed 16,000 times as effectual as air (see Ganot's "Physics," paragraph 985, 11th edition). When we consider the great size of many of the rays, their *length* and *straightness*, compared to terrestrial fissures, together with the foregoing features, which are associated with the fissures which we can *see*, I feel sure that "F.R.A.S." will agree with me that it all goes a good way towards a demonstration that the bright rays are *not* due to snow deposit derived from invisible fissures in the crust.

I must, of course, admit that at first sight the explanation which I have put forward may be rather startling, or even incredible; but when all the circumstances of the case, as far as we can get at them, are taken into account, when we see the known peculiarities of the ray's whiteness, superficiality and radiality fitting so completely into the (previously) assumed conditions of a deeply-snowed surface (stained by meteoric dust), and an outer void or vacuum, I think the view of their electrical origin will not look so utterly improbable after all. Their being looked on by Mr. Ranyard as possibly long lines of *snow* is a distinct advance in this direction.

The "Theory of Lunar Surfacing by Glaciation" is no exception to the rule that revolutionary views are often most adversely criticised (with the best intentions) ere thoroughly understood, and it is with the hope that I may elucidate matters gradually (ere I join the majority) that I send this.

Sibsagar, Asam, India. **S. E. Peal.**

## PERSEIDS.

[31722.]—Since the subject of the Perseids has been called up, I will say that here on August 10 the conditions were most favourable for observations. I sat out in an open yard about 40 minutes and counted 59 meteors, two of which passed from west to east at almost right angles to the Perseids, two passed from east to west, and one passed from south to the north; one large one passed from Perseus south, and apparently melted off in bluish fragments for a long distance, when it exploded and disappeared, while its fiery trail lasted fully two seconds. All the other meteors moved at almost lightning speed, and disappeared about the planet Jupiter. For a number of nights prior to this occasion, many large meteors came from the same radiant, and were of the same quality. I should have perhaps said that my observations were made between eight and nine o'clock.

Milford Centre, Ohio, U.S.A. **R. Gabriel.**

## THE "TRUTH" ABOUT THE COMPASS.

[31723.]—You did me the favour (page 148) of inserting a letter on the "Truth about the Compass." May I venture to add to it that it seems to me that the N. point can be found at once, just as easily as the S., by turning away the hour hand from the sun. When there is no shadow under the hand, the rest of the calculation "goes without saying." **V.**

[31724.]—In my letter on this subject in your last it should read:—

"After 6 p.m. it is the same; at 9 o'clock the sun will be north-west, &c."

This of course is in those latitudes where the sun is visible at that hour, but it applies equally at any time after 6 p.m., as well as before.

Fordingbridge. **T. Westlake.**

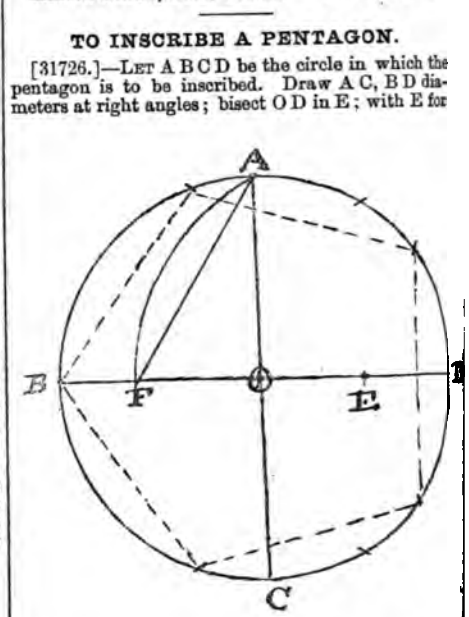
## TELESCOPES.

[31725.]—While I have had no experience with reflectors, I have had some with refractors, and find that my experience is the same as that of many others, i.e., that the same telescope will not do the same work at all times. I occasionally find a time when the refractor shows the planets as apparently making wry faces, and lunar detail is very indistinct, and by this peculiar rushing of the atmosphere I have learned to foretell rain to almost a certainty—for from 24 to 36 hours. In our country, the best night for definition is a night when we have a pale blue sky, with an occasional light fleecy cloud floating near the point of observation. In a letter to me, Dr. Swift says—"there are times when my telescope completely breaks down," and yet it is a 16in. Clark refractor. This breaking down is due to the atmospheric moisture and interchange of currents. I quite agree with Mr. Linscott that "Tenebris" will find that all conditions being equal, the reflector will form just as perfect an image as the refractor. Perhaps some reflector tubes are too short, and the heat from the observer's body and breathing may disturb the definition, and possibly the heat from the breath and body may be absorbed by the tubes, and thus cause undulation in the medium through which the rays must pass. A tube might be temporarily lengthened and covered with some good non-conductor of heat, and a test made on the same objects with the same powers. If "Tenebris" has a good speculum, he will find the cause for his "corkscrew" images in the atmosphere, the tube, or the flat, or in all combined.

Milford Centre, Ohio, U.S.A. **R. Gabriel.**

## TO INSCRIBE A PENTAGON.

[31726.]—Let A B C D be the circle in which the pentagon is to be inscribed. Draw A C, B D diameters at right angles; bisect O D in E; with E for centre, and E A as radius, draw the arc A F. The chord A F is the side of the required pentagon.



Liverpool, Oct. 11. **W. S.**

## ON REGULAR POLYGONS.

[31727.]—In the letter 31691, Lord Grimthorpe gives a method for constructing the regular pentagon which he seems to regard as novel. It is only one case of the application of a general law which may be described thus:—In order to form a series of approximations for the pentagon we begin with the terms 0, 1, and continue the series by making each new term equal to the sum of the two preceding terms in this manner:—

0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144 . . . .

When any one of these terms is taken as the side of a pentagon, the following term gives the diagonal. The same numbers enable us easily to construct a decagon; thus if we make a circle having its radius equal to 144 parts of any scale, the chord 89 of these parts will step round the circumference ten times almost exactly, the error being too small to be detected by any ordinary compasses. The precision is greater the further we proceed in the progression. It will be seen that the square of any one term differs from the product of the adjoining ones by unit. This is all very old; the following processes for figures of seven and of nine sides are recent.

The long diagonal of a regular heptagon may be found in this way:—Beginning with the three terms 0, 0, 1, we form the succeeding term by doubling the last and adding the difference of the preceding terms. Thus:—

0, 0, 1, 2, 5, 11, 25, 56, 126, 283 . . . .

Any one of these may be taken as the side, and the following term as the long diagonal of a regular heptagon. If any one term be used as the radius of a circle, the preceding term will step 14 times round the circumference.

Again, if we begin with the same terms 0, 0, 1, and deduct the last term but two from the triple of the last, to make the new term thus:—

0, 0, 1, 3, 9, 26, 75, 216, 622 . . . .

we get the side and the long diagonal of the enneagon.

These processes are described in the 26th volume of the *Transactions* of the Royal Society of Edinburgh, page 61.

31, Mayfield-road, Edinburgh. **E. Sang.**

hat is the perfect non-conductor in Maxwell's theory. *Where there is no matter, in the ordinary sense, there is no dissipation of energy* [the italics here and elsewhere are my own, to call special attention to some points]; and ether, whatever it be, is perfectly conservative and non-dissipative. *Whilst conductivity depends upon the pressure of matter*, the existence of capacity is independent of matter, though modified in amount by its presence; that is, capacity is a function of the ether, *which is the standard dielectric of least capacity*."

Now let us study this a little. Where we know most, we find *matter* is the agent; where we *know* little, but work in the mines of the imagination, we can assert that ether is the agent. Mr. Heaviside is fond of jokes, and often relieves the heavy strain of mathematical reasoning by poking a little fun at himself or someone else. I must quote one:—"There is some reason, I believe, that there are many of these mines in Spain, probably—though this is uncertain—in the neighbourhood of the old castles." "Castles in Spain" are the French equivalent for our castles in the air. But now just note: "Capacity is a function of the ether"; others tell us it is the only actual agent, merely modified by matter, yet "the ether is the dielectric of *least* capacity." Now, translated into experimental fact, this merely means that exhaustion reduces the capacity of air and dry gases, and that the guessers choose, without the smallest reason except that they can base a theory upon it, to say that we are getting to the standard "ether," rather than to recognise the effect of the change of the molecular distribution and motions in the ordinary matter.

But this ether, when we have put a pinch of salt upon its tail (it is well to use it afterwards to season the etherial tale) turns out to be the dielectric of *least* capacity; but if it is in ordinary matter that we find this attribute most highly developed, is it not common-sense to recognise that it is in the reduction of the quantity of this ordinary matter (never to be got wholly rid of) that we have the explanation of the reduction of the capacity of exhausted air, and to the presence, *the known presence*, of countless myriads of molecules in the best vacua, that this residuary capacity is due.

Well may Mr. Heaviside go on to say "ether is a very wonderful thing. It may exist only in the imagination of the wise, being invented and endowed with properties to suit their hypotheses; but we cannot do without it," that is to say, being interpreted, the hypothetical theorists cannot do without it. They do not want much foundation to build on, it is true, but they want some, and so they create it, and call themselves *wise*. But now listen to the cry wrung out by the unrecognised consciousness of the fallacy. "We may know some day. But if not, what matter? Things will go on just the same whether we know how it is done or not. What vanity is this the philosophers are striving after? Is it not science falsely so-called when there is the infinite blank of the unknowable behind? And, speaking of blanks, might there not be a great blank in space to which we shall arrive some day, to find all theories confuted?" Only think what some of our friends would say, and what bogies of Sir W. Thomson and Clerk-Maxwell would be held up, if I had said this; but they are the words of a great ether apostle.

No wonder Mr. Heaviside learnt, as he says, in reference to his early doubts about the electric fluid theories, *El.* XIV. p. 178, "I simply did not believe, except so far as mere statements of experimental facts were concerned. This had its disadvantages; one can get on faster if one has sufficient faith—which we know can move mountains—to accept a certain hypothesis unhesitatingly as a fact, and work out its consequences undoubtingly, regardless of the danger of fixing one's ideas prematurely." That is what some of my critics abundantly exemplify.

Discussing the nature of electric currents, Mr. H. says: "Had we not better give up the idea that energy is transmitted through the wire altogether? That is the plain course. The energy from the battery neither goes through the wire, one way or the other, nor is it standing still. *The transmission takes place entirely through the dielectric.* What, then, is the wire? It is the sink into which the energy is poured from the dielectric, and there wasted, passing from the electrical system altogether. All difficulties now disappear."

I commend this to those of my critics who have contended that the ether is not applied to conduction, but only to induction. I do not intend to discuss it here; at present my object is to lay the subject open, to collate my texts. I only need say here, that where the word "dielectric" is used, the ether lies behind it, as the ether is the standard dielectric, and the ether theory is the real thing in the mind of the writers. Thus describing the imaginations, Mr. H. says, "in passing from the battery to the wire through the dielectric the energy current is continuous (or the ether machinery frictionless)."

I wish to finish with Mr. Heaviside first, so I pass to *El.* XXII. p. 24, where, in discussing a little difference of mathematical opinion between himself and Sir W. Thomson, he says: "But there really is infinite speed of propagation of potential sometimes; on examination, however, it is found to be nothing more than a mathematical fiction, nothing else being propagated at the infinite speed." Thus something *really is* which is really only a *mathematical fiction*. Is not that just what I say is true of so many of these mathematical matters? I do not propose to enter on the points, because it involves such learned matter as this: "Within moderate limits, and excluding permanent magnetisation, $\mu$ may be taken to be, like $k$ and $c$, before, a scalar constant in case of isotropy, and a linear vector operator in eolotropic media, being then, like $c$, self-conjugate, or without the rotary power." A very little of that goes a long way.

When Hertz's experiments were first made public there was a considerable jubilation because they were said to have "demonstrated" the existence of the ether, and I have noted some interesting correspondence, which I will begin upon with an extract from Dr. Hertz to Dr. Oliver Lodge: "It is very difficult to tell an electrician of the elder school that lightning does not go through copper or iron, but goes only by means of air, or guttapercha, or insulators."

Prof. Poynting says to Dr. Lodge, *El.* XXI., p. 829, "My first difficulty is as to the interpretation of Hertz. You say, though I think Fitzgerald is responsible for the statement, that ether is a demonstrated fact. I do not see how Hertz adds to our certainty. Is not our belief in ether due to the fact that light takes time to travel in interplanetary spaces, where we cannot put matter enough for it to travel by, so that we have to imagine something else for it to use? These disturbances (Hertz's) probably make use of the same ether. Does this prove its existence any more? I should expect a sceptic to ask, Why may not electromagnetic disturbances make use of air, since Hertz carried out his experiments in air. *I could only reply to the sceptic that he was a very disagreeable person.*" Dear me! Why that is the only answer I have got as yet from my various critics. Is there any other? He goes on: "Thomson's 'Simple Hypothesis' paper appears to me to be a very serious attack on Maxwell's theory. I can only come to the conclusion that it would lop off, not only Maxwell's excrescences, but his whole theory." Good gracious! The other day—in fact, several other days—my critics reproached me for venturing to oppose Sir W. Thomson and Clerk-Maxwell! What if they turn out to reproduce the tail (no, tale) of the Kilkenny cats, and do not leave me "ether" to oppose? As Prof. P. goes on to say, after a lot of cabalistic figures, "this is awful!" Prof. Lodge says: "With regard to Thomson's paper, it is certainly very anti-Maxwellian, but I believe it only represents a transition stage through which he was somewhat rapidly passing, and through which he may now have almost passed. I certainly do not know where he is now." Neither do I; but merciful powers! are all these mathematical demonstrations only passing stages? Mr. Searle, Mr. Quinn, for goodness sake come to the rescue! Whom *are* we to believe? *What* is the truth?—and where is the pump to fetch it out of the well? Readers should understand that there are private friendly letters, the imprudent publishing of which seems to have let several very wild cats out of their bags.

A little more of the agreement of mathematicians, *El.* XV. p. 21. Prof. Fitzgerald (an ardent etherialist) says: "Sir W. Thomson's speaking of the ether as *like* a jelly must be strongly protested against. It is in some respects *analogous* to one; but we certainly know a great deal too little about it to say it is *like* one. I also think that Sir W. Thomson is lending his overwhelming authority to a view of the ether which is not justified by our present knowledge, and which may lead to the same unfortunate results in delaying the progress of science, as arose from Sir Isaac Newton's equally guarded advocacy of the corpuscular theory of optics." Well, is not that what I have said? In my next I will call Sir W. Thomson and Dr. Lodge into the witness-box. **Sigma.**

### ELECTRICITY AND ETHER.

[31730.]—According to all the definitions that I am acquainted with, momentum does not in any way depend upon gravitation; but "Sigma" appears to have his own definitions. The fluid is supposed gravitationless, not of necessity, but to simplify the treatment. Electric phenomena can be more simply explained by means of action at a distance than by a medium. It is only when we consider the connection between light and electro-magnetic phenomena that the latter hypothesis obtains the advantage.

Then we have to consider whether (with "Sigma") we shall require two media or ethers, or whether one may not be sufficient. All the objections "Sigma" brings against the ether are to himself suicidal. Those who reject action at a distance are, to be consistent, bound to give another explanation of gravitation phenomena, and, in fact, such phenomena can be explained by a medium (or ether, if you will) consisting of a gravitationless fluid; so that from this point of view, which ought to be "Sigma's," weight would be an apparent, but not an essential, property of matter. It is very possible that universal gravitation is a false hypothesis; but it has been almost as valuable as if it were true in reducing so many facts to one grand *ensemble*.

It would be well for "Sigma" to bear in mind in his experiments that many results can receive two explanations, and that we should accept that one which is most in harmony with other results. "Sigma" elects to travel first-class solus; I am content to travel third-class with the common ruck of mathematical physicists of Europe and America, notwithstanding "Sigma's" opinion as to the demented state of their reasoning faculties.

An hypothesis is not taken upon trust because of the name of the proposers; but because it explains certain facts. Of the mathematics of such explanations "Sigma" does not, I presume, pretend to be a judge; but as to some of the facts, the mathematical physicists of the world, who are also skilled experimentalists, say they do exist. "Sigma" says they do not. **W. C. B.**

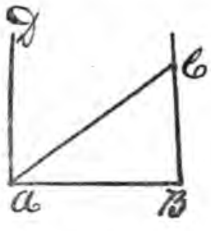
### LAYING DOWN ANGLES.

[31731.]—Having frequently to lay down angles of various magnitudes, it occurred to me to construct a table, by the aid of which any angle may be laid down almost immediately, or the degrees in any angle found with equal facility. Appended below I give the table, with examples showing the method of application.

Table.

| Deg. | Inches. | Deg. | Inches. | Deg. | Inches. |
|---|---|---|---|---|---|
| 1 | ·104 | 16 | 1·72 | 31 | 3·60 |
| 1½ | ·157 | 16½ | 1·78 | 31½ | 3·67 |
| 2 | ·209 | 17 | 1·83 | 32 | 3·75 |
| 2½ | ·262 | 17½ | 1·89 | 32½ | 3·82 |
| 3 | ·310 | 18 | 1·95 | 33 | 3·89 |
| 3½ | ·36 | 18½ | 2·01 | 33½ | 3·97 |
| 4 | ·42 | 19 | 2·06 | 34 | 4·05 |
| 4½ | ·47 | 19½ | 2·12 | 34½ | 4·12 |
| 5 | ·52 | 20 | 2·18 | 35 | 4·20 |
| 5½ | ·58 | 20½ | 2·24 | 35½ | 4·28 |
| 6 | ·63 | 21 | 2·30 | 36 | 4·36 |
| 6½ | ·68 | 21½ | 2·36 | 36½ | 4·44 |
| 7 | ·74 | 22 | 2·42 | 37 | 4·52 |
| 7½ | ·79 | 22½ | 2·48 | 37½ | 4·60 |
| 8 | ·84 | 23 | 2·55 | 38 | 4·69 |
| 8½ | ·89 | 23½ | 2·61 | 38½ | 4·77 |
| 9 | ·95 | 24 | 2·67 | 39 | 4·86 |
| 9½ | 1·00 | 24½ | 2·73 | 39½ | 4·94 |
| 10 | 1·06 | 25 | 2·80 | 40 | 5·03 |
| 10½ | 1·11 | 25½ | 2·86 | 40½ | 5·12 |
| 11 | 1·16 | 26 | 2·92 | 41 | 5·21 |
| 11½ | 1·22 | 26½ | 2·99 | 41½ | 5·31 |
| 12 | 1·27 | 27 | 3·06 | 42 | 5·40 |
| 12½ | 1·33 | 27½ | 3·12 | 42½ | 5·50 |
| 13 | 1·38 | 28 | 3·19 | 43 | 5·59 |
| 13½ | 1·44 | 28½ | 3·26 | 43½ | 5·69 |
| 14 | 1·49 | 29 | 3·32 | 44 | 5·79 |
| 14½ | 1·55 | 29½ | 3·39 | 44½ | 5·89 |
| 15 | 1·61 | 30 | 3·46 | 45 | 6·00 |
| 15½ | 1·66 | 30½ | 3·53 | 45½ | 6·10 |

*Application.*—It is required to lay down an angle of 39½°. Take a base line A B (always 6in. long); at one extremity erect a perpendicular B C; opposite 39½° in the table is 4·9in., which set off from B along the perpendicular. Join this point with A, and B A C is the angle required.



It is required to lay down an angle of 78½°. When the angle required exceeds 45°, deduct it from 90°; thus 90° − 78½° = 11½°. Opposite 11½° in the table we find 1·2in., which set off along B C as before; then joining this point with A, we have an angle B A C = 11½°. Erect a perpendicular at A, then D A C = 78½°; and so we may lay down angles from 1° to 180°.

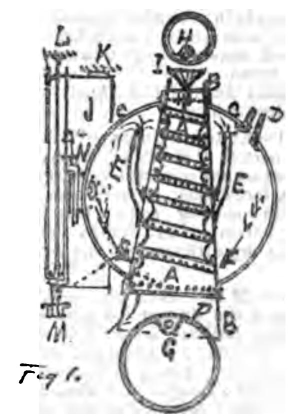
The converse of this—namely, the measurement of angles with the aid of a set-square having a 6in. base—is so obvious as to need no explanation.

N.B.—Angles may be laid down to one-fourth of a degree as follows:—Suppose we require 27¼°; we observe in the table 27° = 3·06; the difference between this and 27½° = ·06. Add half of this to 3·06, and we get 3·09 to set off for 27¼°, and so on.

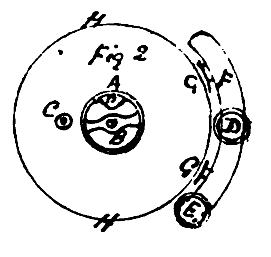
**R. C. Taylor.**

## KILIARY POWER FOR TRICYCLE.

1732.]—The boiler that I have here forwarded hese engines is what I stated before—designed aërial navigation, and it arose this way. reen 20 and 30 years ago there was a monstrous r shown up in one of the mechanical papers, by one Kaufman, I think, or some such name, I and a shopmate were looking at it. I made emark that if I could find a good machine for rating a good blast I thought that would go a way towards solving the problem—i.e., aërial gation. He stated that he could construct a machine that would blow the largest tree that ever grew; but it would want a good e-power engine to drive it, and that was out of question in a balloon. I stated that if he could orm his part, I would construct a good horse- er engine that should be with boiler to drive in 56lb. I got my design out; but I do not ve that he ever attempted his part of the busi- Water was to be used to get up steam, and ire was to be petroleum burner; the boiler is

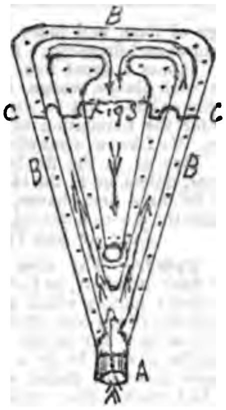


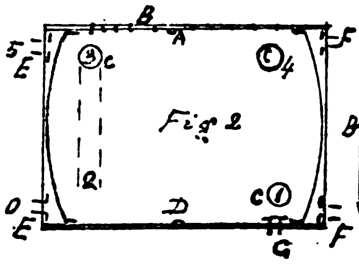
s made of copper, A A, Fig. 1, inside tube or ox, and it is spirally corrugated; in fact, a ad around it. B B is another cone over that, riveted as shown, so that it forms a serpentine nnel; the B tube extends below. These are to nade of No. 16 B.W.G.; rivets ⅛, or 10 B.W.G. per wire snapped on the head on both sides; is a spherical shell. Over all this is copper,

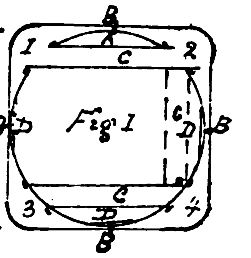


3.W.G., and the cones, having been made as wn, are riveted at both ends. G and H show the ends, and the lugs there shown are the end he tube with the thread sunk in it. The thread rought out to the end, and a piece of brass d in and swashed in its place. H is where the er enters, and G is where the snifting valve is d, which is set at what pressure you intend to k; and as well as getting rid of your surplus er, if you have any, also acts as a ty-valve. No other fittings required. D where the connection is to be made for the ines E E. There are two holes made here, and e small short pipes to carry off the steam into the iver as soon as it is made, but three or four can made to advantage in the lower thread, as near bottom three or four holes are made from the iver or steam chamber to drain the water in to l out at G. F F are the holes. I is a baffling cone, the oil reservoir for supplying the lamp, L is the dle for feeding, K is the opening with a screw to charge the same. This lamp body or cistern is de of No. 22 copper B.W.G. It is semicircular, 5in. g, 7in. deep, and 1in. thick, furnished with two brass ks N that hook into two bras flat staples riveted n the boiler O, and connected with the pipe and pling union nut M. Fig. 2 is looking down on top. A, inlet for water feed; B, stay with pin ted in for baffler cone; C, connections to gines; D, needle valve to lamp, screw down; screw cap for filling tank; F, tank; G G, staples l hooks; H H, the copper steam receiver.

Now having got so far with it, the next part is water supply. Now I reckon three quarts is as ch as we need hamper ourselves with. If we l we can do with more it can easily be remedied. e in the sketch at Fig. 1, a square cylinder with







a round one inside. Now the whole will be strong enough if constructed of No. 22 B.W.G. sheet copper. I select this as before for economy—first, if it is a failure it can easily be turned to account, secondly, it is most durable; and again, it is one of the easiest metals for amateurs to manipulate upon. A is the circular tank for water, B is the trunk, square, with obtuse corners. Now you will see that there are three cross tubes through the cylinder C C C. At D D D are some reeds struck up in the three sides, as shown at D, Fig. 2, that is to drain the water from the top angles to the bottom, where it can be drawn off. Now the water tank is A, but being constructed like this, I intend that these angles and cross tubes should supply us with a condenser. Fig. 2 further shows how the thing is constructed; A, the trunk, is outside; B the cylinder, C C C the cross tubes, which run into the angles, as shown at Fig. 1, D. Fig. 2 is the reed, which two or three can be put in the length; E E, thimbles sweated in the angles for connections for exhaust steam, F for drainage, or to draw the water, G discharge from bottom of steam generator, so that the surplus water is returned to tank. Now the exhaust enters at O, passes along the angle near, through the cross tube C 1, back through the off side, up 2, out at C 3, along the top off side, through C 4 to the top of the near side, and out at 5, or may be may be made to travel the other way, and this is 4¾in. square outside trunk, and 13in. long; the angle pieces can be prepared with their laps, and put on separately and lapping one another, the inside tube riveted along centre of trunk top and bottom and both sides, the ends of cylinder dished and flanged, and pushed in tight, and if riveted and put together as shown, will make a sound job. The ends and angles will want no rivets, but ¼in. lap, and cleaned well, and sweated with chloride zinc and soft solder, all joints served the same, i.e. sweated. If that should not be baffling enough for the exhaust, a surface affair like Fig. 3 might be made to couple up to the outlet of condenser tank of the same metal. A is a ferrule for connecting, made of brass; B B B, a piece of copper, or two pieces, cut as shown, and set up upon a piece of hard wood, as shown at section C C,—of course the wood is carved out that the copper may be dressed into the channels. The steam enters at A, and is split down each side; passes along the channel, as shown by the arrows, and across the bottom, and must again enter the centre chamber, and at O this may be made 8in. long and 4in. wide at broad end. By this we can save a great deal of our water and heat, as the heat will be taken up principally by our tank condenser. By this I am in hopes that our exhaust will not trouble us much. How does the "Petro" experiment get on? **Jack of All Trades.**

## CONTINENTAL LOCOMOTIVES.

[31733.]—Taking a great interest in the various articles on the locomotive engine which appear in the "E. M.," I am sorry to find no notice is taken of the locos. on the Continent. Seeing the improvements continually taking place in English practice, we are very apt to consider ours the best, without following those which take place across the Channel. The French have made vast improvements in the last few years; indeed, the Northern Co. have turned out a very fine four-coupled bogie express, No. 2101, which will compare most favourably with any of our "bogies," also the four-cylinder compound locomotive, No. 701, is worthy of particular attention.

The Eastern Co., who for a long time ran their express trains with "Cramptons," have now some splendid 4-coupled "converted Cramptons," outside cylinders driving hind coupled wheels of 7ft. 7in. in diam., built in 1877, which I think are the finest on the Continent.

The Southern Co. for their express trains have engines of a similar type, but wheels 6ft. 10¾in. and cylinders 17 by 23½, which have attained a speed of from 48 to 54 miles per hour; but the repairs would, I should say, be more for this type than with engines with wheels of a larger size. The Italian Mediterranean Co.'s six-coupled bogie engines, especially "A. Depretis," No. 3016, show us that we have yet much to learn in locomotive design.

I hope that more notice will be taken of the locomotives on the Continent, which would be worthy a corner in the "E. M.," and would be of great interest to many readers, as well as **D. W. L.**

## DRY BATTERIES.

[31734.]—Myself an experimenter—at least, in my leisure moments,—I may, perhaps, be allowed to make a few remarks on Mr. A. E. Ball's interesting letter, 31714. The writer gives us, unfortunately, no clue to the construction or composition of his cells, so that, in spite of other minute details, his observations have not much more value than generalisations; it will, therefore, not be considered "out of order" if my own remarks are mostly of an equally general character. Imprimis, it should always be borne in mind that the circulation of the liquid is of fundamental importance in electro-chemical generators, so that all so-called "dry" batteries necessarily fail in a most essential particular, and are even conceptually faulty; it is, therefore, clearly out of the question that a "dry" battery of a certain composition should ever be as efficient as a "wet" battery of the same composition, and the employment of a "dry" battery can only be excused on the plea of convenience in handling—a plea that avails but in a few instances. Even if the operations of gilding and plating which Mr. Ball mentions could at all be conducted satisfactorily by the employment of "dry" cells, there would be no reason whatever for preferring them to ordinary cells; as a matter of fact, however, a "dry" cell is comparatively useless for such a purpose. As regards the heating of platinum wire, would it be too much to ask Mr. Ball what length of wire, of a given gauge, could be heated to incandescence by a number of his cells of a certain size?

Perhaps there will also be no objection, in the interest of science, to divulge the composition of the cell that had an E.M.F. of 3½ volts, for only "a week or so"; (an explanation of this curious result might be that the E.M.F. of the cell was only measured after a week). I only know of the element magnesium against lithanode in dilute sulphuric acid, that could possibly reach such a high voltage.

Lastly, what commonly-known storage cell (properly so called) depends upon layers of gas for its electrical condition? Surely the platinum arrangement of "Ritter" does not deserve that name, and is not meant! Is Mr. Ball aware that a layer of gas on the plates of his cell would not conduce to its effectiveness, and that the E.M.F. of H against O under ordinary pressure is only about 1 volt, and would therefore not increase the voltage of his cell to 2 volts?

Mr. Ball is a very ardent experimentalist, and evidently has time at his disposal. His ambition, too, must be unusually great, or a dry cell maintaining an E.M.F. of 3½ volts for a week would have elated, and not disappointed, him. A year ago I myself tried my hand at "dry" cells, and though the results are chiefly records of failure, yet I hope it will be none the less useful if my failures are mentioned, with the Editor's permission, in some future letter, together with—what I hope—the successes of my present researches. In the mean while the subject of dry cells will, I trust, be continued by amateurs and others, who have real facts to record and information to give. Perhaps, also, Mr. Ball's present experiments may be crowned with success, if carefully observed, systematically recorded, and impartially discussed.

**Henry G. Leitner.**

Bricks boiled in coal-tar are rendered hard and durable, and machine-made bricks, if boiled for a long period—say, 24 hours—become waterproof. Bricks thus treated are well adapted for sewers, cesspools, and the foundations of buildings.

# REPLIES TO QUERIES.

*⁂ In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[72168.]—**Electric Bell and Battery.**—I am surprised Mr. Allsop does not accept Mr. Walker Moseley's explanation of this question. I don't see how it could be put more clearly. I have fitted, altered, or repaired over a thousand installations, and left them, no matter how I found them, arranged on the principle Mr. Moseley very truly and clearly explains. I am now engaged in one of the largest hotels in London, and I am sure a hundred pounds extra would have to be spent on it if it had been done on the "zinc to push" principle. It is true a few electric-bell contractors adopt it, because it is a precaution against breakdown before the contractor gets his money, or the term of guarantee expires; but the wear-and-tear is greater, and the reckoning comes some day, though seldom very much later. WILLIAM EDWARDS.

[72168.]—**Electric Bell and Battery.**—In reply to Mr. Moseley, I may say that the simple case I have shown in the issue of Oct. 10 takes into consideration every point that can in any way affect the question; and if Mr. Moseley will go through the train of reasoning with an unbiased mind, he will see that it is perfectly correct. However that may be, Mr. Moseley may try to impress his "carbon to push" hallucination on electricians for another seventeen years; but he will never convince me if what he has put in the *Electrician* and "E. M." already is all he can offer in support of it. Judging by the effect of the first seventeen years on the electric-bell fraternity, it would, I think, be pure waste of time. In the point about the wiring of an hotel, I have, in my book, pointed out on the same page that it is only to make the best of a bad job, and that the fault should be repaired at the first opportunity, which any one with a bit of gumption would see. Merely saying that he refuses to believe that I mean what I write, is a very puerile way of evading a reply. If Mr. Moseley knows of a really sensible reason why the carbon of the battery should be put to push, then surely he might let us have it in full. I have never been able to (and I never knew any one else who could either) see the reason in his articles in the *Electrician* of 1879, and I certainly can see none in his letter in the issue of the "E. M." of Sept. 26. My contention is, that in ordinary electric-bell work (provided the insulation is good), it is perfectly immaterial to which pole of the battery the wire from the pushes is connected, and I have never met with any one (except Mr. Moseley) who held a different opinion. F. C. ALLSOP.

165, Queen Victoria-street, London, E.C.

[72284.] — **Cement Kiln.** — To "CEMENT CLINKERS."—What "covers" mean I am at a loss to know. There is evidently a mistake. Clinkers or concrete was meant, I have not the least doubt; and as to the lettering, there are two A's too many—that is in the ground-plan for the fire-bed or racer. What I give you there is such as I have burned bricks, tiles, lime, &c., in of various grades and shades. I have had something to do with cement where it is burnt the same as lime, with breeze, in a conical kiln—continuous charging at the top, and drawing from the bottom. If you know anything about it, you must know that if you fire with wood you must form a grid of something to keep your fireway clear, and that fire-bars are out of the question, and these grids or arcs of bricks are open for draught, and the bricks upon the top form a baffler to the heat, that all may be thoroughly soaked. Then, as regards the clinker, the draught carrying the potash and wood ashes through the lower part becomes thoroughly saturated with soluble silicate of lime, and is an extremely hard clinker, but it renders the cement better, as the silicate is soluble. In the burning of the grey chalk lime, I have had the lime saturated very near an inch deep with silicate, and that used to vary according to what fuel we used. Sometimes we had nothing but ferns and furze, and very small underwood; at other times fir loppings—these all green. But at other times we had stock fagotts, nut, dogwood thorns, &c. When firing with the green stuff, I have seen the chalk run down into the fire like water, and when we have drawn charge, and attempted to clean out fire race, it was a perfect clinker, and had to be got out with picks and bars. But when exposed to the air after out, it would dissolve, or, as one of our old hands called it, "mutter down." This lime, when slaked in hot water and put upon the walls, would set with a glaze on it like a piece of pottery ware. To draw, when the kiln is cooled down, take D down and draw. If melted, it is a proof of over-firing, and that is very likely to occur with green, and I have seen good kiln hands have a mistake at times. Fire with what you will, the clinker has always been sorted, where I have been, and there is always refuse. Where I was once the firing was carried too far with a charge of lime, and fancy moulded white bricks for cornices and dressings. It was for a church in Surrey. It was a great loss. It took four hands a month with sledge, wedge, and pick and bar to get the clinker out. But it was not all lost, for it was used for the foundation of another part of the structure. So I know what clinkers are in brick or cement. But as to the fire-bars, they are out of it altogether, unless, as in the old conical limekiln, when put in for a first charge, or when drawn, put in to break the crown down on. JACK OF ALL TRADES.

[72311.]—**Water Power.**—Why does not this querist refer to his back numbers, or to the text-books? There are water motors which will give, when properly treated, say 70 per cent. of efficiency, and as the querist does not say which kind he intends to use, he may be advised to try a turbine, or, say, the Thirlmere motor of Bailey and Co., Salford, advertised last week. They make water motors as good as they go, and would, no doubt, tell him all the particulars he wants. The power required is so small (¼H.P.) that a liberal margin must be allowed in calculating; but no doubt the firm mentioned can answer in once. At any rate, if they can't, I don't know who can, for they must have all the data, so to speak, at their fingers' ends. NUN. DOR.

[72316.]—**Cheap Blue.**—This query is a caution. Why does not "Fred" get someone to analyse the "blues" already in the market? TED.

[72321.]—**Modern Miracle.**—It is impossible to answer this question without inspecting the apparatus. It may be done by mirrors, or by lifting wires, or a trap (in spite of the oilcloth). C.

[72332.] — **Cement for House Cistern.** — "R. M." asks for a cement for his house cistern, but omits to mention the material of which it is made. However, marine glue will do for anything if the surfaces are thoroughly cleaned before applying the cement, and it is advisable to make them hot, as well as the cement. Perhaps plaster of Paris would do. NUN. DOR.

[72340.] — **Schneeberger Schnupftaback.**— How can any reader answer this question without a sample of the stuff? Possibly it may be some preparation in which nitrate of bismuth is the active agent, judging, or rather guessing, from the word "schneeberger"; but try a good pharmaceutical chemist. Possibly he may know the exact formula. The nitrate, or sub-nitrate of bismuth, is a white, impalpable powder, and consequently "mountain snow" to the Germans. NUN. DOR.

[72341.]—**Driving Mechanism for Tricycles.**—"Cycloid" asks if there are "tricycles driven by rack-and-pinion mechanism?" It is not quite clear what he means; but there are cycles with the sun-and-planet motion, which may be said to be a "rack-and-pinion" movement—in a sense; but certainly no mechanic would think of driving a tricycle in any but the most direct way possible in the design adopted. Even the chain is a disadvantage, from one point of view, but it overbalances the advantage of direct driving. "Cycloid" must not forget that his "double rack and pinion" introduces more friction or rubbing surfaces, and more places for dust. NUN. DOR.

[72358.] — **L. and S. W. Tank Locos.** — Thanks to "Locomotive" for his corrections. During the year 1888 I constantly saw Nos. 77 and 78; they were stationed at Twickenham, and were built by Stephenson in 1885, the builder's numbers being 2602 and 2603. The next being No. 82, being built by the same firm in the same year, builder's number being 2604—all the above being ten-wheelers. I understand that Nos. 77 and 78 have been renumbered; perhaps they may have had the Nos. 58 to 60, or 106 and 107 given them, as these numbers do not appear on my list of 1889. No. 129 is a ten-wheeler, built by Stephenson, 1885, builder's number is 2610. Nos. 77, 78, and 129 had side tanks like 516. Nos. 52, 53, and 54 were at Nine Elms in 1889 I believe. I should advise "Locomotive" to write to Mr. W. Adams for permission to go over the Nine Elms Works; but, of course, having a friend connected with the railway is a great advantage in that matter.

NORTH WESTERN.

[72361.]—**Power of Elastic Springs.**—Does "Inventor" mean by "elastic" indiarubber springs, or what? Unless he says, how can he expect anyone to tell him whether they can store more power than steel springs? M.

[72369.]—**Resin Oil.**—If "E. C. M." will give a definition of "resin oil," he may be able to obtain the information he requires as to sweetening it; but as his query stands, one can imagine that crude turpentine is meant, and that can't be "sweetened." A. C.

[72379.]—**Colouring Wax Ornaments.**—Why not mix the required colour with the wax? C. L.

[72382.] — **Electrical.** — Descriptions of the Lalande-Chaperon battery have appeared—e.g., in Vol. XXXIX. pp. 268, 317, 551, and in Vol. XXXVII. p. 500. It was patented; but whether it is protected now I cannot say without going to the Patent Office and searching. NUN. DOR.

[72384.] — **Hot-Water Apparatus.** — The cylinders collapse because they are not strong enough. What is the immediate cause depends on the arrangements of the apparatus. M.

[72385.]—**Telephones.**—After the end of this year any one can use Bell's telephone without risk of infringement, as the patent then expires. NUN. DOR.

[72393.] — **Magic Squares.** — Correspondents have used the word "nasik." It is not in the new Imperial Dictionary. What does it mean, in what science is it used, and what is its derivation? Z. Y. X.

[72425.]—**Oleate and Stearate of Lead for Phonograph.**—The neutral oleate of lead is a white powder, and I presume the basic salt is what is needed. It is made by boiling oleic acid with excess of basic acetate of lead. The basic stearate of lead is made in a similar manner, using stearic acid. I have no special knowledge of either substance, and merely reply because the query is addressed to me.

WM. JOHN GREY, F.C.S., Analytical Chemist.
Newcastle-on-Tyne.

[72431.]—**Model Pumps.**—With reference to the latter part of "F. T.'s" query, I must say I have never had any opportunity to try my arrangement on a large scale. I once heard of a Continental firm making self-acting regulators or "starting valves"; but though the means were different to my arrangement the same ends were attained. A. F. SHAKESPEAR.

[72502.] — **N.B. Railway.** — The principal dimensions of the six-coupled tank engines on the North British Railway are as follows:—Diameter of wheels, 4ft. 6in.; diameter of cylinders, 15in.; stroke of cylinders, 22in.; inclination of cylinders, 1 in 10. Boiler: Length of barrel, 9ft.; diameter outside, 3ft. 9in.; height of centre from rails, 6ft. 3in.; number of tubes, 146; outside diameter of tubes, 1¾in.; thickness of boiler plates, ½in.; height of top of chimney from rails, 12ft. 3⅝in. Heating surface: Tubes (outside), 602sq.ft.; fire-box, 62sq.ft.; total, 664sq.ft.: Firegrate area, 13·3sq.ft. Wheel base: Centre of leading to centre of driving, 6ft. 4in.; centre of driving to centre of trailing, 6ft. 10in.; length of engine over buffers, 28ft. 1½in. The link-motion is of the Stephenson type, the engine being reversed by the usual lever: Mr. Drummond preferring it to a wheel for tank engines. The springs are underslung. The safety valves are above the dome, the regulator valves being inside. The engine is fitted with the Westinghouse automatic air-pressure brake, applied to all the wheels; there is hand gear in addition, arranged so as to permit of separate or combined action. The main and auxiliary reservoirs are fixed beneath the coal bunker. The wing tanks contain 600 gallons of water; the coal-bunker has a capacity of 48c.ft.

Glasgow. METEOR.

[72521.]—**Leverage.**—If the bar be of equal section throughout, then a weight of 6lb. at G will overbalance the weight on the shorter arm to the extent that the long arm would overbalance the short arm before the weights are attached; therefore, before it can be true that the 6lb. at 12in. balances 12lb. at 6in., both arms in themselves must be in equipoise. Should the two arms not be in equipoise, it would be necessary to find what weight would be required to put on the light arm to balance the heavier arm. It does not follow that the longer arm is the heaviest, unless the section of both arms is uniform. To ascertain this counter-balance weight, let W be the weight of heaviest arm, $x$ the weight of counter-balance applied at centre of gravity at lighter arm, $l$ the weight of counter-balance applied at any other point than at centre of gravity of lighter arm, $y$ the distance of such other point, D distance of centre of gravity from fulcrum or point of suspension of the heavier arm, $w$ weight of lighter arm, $d$ distance of centre of gravity from fulcrum of lighter arm,

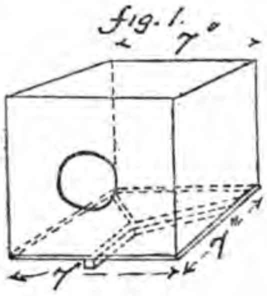
$$\text{then } W \times D = w + x \times d$$

$$x = \left(\frac{W \times D}{d}\right) - w$$

$$l = \frac{x \times d}{y}$$

The total weight on suspension rod or cord is always equal to the sum of all the weights attached to the bar, plus the weight of bar. GEORGIUS.

[72527.]—**Running Postmen in India.**—The last 20 years of railways and mail carts have nearly abolished the "post runners" of India, and the palanquin bearers also; the latter, far more wonderful in their performances. The Zulus, and Kaffirs too, of South Africa, are fully equal in wind and speed. In those hot climates the breathing organs are unencumbered by clothes and tight fastenings, so the lungs are free from infancy to perform their unobstructed functions. Closing the



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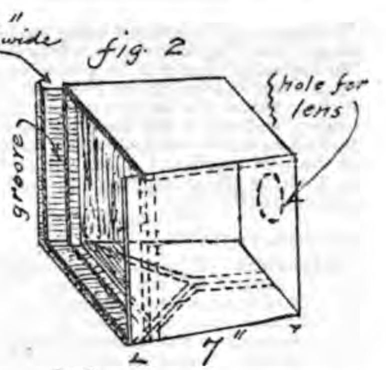

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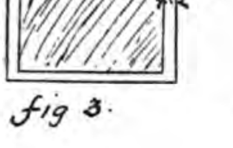

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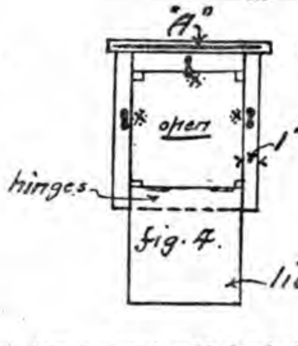


fig. 4.

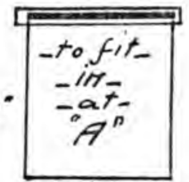


fig. 5.

while running was not general, though a athlete may do so in foot races. I have the post runner frequently shout and yell to the prowling wolves, hunting in his foot- occasionally treating the hungry brutes to the g blow of a baked clay ball, propelled from ellet bow," which he carried with a bag full projectiles—very efficacious, I was told, in g pursuit; but the tiger, and other voracious often ate these active men. It was not diffi- find a successor, and not until half a dozen e had been devoured was there any panic. youth I travelled many hundred miles in the ox locally known as a "palanquin," ng men at stages of eight to ten miles apart. rriers were usually eight men, who occa- relieved each other, besides four who heavy tin boxes in slings, and torches ht. My "Palkie" was crammed with ons, a rifle, ammunition, and large l box, drinking water, with a camp-bed n the roof. Yet the singing, shouting, tics day and night were incessant, especially ersing tiger-haunted jungles. Three miles ur, occasionally more, were accomplished the many days and nights of my travel, yet arely have I seen a bearer ill. These men closed their mouths, a consolatory kind of or an extempore chaunt on the expected ty of the English inmate, rather interfered his sleep. When an improved form of uin, placed on wheels, and drawn by ponies, lopted, the indignation of the bearer class furious. A monster meeting crowded the plain at Calcutta, and remained there for waiting a reply from Government to their n on loss of employment by the adoption of ehicles for stage travelling, "bringing ruin mselves and their families," they stated. vere a happy, contented class then, making the roadside till they got an engagement. of juvenile fun I have got up a race—self end in our respective palanquins—for a one- prize, doing our mile at very fast speed, yet man of the eight was breathless, though g and joking during the match. The Kaffir ulu *homies*, called by them *impees*, go at a t for days together, whether advancing to a f attack or retreating from an enemy, and o, with the weight of a blanket, knobkerries ), a firearm, and ammunition, bundle of s, and food. I never saw a breathless African , yet they frequently sing as they run. I ow of one European who ever beat them on he was a settler, who, during one of the Kaffir wars, outrun their best warriors across y, and saved his life. He was one of twin s, both great athletes. All the grooms of will follow a horse or carriage, more fre- leading the way and warning foot-pas- of the Englishman's advance, shouting as , and this, too, for miles together. Eos.

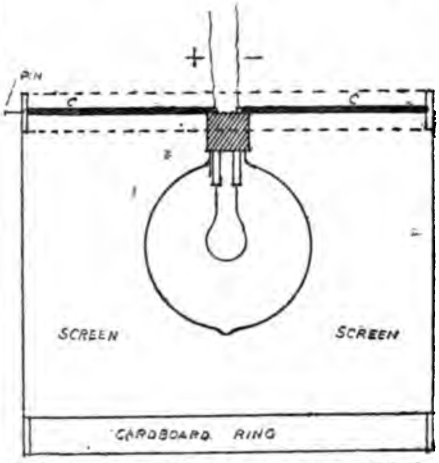
32.]—**Photographic Camera.**—I inclose a ugh sketches of the above, which may help Fig. 1 shows the camera itself, which is a square box about 7in. each way, all round, ne side left open to fit the dark side into We call this opening the back of camera. front there must be a hole cut to allow for the he size of this being cut accordingly. The must be lined with something very black, such as black velvet, so as to allow no light in the camera. A double bottom should be fixed, so that a stand can be screwed on, without driving the screws into the camera itself. The Y-shaped piece, on bottom, as shown in Fig. 1, is provided with a long screw, put on so as to point downwards, so that the stand, which is simply three legs, can be screwed on and off at pleasure. Fig. 2 is the same as Fig. 1, but reversed the other way, showing the open side of camera, a groove being made, according to size of dark slide (Fig. 4), for the slide to work in. Fig. 3 is simply a wooden frame about 1in. wide, having a piece of ground glass fitted into this frame. The frame to be made to work easily (but not loosely) in the groove, same as the dark slide, the groove shown in Fig. 2. Fig. 4 is the dark slide, which is simply a frame, consisting of four layers of wood upon each other, but laid very carefully, so as to permit of no light anywhere. The little corner piece, which projects from every corner, must be made such, where the plates must be laid when operating in photography. A lid, as shown, must be provided on one side of the slide, to lay the plates in without pulling out the slide, which would spoil the plate if in the camera. The other side of the dark slide a shutter (Fig. 5) must be made, which fits into a slit made at the top of the dark slide as shown (Fig. 4), to draw out when producing a photograph. I think the inclosed sketch will give you all the information you require. But if you wish for further details please ask the exact queries, when I shall be pleased to reply. A. B. T.

[72563.]—**Logarithms.**—The remarks on Sang's logarithm tables in "E. M.," page 80, have met the author's (Dr. Edward Sang) notice. He says: "In the first issue of these logarithms, the first thousand had their logs. to ten places; but it was found that the inconvenience exceeded the convenience, and in the second issue all are given to seven. Namur's table to 12 places up to 434 milliards, is not a table at all, but a collection of small tables by help of which the 12-place logarithms may be computed—the buyer will find his mistake." So "F.R.A.S." was right, after all. W. S.

[72573.]—**Electric Light for Dark Room.**—Reckoning an ordinary burner consuming 5 cubic feet per hour, at about 13 candle-power, we will suppose that we procure a 16c.p. lamp of 48v., taking 1 ampère of current. To work this, we shall need 24 cells of the Fuller type, charged with chromic acid solution in the carbon compartments, and dilute sulphuric acid in the zinc compartments. These batteries must be replenished every day, the zincs cleaned and amalgamated, and the carbon connections carefully looked to. On the perfection of the contacts much of the efficiency of the battery depends. A twin lamp cord can then be taken from the battery, up the side of the wall, to the centre of the ceiling, from whence it may hang down and support a small shade and lamp holder. Ruby lamps can be purchased of most dealers in lamps, but these are not ruby glass, but simply stained on the outside, not always with the most non-actinic colours. A switch in circuit is convenient for shutting off the light when desired.

S. Bottone.

[72573.]—**Electric Light for Dark Room.**—Suppose you require a 5c.p. light, you will want battery-power giving sufficient voltage. I have no doubt some electrical friend will give you particulars in that respect, so I will not trouble you on that point. An incandescent light is more difficult to make non-actinic than a gas or oil-flame. You probably want it for working dry plates, so you must remember that the less light you have the better, though by no means need you work in darkness. I mention a 5c.p. lamp for this reason: supposing your dark room is of average size (some 6ft. square). Also remember that the closer the lamp is to the plate the sooner it will fog. It is a good plan when using a strongly lit ruby dark room to have a cover always over the developing tray when in use, except when examining the plate; and also put an extra ruby or yellow screen over electric lamp when opening a box of plates. And now about the cover for the lamp: Don't be persuaded into using a ruby-coloured lamp (even if such things are made for photographers); but if the lamp is to be suspended from the ceiling, make one or two screens—say, one yellow and ruby, one double ruby—of the transparent material used for dark rooms, in the following way, or any other way you please:—Two small circles of cardboard, about ½in. wide, one for top and one for bottom, 5in. or 6in. apart, and glue your transparent medium round them. Also make cardboard disc, to act as a top for the screen, which top must be fixed on to top of lamp by making a hole through centre and drawing the wires through it. Make it so as to fit the lamp screens described. The screens then hook on with bits of wire, or bent pins. The rough sketch may assist. F. G. Willatt.



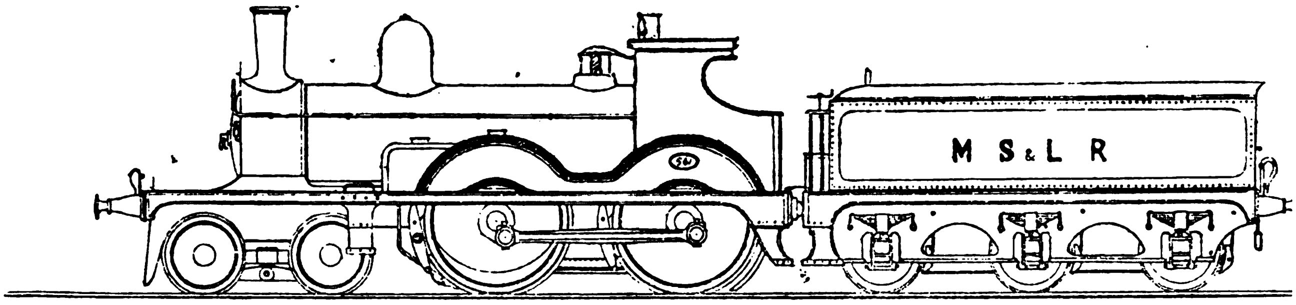
*c c* is the permanent disc or cover, upon which the screen hangs by means of two or three pins. There is a bottom to the screen of the same ruby medium.

[72579.]—**Electric Motor.**—I have not seen the article in the *Daily Telegraph* referred to by "E. W." but I have lately received the prospectus of a limited liability company now in course of formation headed "The Vaughan-Sherrin Electrical Engineering Company, Limited." This company has been formed (says the prospectus) for the purpose of acquiring the patents and working the inventions of Mr. John Vaughan-Sherrin, who has accomplished what has hitherto been deemed impossible—viz., the propulsion of boats, Bath chairs, tricycles, &c., by electricity without accumulators, by means of a generator and a new motor. The generator is a two-fluid primary battery in which the anodes are of zinc and the cathodes of carbon, specially prepared. The depolarising liquid is a special composition which can be produced at low cost; the zinc elements are immersed in plain water. The net cost of electric energy is estimated at from 9d. to 10d. per Board of Trade unit. It appears from certain letters which are printed with the prospectus that a Bath chair fitted with the new motor went on the level road at the rate of about seven miles an hour, and up a hill of about 1 in 8 it went at a steady walking pace; the cost was only about 1s. 6d. a day. There is a long report by Prof. Silvanus P. Thompson, which goes very fully into the matter, and ends with the following paragraph:—"The electrically-propelled Bath chair is fitted with one of Mr. Sherrin's smaller motors, and is driven by the current derived from ten of his cells. In a short run which I took in it, on unfavourable roads and in muddy weather, it ran at about six miles per hour on the level, and ascended a gradient of about one in eight at the rate of about two miles per hour. It was perfectly easy to manage, and the batteries gave no trouble either from spilling or fuming. I consider the electric chair a thoroughly practical and successful vehicle. Of the electrical tricycle I have made no trial, pending certain alterations now in progress in its structure." I suppose that the same motor might be employed on a larger scale to omnibuses and other vehicles, but no mention of these is made in the prospectus;

perhaps because of the Act of Parliament, which prohibits the use of vehicles so propelled on common roads except under certain conditions, one of which is, that a man with a red flag must precede the vehicle to give notice of its coming. However, this Act could hardly apply to tricycles driven by the new motor, as such machines would present exactly the same appearance as if they were driven in the ordinary way, and there is no smoke and hardly any smell. If I were quite satisfied on this latter point I think I should take shares in the new company, or, at any rate, purchase one of their machines, the cost of which is not very great. The weight of the motor is said to be only about 38lb. The offices of the company are at 48, Eagle Wharf-road, N., where, no doubt, further particulars could be obtained.

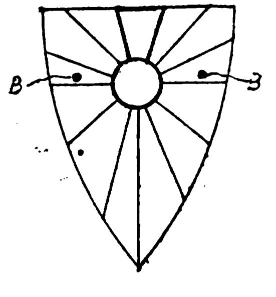
Bath. M.I.C.E.

[72540.]—**M.S. and L. Locomotives, 560 Class.**—In answer to "Loco.," I beg to send an outline sketch of Jubilee, No. 561, now used for the fast heavy trains on above line, and was in the Manchester Exhibition. DOUGLAS LEITCH.



[72584.] — **Fountain.** — Try a "perpetual" fountain. One water-tight reservoir above another, and a basin above both. From bottom of basin carry pipe to near the bottom of the lower reservoir. From top of said reservoir to top of upper reservoir carry another pipe. From bottom of upper reservoir carry a pipe through bottom of basin to a trifle above edge. Pour in water into the dish, and it will run down to lower reservoir; then, having filled it, the water will rise through second tube to top reservoir. When the water covers the lower end of jet-pipe, the fountain will play, and continue for a considerable time, part of the water being self-raised. Sketch if required. CALDEMONE.

[72587.]—**Making Gold Band Ring.**—"Vir Sapientiæ" is going the wrong way to work when he casts a plain band ring, unless he wants a very thick one; in that case he would succeed if he follows my instructions. First make a lead ring the size and thickness required, then get two pieces of cuttle-fish (to be had from all wholesale chemists), rub the soft side down flat, then force the ring half way into one of the pieces of cuttle-fish; lay the other piece of cuttle-fish on top of ring, and press it down until the two faces of cuttle-fish meet; then with a sharp knife cut the hard surface, so that you can press two stocking-needles through the two pieces of cuttle-fish. These two needles not only answer the purpose of keeping the mould together, but they serve as guides in getting the two impressions on top of one another. Now pull the needles out, then separate the moulds and withdraw the lead pattern; then cut a gateway and draw a point of a needle across the faces of the moulds to form air-lines. A small sketch will make it more plain.



A, gateway; B B, holes for needles to go through; the fine lines are the air-lines. Now put two moulds together and put the needles through the holes, then get a piece of iron binding wire and tie the moulds tightly together. You can melt your gold in a crucible—or on a piece of charcoal with gas and a blowpipe. I don't know what "Vir Sapientiæ's" idea was for adding pewter to the gold; that is just what all goldsmiths guard against, as the slightest little bit of pewter will ruin an ounce of gold—pewter makes gold brittle and unworkable. I am afraid the gold will have to be refined before it is much use. The foregoing is how to cast a ring, but to make a plain gold band ring, it would have been far better if "Vir Sapientiæ" had sent his gold to any of the gold and silver smelters in the West-end or Clerkenwell, they would (for say 1s. 6d.) cast the gold in an ingot, and roll it the exact thickness required; then all he would have to do would be to turn or bend the gold round and solder with gold solder, then finish by filling up, scraping, sand-papering, polishing, or colouring.

WORKING JEWELLER.

11, Grundy-street, Poplar, E.

[72594.]—**Aquarium.**—If in window with glass over it, back only exposed to outer air, cover the outside tightly, from bottom to a few inches higher than surface of water, with old carpet or close matting, and exclude draught as much as possible. Suspend small paraffin lamp just above during severe frost; prevent continued frosts making a solid band of ice all round by breaking portions of ice. F. HARRISSON.

[72595.]—**Loss of Head, &c.** — It appears to be about 4·990ft. deducted from the 40ft., or, say, 5ft. in round numbers. See Nathaniel Beardmore's ("Tables Hydraulic"), 1852, quite a unique book, with tables, maps, and letterpress. Was published at the time by Waterlow and Sons, Weale and Co. (now Crosby Lockwood), A. and C. Black, &c.

CHANCERY LANE.

[72599.]—**Tidal Waves.**—If your correspondent can get at a copy of Nathaniel Beardmore's "Hydraulic Tables," 1852, probably at British Museum (with similar works), he may get some particulars in the letterpress and maps attached to that book. It does not apparently refer to the Seine or foreign rivers. There is too much to copy out.

CHANCERY LANE.

[72599.]—**Tidal Waves.**—In penetrating into the estuary of a river, the tidal wave, retarded by the shallows and narrowed by its banks, must necessarily swell because of the restriction of the liquid mass in its bed. All the inlets or bays into which the tide penetrates present thus the spectacle of the "bore"; but in some cases, the regular inclination of the bed, the uniformity of the shores, or else an intersection of various currents, diminish the first undulation of the tidal wave, or permit it to be confused with other irregularities of the surface. Elsewhere, on the contrary, all the topographical conditions are found united to give a great height to the "bore," and then it rises like a moving wall from one shore to the other of the estuary. At the mouths of certain rivers, such as the Amazon, Hooghly, Seine, Dordogne, Elbe, and Weser, the waves of the "bore" assume enormous proportions at the time of high tides and become formidable phenomena. In the Amazon the "bore" called *pororoca* because of the roaring of its waters, rises, in three successive waves, attaining together from 30 to 50ft. in height; and vessels, surprised by this sudden flood, are in great risk of capsizing. At the mouth of the Ganges, the "bore" is also very formidable. As the old Hindoo legend says:—"Bagharala, having taken the divine Ganga as his spouse in the midst of snows, raised her in his arms, and, mounting his chariot, traced with its two large wheels the banks of the wide bed of the goddess. But when they arrived at the sea-shore, Ganga recoiled with affright before the impure and monstrous ocean; she fled abruptly by a thousand channels, and since that epoch she comes and goes by turns, now venturing to descend, and now fleeing again towards the mountains, twice a day." It is in the bay of the Seine that the "bore," "mascaret," or "eager" has been most regularly and carefully observed. Flowing from the open sea with a speed of 15 to 20ft. per second, the liquid wall remains curved towards the centre, under the pressure of the fluvial current. The two points of the enormous crescent break in foam on the shores; while, in the middle of the concavity, the even, rounded wave advances without even rippling the water before it. It seems to turn on the river like a gigantic serpent; rising 6½ to 10ft. above the liquid plain; whilst behind it rise waves or *éteules* in concentric undulations quite as high, the advanced guard of the tidal mass. The "bore" in the Severn has not the amplitude of th
occurs in the Seine; it is, however, dang
rowing boats. It is probable that the
Thames, and the Forth likewise poss
"bores"; but they must be of small ext
know of no observations being on recor

[72607.]—**Testing Emeralds.**—A "
is easily detected, whether emerald or
supposed stone, by placing it face down
the back of the hand and looking at
through it. If a doublet, the colour of
will vary according to the refractory pow
different materials. NUN

[72609.]—**Portland Cement.**—Many
been burnt in an ordinary limekiln in a b
the bank used to dry the pug on. Use no
coal. JACK OF ALL T

[72614.]—**Guessing a Person's A**
following will be found to answer well.
half-dozen bits of paper into 30 squares e
number thus—

A

| | | | | | |
|---|---|---|---|---|---|
| 3 | 6 | 7 | 10 | 11 | 2 |
| 14 | 15 | 18 | 19 | 22 | 23 |
| 26 | 27 | 30 | 31 | 34 | 35 |
| 38 | 39 | 42 | 43 | 46 | 47 |
| 50 | 51 | 54 | 55 | 58 | 59 |

B

| | | | |
|---|---|---|---|
| 5 | 6 | 7 | 13 |
| 14 | 15 | 20 | 21 |
| 28 | 29 | 30 | 31 |
| 52 | 38 | 39 | 44 |
| 47 | 53 | 54 | 55 |

C

| | | | | | |
|---|---|---|---|---|---|
| 3 | 5 | 7 | 9 | 11 | 1 |
| 13 | 15 | 17 | 19 | 21 | 23 |
| 25 | 27 | 29 | 31 | 33 | 35 |
| 37 | 39 | 41 | 43 | 45 | 47 |
| 49 | 51 | 53 | 55 | 57 | 59 |

D

| | | | |
|---|---|---|---|
| 9 | 10 | 11 | 12 |
| 14 | 15 | 24 | 25 |
| 28 | 29 | 30 | 31 |
| 42 | 43 | 44 | 45 |
| 56 | 57 | 58 | 59 |

E

| | | | | | |
|---|---|---|---|---|---|
| 17 | 18 | 19 | 20 | 21 | 16 |
| 22 | 23 | 24 | 25 | 26 | 27 |
| 28 | 29 | 30 | 31 | 48 | 49 |
| 50 | 51 | 52 | 53 | 54 | 55 |
| 56 | 57 | 58 | 59 | 30 | 60 |

F

| | | | |
|---|---|---|---|
| 33 | 34 | 35 | 36 |
| 38 | 39 | 40 | 41 |
| 44 | 45 | 46 | 47 |
| 50 | 51 | 52 | 53 |
| 56 | 57 | 58 | 59 |

The person whose age you wish to guess re
you those bits only on which her age occ
adding together the figures in the right-
corner square, the age is obtained. Thus,
aged 45 returns you B, C, D, and F;
numbers as above, 4 + 1 + 8 + 32 = 45.
be done as quickly as possible.

JOHN D

[72616.]—**Brazing.**—It is done with sp
borax. A charcoal fire is best; but if the p
been tinned look sharp after it, or you
have a hole through it. JACK OF ALL T

[72619.]—**Producing Darkness.**—Thi
phenomenon may be easily shown to the
admitting the sun's light into a dark room
a small hole about $\frac{1}{40}$ or $\frac{1}{50}$ of an inch in di
receiving the light on a sheet of paper. If
a needle or piece of slender wire in this li
examine its shadow, we shall find that the
consists of bright and dark stripes, succeed
other alternately, the stripe in the very
axis of the shadow being a bright one. Th
light which are bent into the shadow hav
the same length of path, so that they form
fringe of double the intensity of either; but

n a point of the shadow at a certain
the middle, have a difference in the
paths corresponding to the difference
lights destroy each other, so that a
produced on each side of the middle
t a greater distance from the middle
becomes such as to produce a bright
n; a bright and a dark stripe succeed-
to the margin of the shadow.

S. BOTTONE.

**arbon Dioxide.**—Carbon dioxide is
ndenses to a liquid under a pressure
per square inch, at 15° Centigrade.
be taken off, the greater part of this
nto gas, and it is proposed to utilise
for propelling bullets from rifles. I
r, that it will be a year or two before
ize at the National Rifle Association
peted for with Giffard rifles.

WM. JOHN GREY,
nt 5th V.B. Durham Light Infantry.

**.ue Pipeclay.**—Stone blue, indigo,

JACK OF ALL TRADES.

**.ectric Boat.**—To MR. BOTTONE.—
ce mentioned—viz., 4¾in. by 6in.
ry powerful motor could be fitted. I
of the double-magnet type, with a
ure 2¼in. diameter by 2¼in. deep, or
ut it could be made smaller, and yet
ful enough to drive the boat. The
is rather cramped, especially as you
er bichromate or chromic-acid cells,
that you must have cells inside the
Still, if you use thin ebonite cells,
good results, if you employ double
ngle zincs; coupling all the cells in
ding the motor to an output of two
volts pressure. This should give you
ower, which should be ample to drive
a good rate. See also my book,
struments."

S. BOTTONE.

**lectric Signalling Lamp.**—There
dvantage in using electricity as an
ess an arc light was obtained, and the
ern lime-light apparatus is probably
ndy than accumulators to yield an arc.
tes that he wants to signal seven miles.
eye oil-lamp will do that in a clear
A lime-light will do up to 20 miles.
HN GREY, Staff-Sergeant 5th V.B.
Durham Light Infantry.

**ectric Signalling Lamp.**—Were
to signal with the appliances you
I should give the preference to a
incandescent lamp with switch, fed
ccumulator, the exact type and size
nt on the length of time the signals
for, and upon the convenience for
e lamp you could not make yourself,
pposing you succeeded, it would cost
more than to buy. The accumulator
e, after reading my description in
strument Making for Amateurs."

S. BOTTONE.

**antern Slides.**—Colours for paint-
e had prepared from several places
n about 1s. 6d. a box. Use fine
ish.

CYMRY.

**evolver.**—You do not need a license
er in the garden of your house.

WM. JOHN GREY, Notary Public.
n-Tyne.

**.E.R. Locos.**—The engine illus-
-cylinder compound on the Worsdell
es system, with principal dimensions
gh pressure cylinder, 18in. by 24in.;
26in. by 24in.; distance between
lers, 2ft. Wheels: Leading, 4ft. 7¼in.;
iling, 6ft. 8½in. Frames: From front
of leaders, 5ft. 4in.; from centre
tre drivers, 7ft. 9in.; from centre
tre trailers, 8ft. 8in.; from centre
end, 4ft. 2in.; distance apart, 4ft.;
Boiler: Height of centre from rail,
h of barrel, 10ft. 7in.; diameter out-
firebox shell, 6ft. by 3ft. 11in.; 242
in. by 10ft. 11½in. Heating surface:
.ft.; firebox, 112in.; total, 1323·3in.
7·33in.; working pressure, 170lb.
ch. Weight of engine: Empty,
; full, 43 tons 6cwt. 3qr. Tender:
9¼in.; 6ft. 4in. between centres;
gallons of water, and 4 tons of coal;
tons 19cwt. Total weight of engine
working order, 76 tons 5cwt. 3qr.

C. F. DENDY MARSHALL.

**alc: and Spinning Metal.**—Talc
nto thin leaves, can be bent into
ms, and can be cut to any device?
moulded into bosses, protruberances,
ittle across the cleavage. It is not
" tin or copper in a lathe when
absolutely necessary, a little melted
applied to the face of the wooden
right way to go to work is to chuck a bit of hard wood on the lathe, and to turn it to the pattern required; then place a piece of thin sheet-brass or copper (previously well annealed) centrally against this pattern, and, to hold it in place, bring up against it the back poppet, the nose of which must be covered with a rounded piece of hard wood to prevent injury to the sheet. Lubricate with soap-and-water or machine oil.

S. BOTTONE.

[72635.]—**Water Regulator.**—You want a reducing valve. JACK OF ALL TRADES.

[72635.]—**Water Regulator.**—You should have a screw-down stopcock in the service pipe. This is compulsory in London. SEKON.

[72636.]—**Striking Force.**—The word "force" as here used is incorrect. "Power" or "momentum" would be the correct term. The power acquired by a weight of one ton in falling 1ft. would be 1ft.-ton, or 2,240ft.-lb.—i.e., it would have the power of raising one ton through 1ft., or of raising 1lb. through 2,240ft. The rule is: Multiply the weight or force by the distance, expressed in feet, through which it moves.

ASSOC. N.S.S.

[72636.]—**Striking Force.**—There is no such term in mechanics as "striking force," because there is no such thing. The energy of one ton falling one foot will be 2,240ft.-lb., and the pressure which it will exert on striking the ground, or anything else, depends on the distance through which it moves after impact and before coming actually to rest. Thus, if the ground yields through one inch then the average pressure exerted will be 26,880lb.; if the yielding be less the average pressure will be greater and vice-versâ. It is to be noticed that the above pressure is merely the average value for a pressure which gradually diminishes. Let $E$ = energy of a moving body in foot-pounds, $d$ = the distance moved after impact expressed in feet, $p$ = average pressure in pounds, then obviously $E = dp$. If $d$ be very small, then $p$ becomes very great, and use is made of this fact in various cases, for example, in presses for coining.

WM. JOHN GREY, F.C.S., Analytical Chemist.
Newcastle-on-Tyne.

[72638.]—**Lathe Gut Band.**—Soak the end in some hot sugar-and-water after screwing it in, then with a bradawl, taper pointed, not chisel, bore a hole and drive a wood peg in.

JACK OF ALL TRADES.

[72638.]—**Lathe Gut Band.**—Pare the end of the catgut to a good fit, screw it in as tightly as possible, using plenty of "end thrust," until $\frac{1}{16}$in. of the gut comes up into the eye or bend of hook. Burn off only as much of this as is necessary with a red-hot wire. Then thrust in a red-hot pointed wire, or bradawl, as far as you can endways. The following incident proves this a strong joint. One day, while turning, the heavy flywheel escaped from its bearings, but, most fortunately for me, it remained suspended in the catgut. Thus a dangerous revolutionary movement was instantly quelled by hanging the principal offender: to the great advantage of the common weal. It is possible to slightly adjust the length by twisting or untwisting.

W. BORRER, JUN.

[72641.]—**Old Locomotives.**—"Historian" will find the Agenoria illustrated in the *Engineer* of March 7th, 1890. D. W. L.

[72641.]—**Old Locomotives.**—An engraving of the Agenoria appeared in the *Engineer*, March 7th, 1890. Vulcan, which was of the same design as Atlas on the same railway, was (Atlas was) illustrated by Mr. C. E. Stretton in the "E.M." for July 5th, 1889. NORTH WESTERN.

[72642.]—**Stomata.**—The cuticle of many leaves, as, for example, those of the common flags (Iris), can be easily removed by gently raising one edge with a thin knife. If this cuticle be then placed on a glass slide and cautiously scraped with a sharp knife and then brushed with a wet camel-hair brush, all the chlorophyll can be removed. It is well to examine the cuticle from time to time under the microscope, in order to see when the operation of scraping, &c., has been carried far enough. S. BOTTONE.

[72644.]—**A 20-Lighter Dynamo.**—Armature, 6in. diam., 8in. deep, wound with 8lb. No. 14 wire; field-magnet cores, 7in. high, 3in. wide by 5in. long, ovoid in section, wound with 4lb. No. 12 on each limb, coupled in parallel for the series coils, and 33lb. No. 20 in one length for the shunt coils. Driven at about 1,500 revs. per minute, this machine will give 20 ampères at 55 volts to 60 volts pressure, according to neatness of winding and perfection of insulation, &c. S. BOTTONE.

[72647.]—**Electrical Resistance.**—Since the resistance of a given length of wire of any given metal is inversely proportionate to its area or cross section, and since the section of a circle is equal to its circumference divided by four, it follows that two wires of the same material and of equal length, having resistance of 2,000 or 3,000 ohms respectively, must have sections or areas respectively as 3,000 is to 2,000, or 3 to 2. Therefore the circumference of these two wires must be as $2 \times 4 = 8$ is to $3 \times 4 = 12$ respectively. Now the diameter of a circle is to its circumference as 1 is to 3·14159. Therefore the two wires will have the respective diameters of $12 \div 3{\cdot}14159 = 3{\cdot}81$, and $8 \div 3{\cdot}14159 = 2{\cdot}54$. Hence the wire having the diameter of 2·54 will present the resistance of 3,000w., while the one having the diameter of 3·81 will have a resistance of 2,000 only. S. BOTTONE.

[72646.]—**Charging Primary Battery.**—The solution you made use of is right, but rather strong with sulphuric acid; 3oz. to the pint is quite sufficient. The probable causes of failure are: the connections between the carbons and their binding screws have become imperfect through corrosion. The acid was employed while still warm, so that it corroded the zincs too rapidly, and as quickly got exhausted. S. BOTTONE.

[72649.]—**L. and S.W. Tank Locos.**—I recently saw 323 at Weymouth. It has been for some considerable time engaged there in passenger traffic between Weymouth and Dorchester, and has done shunting at Weymouth, and has taken local goods trains to Dorchester. It was stationed at Weymouth sheds. No. 321 I saw some time since at Wimborne, taking traffic from Bournemouth to Wimborne and Brockenhurst. This was some time ago. CAUCASUS.

[72649.]—**L. and S.W. Tank Engines.**—I am much obliged to "Locomotive" for putting me right about the South-Western tank; I did not know that the later ones had departed from the original pattern. I should not be at all inclined to think 318 class were broken up yet—they are only about 15 years old; but I do not know for certain. I expect "Locomotive" will find it a difficult matter to get shown over Nine Elms works, unless he can bring any influence to bear. He should get introduced to someone in power, if possible. In answer to the questions asked in reply No. 72358, I believe Nos. 129 and 78 are bogie tanks, built at Robert Stephenson and Co.'s, 1885, and am certain there is a 10-wheeler numbered 77. What will be done with Nos. 77 and 78 now the new ones are out? C. F. DENDY MARSHALL.

[72653.]—**Propelling Boat.**—According to my experience, a ½H.P. motor does this easily.

S. BOTTONE.

[72655.]—**Railway Curves.**—According to the specifications for laying out a railway, and also by the regulations issued to plate-layers, both rails are to be laid on an exact level, and no special mention is made as to laying curves. SEKON.

[72655.]—**Railway Curves.**—The natural tendency of a train going at any speed is to travel in a straight line, and run off the outer curve. The outer rail is, therefore, raised to resist this tendency, and keep the train on the line. CALDEMONE.

[72655.]—**Railway Curves.**—The rails are generally laid so when a curve occurs in the line. The object of doing so—i.e., making the inner rail lower than the outer—is to give the train greater "bite" on the rails while rounding the curve.

LEONARD FROSSBROOK.

[72655.]—**Railway Curves.**—The outer rail is slightly raised to counteract the centrifugal force in the same way as are the corners of a bicycle track. The "extra strain when a train is going round a curve" would tend to depress the outer rail, not the inner. Everything in turning a corner tends to fall outwards; hence the train is purposely tilted over inwards. C. F. DENDY MARSHALL.

[72655.]—**Railway Curves.**—The inner rail is not depressed—it is the outer rail that is raised. As the engine and carriages move round a curve, the centrifugal force has a tendency to make them fly off in a straight line. To prevent this and keep the flanges of wheels on the outside of the curve from the rails, the larger or outer curve is raised higher than the inside one. This is not necessary in narrow-gauge railways unless the curve has a less radius than 1,400ft. N. E. R.

Herrington.

[72655.]—**Railway Curves.**—The outer rail on a curve is always raised to a greater or less degree, depending principally on the radius of the curve, and the velocity of the trains which travel round it. The sharper the curve and the higher the speed, the greater the super-elevation or "cant" of the outer rail. This super-elevation is given to the rails when they are first laid, and is kept up by the plate-layers: the amount can be determined by formulæ. Will send formulæ if desired, but you will find them in any book on civil engineering or permanent way. Those given in Molesworth's are very good ones.

Glasgow. METEOR.

[72655.]—**Railway Curves.**—In laying a railway the outer rail of a curve is placed higher than the inner rail, in order to counteract the tendency the train has to leave the line while going round the curve. The amount of this elevation varies directly as the width of the gauge, directly as the square of the velocity with which the train is to traverse the curve, and inversely as the radius of the curve. The formula is—

$$E = \frac{4\,W\,V^2}{5\,R},$$

where W = width of gauge in feet, V = velocity in miles per hour, R = radius of curve in feet, and E = elevation of the outer rail in inches. Thus, for a curve 2,000ft. radius and a velocity of 30 miles per hour, the elevation would be—

$$\frac{4 \times 4{\cdot}7 \times 900}{10{,}000} = 1{\cdot}692\text{in.}$$

Merlin" is mistaken in imagining that there is any extra stress on the inner rail of a curve when a train passes over it. The extra strain comes on the outer rail.

WM. JOHN GREY, F.C.S, Analytical Chemist.
Newcastle-on-Tyne.

[72656.] — **N.W.R. Condor.** —This is one of the "Precedent" class, for a sketch of which see the ENGLISH MECHANIC for Aug. 22, 1890, reply No. 72052. Her number is 868, and date June, 1877. Driving wheels, 6ft. 7½in.; leaders, 3ft. 7½in.; cylinders, 17 by 24. C. F. DENDY MARSHALL.

[72656.]—**N.W.R. Condor.**—The following is, I think, a correct description of colour of most N.W.R. locos.: Colour all over is black; picking-out colours, white, yellow, and red; broad white band, edged with yellow and thin red stripes; number plates are red enamel (ground), with brass rim and brass figures; colour inside cab, dullish red; buffer boards, red, and no number on them; name-plates, also brass, with name, date, and year put thereon in black letters. LEONARD FROSSBROOK.

[72656.] — **N.W.R. Condor.** — No. 868 Condor (at Rugby) is one of Mr. Webb's "Precedents," illustrated in the "E. M." for Aug. 22, 1890. Dimensions as follows:—Diam. of driving wheels, 6ft. 7½in.; diam. of leading wheels, 3ft. 7½in. Wheel base:—Leading to driving, 7ft. 5in.; driving to trailing, 8ft. 3in.; total, 15ft. 8in. Cylinders, diam. of, 17in.; stroke, 24in. Boiler, length of, 9ft. 10in.; diam. of, 4ft. 1½in.; pressure, 140lb. per square inch; thickness of plates, ⅝in.; number of tubes, 198 of 1⅞in. diam. Fire-box, length of (top), 4ft. 9⅛in.; (bottom), 4ft. 10⅝in.; breadth of (top), 3ft. 5¼in.; (bottom), 3ft. 6in.; height of, 5ft. 9¼in. Heating surface:—Tubes, 1,013sq.ft.; firebox, 89sq.ft.; total, 1,102sq.ft. Weight of engine and tender in working order, 57 tons 4cwt.; tractive force per pound pressure on piston, 87·8lb. NORTH-WESTERN.

[72660.]—**Dynamo.**—You will not get 75 volts out of 80 yards of wire unless you drive at a very high speed, since half the wire on a ring armature is "dead" wire, so that only 40 yards are really active. Besides, No. 10 wire is much larger than is needed to carry 25 ampères on a ring armature. You would find the following proportions give good results. Before making the machine I should advise you to read the sixth edition of "The Dynamo: How Made and How Used." Armature 7in. diameter, 8in. deep, wound with 11 to 12lb. of No. 14; field-magnet cores, oval in section, 3in. by 5in. in section, 9in. long, wound with 100lb. No. 18 connected in shunt. The punchings I employ for machines of this size have 16 sections, and they give me very good results. S. BOTTONE.

[72663.]—**Nitrate of Soda Battery.**—Make up the cells with porous inner pots precisely as in a Bunsen. Let the zincs be amalgamated, and surround them with a dilute solution of sulphuric acid, 1 acid to 12 of water. For the porous cells, along with the carbon, use a mixture of nitrate of soda, 1lb.; water, 1 quart; sulphuric acid, 1 pint. The addition of an ounce of bichromate of potash, or, better still, chromic acid, greatly increases the efficiency, and for a short time prevents the generation of the poisonous nitrous fumes.

S. BOTTONE.

[72664.]—**Neatsfoot Oil.**—To obtain this free from sediment and cloudiness, it should be filtered through good blotting-paper, and will take some hours to filter. SEKON.

[72664.]—**Neatsfoot Oil.**—Get a set of feet and dress—i.e., scald the hair off—I suppose you know how to do that—take the hoofs off, then put them in a copper and give three hours' good boiling, or if it is five all the better. Take out the heels and let the liquor remain until cold, then skim the oil off; pour some hot water on the oil, and let it settle, and your oil should be as clear as water; but a copper must be used for it, as the acid action upon the copper and that upon the gelatine precipitates it in the shape of a brown curd.

JACK OF ALL TRADES.

[72665.]—**Rope and Drum.**—About 191 turns.
C. F. DENDY MARSHALL.

[72665.]—**Rope and Drum.**—Multiply diam. of drum by 3·1416; this will give circumference of drum. Divide 600ft. (brought to inches) by circumference, and you will get what you require.

CYMRY.

[72665.]—**Rope and Drum.**—Multiply the diameter of drum by $\frac{22}{7}$, and the result is the circumference, which is equal to amount of rope wound in first revolution. For the second and successive revolutions add 3in. to the last diameter and multiply by $\frac{22}{7}$. Example: $12 \times \frac{22}{7} = \frac{264}{7} = 37\frac{5}{7}$, therefore $37\frac{5}{7}$in. of rope would be wound in the first revolution. Second revolution: 12in. + 3in. = 15in. diam. of drum with one layer of rope on it, $\frac{15}{1}$in. $\times \frac{22}{7} = \frac{330}{7} = 47\frac{1}{7}$ = amount of rope wound by the second revolution. C. BELL.

[72667.]—**Charging Accumulator.** — As a rough-and-ready rule, you may say that the cells are charged when the liquid begins to bubble up, or "boil" freely. But it does not injure the cells to continue charging after this occurs.

S. BOTTONE.

[72667.]—**Charging Accumulator.**—For the last five years I have relied entirely upon the voltmeter for determining when the battery is fully charged, and certainly prefer this method to the hydrometer. With the latter you have to remove the glass plate, which should cover each cell, insert the hydrometer, wait till it floats steadily, take the reading, replace the glass cover, and repeat this throughout the whole battery. Then, when the observations are complete, it will generally be found that no two cells read precisely alike. Sometimes, also, the dynamo is at some considerable distance from the battery, and specific gravity tests at the latter are inconvenient. If a good voltmeter be read on the charging circuit at the dynamo house, at intervals of half an hour, it will be found to increase steadily in its indication of volts, until a point is reached at which it becomes stationary, and when that is the case you may assume that the battery is fully charged. For instance, the following are the figures of a recent charging here:—

| | | |
|---|---|---|
| 7h. | 30m. | 51 volts. |
| | 45 | 60 ,, |
| 8 | 15 | 61 ,, |
| | 45 | 63 ,, |
| 9 | 15 | 64 ,, |
| | 45 | 65 ,, |
| 10 | 15 | 67 ,, |
| | 45 | 67 ,, |

We know by practice that, when charging twenty-five cells, 67 volts, or, at the most, 68, is the highest reading that can be obtained, and when the voltmeter has maintained that reading for half an hour the attendant stops running. For testing the cells individually in the battery room, I have wires from each (attached to the connections) brought to a testing board, to which a two-pronged plug—itself attached by a flexible cord to a galvanometer—can be applied. This gives the reading of each cell in turn, without moving from the board; and for the galvanometer the "intensity" coil of an ordinary detector is used, to which, however, an extra resistance of about 50 ohms in fine g.s. wire has been added, so as to have a convenient deflection of about 70° for two volts. Occasionally a cell will read lower than the rest, showing that it requires examination. As a means of estimating the residual charge in a battery, in order to decide whether it needs recharging to meet a given expenditure of current, the hydrometer is certainly useful, though, even then, the differing indications of the several cells will be found confusing; and, for my own part, I think one of the Ferranti meters on the charging circuit at the house switch-board, and another beside it on the discharging circuit, more reliable. I trust Mr. Bottone will excuse my offering a reply to a question addressed specially to himself. ANTARES.

[72669.]—**Gassner Battery.**—To MR. BOTTONE.—The following will be found a good composition:—oxide of zinc ¼lb., plaster of Paris 1lb., chloride of zinc ⅛lb., water 1½ pint. If the carbon plate be soaked for an hour in a saturate solution of potassium permanganate, it will conduce considerably to its activity. It is immaterial to the action what shape the zinc takes. S. BOTTONE.

[72670.]—**Incandescence Lamps.**—To MR. BOTTONE.—Theoretically, no difference; practically, a good deal. If you are working a 16-volt lamp, you will only require about 1 ampère of current to flow through your lamp, since every candle-power requires about 3·5 watts. If you are working with an 8-volt lamp you will find that at least 2 ampères must flow through the lamp, so that in this latter case your battery will run down in half the time, or even less. Again, if you are using a dynamo, you will find it easier to work with a high voltage and small current, than the reverse, since lighter conduction can be used, and there will be less waste in transmission. S. BOTTONE.

[72671.] — **Boiler.** — For such a small boat, I strongly advise you to be content with 20lb. or 30lb. pressure, the advantages of the higher one being completely counteracted by the heavier boiler necessary. For material, use copper; brass is not to be trusted. I should make the fire-box 8in. long, 4in. high, and 5in. wide, leaving ⅜in. water-space at bottom and sides, and put four or five ¾in. fire-tubes through the smoke-box. In models, the fire-box should never be longer than twice its height, that being the greatest distance the fire will run. Cross tubes are unsatisfactory in models, as they get choked with deposit, and then they have to be removed to be cleaned. A. F. SHAKESPEAR.

[72673.]—**Pump.**—Too small for anything certain in action. JACK OF ALL TRADES.

[72676.]—**To Mr. Allsop or Mr. Bottone.**—No. S. BOTTONE.

[72676.]—**To Mr. Allsop or Mr. Bottone.**—I should not advise you to attempt to do what you require by means of a water-motor unless you want to pay a lot of money for a very small light. Your best and cheapest plan would be to put down a small gas-engine and dynamo. F. C. ALLSOP.

[72677.]—**Force.**—Force in a bent tube tends to straighten the tube. On this principle the Bourdon gauge is constructed. ASSOC. N.S.S.

[72678.]—**Pump.**—Inside diam. of suction-pipe should be ½in.; the valve should be slightly larger. None of the valves should rise more than $\frac{1}{16}$in., and they should be confined to that amount by a pin or screw placed above them. What you complain of is, probably, caused by valves having too much rise and so getting off their seats. The upper valve and the one on the boiler should be slightly larger than the suction valve. Ball valves are certainly best; but they are difficult to make or obtain. Next to these I prefer flat valves. Conical valves in models obstruct the water-way. A. F. SHAKESPEAR.

[72679.]—**To Mr. Bottone.**—You should make a pair of field-magnets about 3in. wide, with a 1in. channel, each limb being ¼in. thick, and about 4½in. high. For full working details of this form of machine, I must refer you to "The Dynamo: How Made and How Used." S. BOTTONE.

[72680.]—**Electric Motor (Wrought Iron for).** — Certainly, the efficiency with an equal number of watts would be about 40 per cent. in favour of the wrought-iron machine.

S. BOTTONE.

[72681.]—**Dynamo.** — The reason is not far to seek. The carcase and armature being all cast iron and the armature small, there is not sufficient magnetic permeability in the F.M. cores to get up a sufficiently powerful field. S. BOTTONE.

[72682.]—**The Polygon of 17 Sides.**—Looking back at p. 39, it is evident that in the value for there is a misprint of $\sqrt{(\frac{1}{2}a^2 - 1)}$ for $\sqrt{(\frac{1}{4}a^2 - 1)}$, which may have led "Mu Nu" to his error. His getting $\sqrt{17}$ from a long oblong, 4 × 1, is a very inartificial and bad way, compared with one whose sides are 3 and $\sqrt{8}$, the arcs intersecting at a much smaller angle. E. L. G.

[72683.]—**Electric Motor.**—As I have exhaustively treated on this subject quite recently in my articles on Electro-Motors, giving full particulars as to size of fields, wiring, &c., used by the best English and American makers, I must refer you to the "E.M." for Sept. 6, 1889, p. 24 et seq. If you cannot refer, but can wait a week, I can supply you with a copy of my new book "Electro-Motors," which is in the hands of the binders. S. BOTTONE.

[72684.]—**Conductivity of Wire.**—Brass wire varies in conductivity with the amount of copper it contains. Roughly, you may say it is six times a worse conductor than pure copper. The same applies to tinned iron. This varies from six to seven times that of pure copper. S. BOTTONE.

[72685.]—**Yew.**—I do not think you will get anyone to speculate in yew. I have had some little experience; I never saw any sound, and have had some large bowls. The other day I saw some felled and the roots burned; no one would give them cartage, it seems, for firewood.

JACK OF ALL TRADES.

[72686.]—**Yew.**—Yew, in the log, costs about 5s. per cubic foot, and requires about the same seasoning as elm. SEKON.

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THE Fishing Society of Denmark having offered a reward of three kroner for every seal killed, the extermination of these animals in Danish waters is only a question of time. It appears that the fishing industry is least successful in the waters where seals abound. Within the last ten months no fewer than 810 seals have been destroyed for the sake of the bonus.

**Artificial Sea-Water.**—Prof. Edward Perrier lately communicated to the French Academy of Sciences the results of some experiments made by him at the zoological laboratory of the Saint Cloud normal school, upon the use of artificial sea-water for the preservation of marine animals, and especially of oysters, in large aquariums. The solutions employed have been reduced by him to the following formula for from three to four quarts: Chloride of sodium, 81grm; sulphite of magnesia, 7grm; chloride of magnesium, 10grm; chloride of potassium, 2grm. During the Exposition, this solution gave as good results as natural sea-water, with very much less expense.

# ANSWERED QUERIES.

*mbers and titles of queries which remain unan-r five weeks are inserted in this list, and if still d are repeated four weeks afterwards. We trust 's will look over the list, and send what information or the benefit of their fellow contributors.*

)eveloping Solutions, p. 540.
'est for Materials Suitable for Paper-making, 540.
.rmature.—To Mr. Allsop, 540.
Iodel Locomotive.—To "J. H.," p. 541.
'atterns on Canvas, 541.
lanjo, 541.
'ompound Tandem Launch Engine, 541.
nk, 541.
'rinting on Tin, 541.
'ricycle to be Propelled by Hand, 541.
'.O. Galvanometers, 541.
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3oiler Question, 541.
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)ischarge of Water, 68.
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'lanetary Influence on the Weather, 68.
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'rgan, p. 69.
)ividing Ellipse, 69.
'olliery Fan Work, 69.
'elescope, 69.
tudders, 69.

# QUERIES.

]—**Screw-Cutting.**—Having a 4in. lathe with slide-rest, I am anxious to use it for screw- The slide-rest screws are seven to the inch. not room for the change-wheels sold, not even mallest sizes. How shall I contrive it? Only est amateurs' models are made, and the threads are from 10 to 50 per inch.—SIMPLEX.

]—**Pumping Water.**—I want to know what of water a pump is throwing, and should be if some kind correspondent would inform me nd it? I have one pump, the stream of water h flows through an opening 12in. wide, and varies from 3in. to 6in. If at 3in. deep, so many per minute, what would be the number of hen 4in. and 6in. deep? I should like to know vay to measure the amount.—MILLBOARD.

]—**Model Loco. Making.**—Has "J. H." at when the engine is in backward gear, the rod of the fore gear fouls the weigh-shaft? Is have I drawn it out wrong?—J. A. P.

]—**Silvering Brass Clock-Faces.**—Would r inform me how to silver brass clock-faces, and l in the dial, and what kind of stuff to use?—A

]—**Current.**—I shall esteem it a great favour ttone or Mr. Fitzgerald will inform me how I can e following? I require a current of 1 ampère, 4 volts pressure; the current to be generated ary battery, outside measurement not to be more deep, 2½in. by 2in. wide; one charge to give a s current for three hours. Is it possible to e above current within such a small compass? must not be platinum or silver. In answering ase give a description of the chlorine cell with '. and I.R.—J. R.

]—**L. and N.W. Locos.**—Will any reader lige me with sketch and dimensions of Charles No. 955? Also numbers and names of those to Mr. Webb's "Teutonic" class.—L. N. W.

]—**Soap-bubbles Filled with Hydro-** have tried to make hydrogen soap-bubbles imes, but with only moderate success. They rst before attaining any size, or on trying to set . Can any reader kindly tell the reason of this, to prevent it?—MECHANICS.

]—**Permanent Way.**—Will some reader of M." inform me what class of rails and fasten- used upon the Metropolitan District, North London, Chatham and Dover, and London, Til- Southend Railways?—DEXTER.

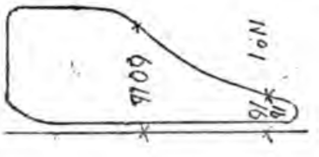
]—**Landing Piers.**—Will some reader of the state the longest landing pier upon which a rail- n in England, and where situated, and if wood nstruction?—DEXTER.

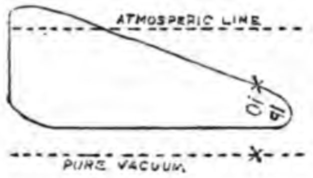
]—**Velocity of Flue Gases.**—I should be me of your able contributors could give some on on this subject? 1. As to the methods of ing the velocity, and also the pressure per square find that if I insert one end of a tube in the and connect the other to a U tube containing e suction is sufficient to raise the liquid 9-16in. level. Is it possible from this to deduce the and pressure per square foot of the gases. is the usual velocity and pressure, working under conditions with Lancashire boilers?—E. A. B.

]—**Electric Search Lamp.**—I should like e experience of electricians who have used one of ps, which is the ordinary type regulated by hand, out 3,000 candles, and run from compound giving 50 to 54 volts. And along with this lamp about 100 incandescents. I use separate leads switch board to the switch lamp, with a resist- bout ¾ to 1w., in series with the lamp which I can reduce to 1-10 of an ohm after the lamp is burning by means of a commutator. Every time I use the lamp my dynamo commutator, which is of drawn copper bars, is badly burnt and requires turning up. Are the segiments too soft, or is my voltage too low, or the resistance? Will any brother amateur or Mr. Bottone kindly assist me?—HARTLEPOOL.

[72698.]—**Production of Life.**—In "Vestiges of the Natural History of Creation," experiments made about 50 years ago by Mr. Crosse and afterwards by Mr. Weeks, are mentioned, in which by the continued action of electricity on silicate of potash there formed about the negative wire from the battery—a gelatinous matter out of which insects emerged. What is known about any further experiments of this sort? About a year ago there was a notice in *Nature* about the opinion or expectation of two French chemists that by some action of electricity it might be possible to produce living protoplasm.—J. S. C.

[72699.]—**Indicating.**—Will any of our friends show me in plain figures how to get the pounds of water and steam per I.H.P. per hour from the accompanying diagrams? H.p. cylinder cuts off steam 23½in. from end of admission; exhaust opens 6in. from end of stroke; pressure at point of cut-off 60lb. from atmospheric line, and at opening of exhaust 16lb. from atmospheric line. Diameter of h.p. cylinder 18in., stroke 5ft., revolutions per minute 60, average pressure 33·5, I.H.P 155. This is diagram No. 1. Diagram No. 2.—Diameter of l.p. cylinder 29½in., stroke 5ft., revolutions 60, average pressure 9·5, I.H.P. 118. Pressure at exhaust point 10lb. to pure vacuum, exhaust opens 6in. from end of stroke. Are the pressures taken from pure vacuum and atmospheric lines, or from the lines of counter-pressures?—YOUNG ENGINEMAN.





[72700.]—**Plaster Casting.**—I have a small model from which I would like a cast, and wish to use gelatine for the mould. I have used wax. Will anyone say if it is used in the same manner, and how it is mixed? Any particulars about same will be very acceptable.—YOUNG PLASTERER.

[72701.]—**Pantagraph.**—Will some ome one inform me how to make a pantagraph for drawing with? Also give illustration of one.—E. J. L.

[72702.]—**Induction Coil.**—I am making an induction coil for a telephone. Will some one kindly inform me how many coils of wire I require on reel for primary, and whether it matters if the secondary wire is wound in the same direction as primary wire? Also the best way to insulate between primary and secondary, and also between each layer of wire in secondary?—JOY.

[72703.]—**Cotton Belting.**—Can any of "ours" kindly tell me how any of the various cotton beltings are prepared for use? They appear to be soaked or dressed in a solution which adds greatly to their durability?—R. C.

[72704.]—**Microscopy.**—Would more perfect or unbroken specimens of diatomaceæ be procured by dissolving chalk in dilute nitric acid than by scraping, washing, &c.? Many readers of the "E. M." (I know several myself) would feel deeply indebted to a microscopical contributor who would favour us with a few articles or papers suitable for the beginner who has just purchased an instrument, but hardly knows how to commence. I do not think our Editor would begrudge the space. Even to the general reader the subject would be quite as interesting as the endless disquisitions on locomotives, dynamos, and the jelly-like ether (or either). We have had most interesting articles on botany, lathe matters, astronomy, and various electrical subjects; but since being a subscriber to the "E. M." I do not remember seeing much of interest to the beginner in microscopy. I am perfectly certain that hundreds of readers would hail with delight a series of articles treating upon collecting, mounting, and manipulation.—MICROBE.

[72705.]—**Coloured Lights.**—I want something to mix with paraffin oil in lamps used in fairs and markets. I don't use glass on lamps, as I want to make the light different colours.—COLOURED LIGHTS.

[72706.]—**Speeding Pulleys.**—Would any reader say how to speed pulleys to communicate motion from one shafting to another—some easy rule; also name the best book on the subject?—A POOR MECHANIC.

[72707.]—**Telephone.**—Would Mr. Allsop kindly answer the following:—In what way do the American long-distance telephones differ from those used in this country? I mean as regards the transmitters. Do they use a larger induction coil, or more battery-power, or what? Is the receiver a Bell receiver? Any information on the subject of long-distant telephones would oblige.—MAGNETO.

[72708.]—**Blacking Engine Fire-box.**—I drive a stationary pump, and as I wish to black the fire-box and smoke-box of engine, will any of your numerous readers kindly tell me the best thing to black it with? I have tried Brunswick black, and that does not stand very well. I also wish to paint some boards that have been tarred. I have painted them once before, and now they are as black as ever.—A ROUGH PAINTER.

[72709.]—**Naphtha Launches.**—I should be glad if someone would kindly tell me the advantage and disadvantage for naphtha or petroleum launches. Are they suitable for sea-work, and can they be relied on? Is there any advantage in them?—do they smell much?—Are they easily worked?—IGNORAMUS.

[72710.]—**Leaves of Plants and Trees.**—Can any reader inform me the cause of the extra thickness seen in leaves when growing close to the seashore? Also what is the chemical action by which this is brought about?—AQUA FORTIS.

[72711.]—**Slate Cistern Joints.**—If Portland cement is used for these joints and allowed to get quite dry before the water is run in again, for how long will the joints last in comparison with red and white-lead joints?—AQUA FORTIS.

[72712.]—**Electro-Magnet.**—Will some reader kindly tell me what size wire, and how many layers, I should wire an electro bar magnet to obtain the greatest strength from same with 1½ volt current?—E. W.

[72713.]—**Indian Ringworm or Washerman's Itch.**—About six years ago, whilst residing in the Tropics, I was unfortunate enough to contract the above disease in my scalp. Since then I have tried almost innumerable ointments and lotions, by medical advice, but have not succeeded in entirely eradicating the parasite. My hair has not been at all affected, being as thick as ever. The numerous lotions and ointments I have tried have all been more or less objectionable, some being dangerous to use, and others damaging to clothes, linen, &c. If some kind friend speaking from experience can prescribe a lotion that will be clean and effectual in use, I shall be everlastingly obliged.—R.

[72714.]—**Sucking Solenoid.**—To MR. BOTTONE.—I wish to make a voltmeter to read to 50 volts, as described by you in No. 72440, Oct. 10th; but as I am not sure about the sucking solenoid, shall be extremely obliged if you will be kind enough to give me full instructions for constructing this most important part of the instrument.—TYRO.

[72715.]—**Lithanode.**—From Mr. Bottone's kind reply to former query, I take it that a plate of lithanode in a primary battery with zinc is gradually dissolved, as well as the zincs, and is not permanent like carbon. This appears to me of little consequence if a pair of plates will give with dilute acid a voltage of over two. Could such cells be used for electric light, or would they polarise? I presume not if the lithanode is a perfect depolariser. Would there be local action when not in use, if zinc plates were well amalgamated, and mercury kept in bottom of cell not touching lithanode?—P.

[72716.]—**Photo-Micrography.**—I am obliged to Dr. Bousfield (letter 31708) for his reply to my queries. He will perhaps pardon me if I seem to inquire about well-known things; but my attention has only been called to photo-micrography during the past twelve months, and I know nothing of mounting sections or of practical work with the microscope. My knowledge, such as it is, is photographic. I gather from what Dr. Bousfield says that he uses the D.D. power with an eyepiece. My trials were without eyepiece. I do not know what the thickness of the cover-glass was on the sections I tried with the D.D. power. I believe it was the ordinary commercial article, not specially selected in any way. The trouble complained of as to sections not being flat was not folds in the sense of one portion of a section overlapping another, but a waviness or corrugation caused by the cutting machine, which does not flatten out in subsequent operations. The sections are sections of lung, cut by being imbedded in paraffin wax. Can this corrugation be avoided? Will Dr. Bousfield please explain the meaning of N.A., and how the light-transmitting power is affected by it? Where can the R.M.S. aperture tables be seen?—MICROBE.

[72717.]—**Small Boiler.**—I should feel obliged if anyone will kindly give me sketch and mode of making a simple boiler for loco., one that will make steam well, and not exceed following dimensions: 11in. by 2¾in., to be heated by a spirit-lamp, and stand a working pressure of 15lb. per square inch? Also to have heating surface in front, and steam-pipe to come out at the end of boiler.—BOILER.

[72718.]—**Optical Screw-Cutting.**—Will anyone oblige by giving a description in detail of the process by which a screw of large diameter is made to fit another? Suppose I wish to make a brass flange into which the screw on mount of photo. lens will fit, how should I go about it with an ordinary lathe and tool?—PATHOLOGIST.

[72719.]—**Defective Eyesight.**—Will some one of our medical friends advise me with regard to my right eye? There are black spots (muscæ volitantes) always flying about; but there is one in particular, visible most prominently when I awake in the morning, seemingly about midway between the eye and the ceiling. It then appears about the size of a man's hand, varying to double that size, and is intensely black. I do not observe anything of this after rising; but objects viewed with the right eye appear as though seen through a smoked glass; with both eyes open all looks right. Occasionally there flits across the field of vision a brilliant blue and gold coloured quivering star, which vanishes almost immediately. There is no pain in the eye, no irritation. Left eye normal. Age 65. Have worn concave glasses from youth upwards. Occupation, printer's reader.—H. G. W.

[72720.]—**Luminous Crayons.**—Where can I obtain information about the luminous crayons, stated in the last "E. M." to have been devised by Mr. Carus-Wilson?—R. M.

[72721.]—**Motor for Boat.**—What size motor should I require for boat 18ft. by 5ft., and what kind of battery would work it best? How many cells would it take to work it for eight hours at a time?—ELECTRIC LAUNCH.

[72722.]—**Paint for Model Loco.**—Will "Meteor" or other correspondent tell me what paint to use for model loco.? I wish to paint it green. I want something that will stand the heat and will not blister. Also how many coats of paint?—MOTIVE.

[72723.]—**Copper Bronze.**—Will any of our readers kindly give me a recipe for a good dark copper bronze for brass?—A YOUNG BEGINNER.

[72724.]—**To Photograph Polished Silver.**—I wish to photograph a large silver article with raised figures. What will deaden the lustre without injuring the silver?—SILVER.

[72725.]—**Mechanical Motion Wanted.**—I have a wheel which is made to revolve by the aid of a driving belt from an engine, and as soon as the wheel starts to revolve I want it to draw a cord or lever tight, and keep it in that position as long as the wheel revolves; but on the wheel stopping, the said cord or lever must be immediately released to allow the cord or lever to return to its former position. Will any reader offer a suggestion as to how I can make above work?—AUSTRALIAN.

[72726.]—**"Cornishman" Locomotive.**—Can any correspondent give a sketch of one of the three engines that are used for the new G.W.R. express between Exeter and Plymouth? They are four-coupled (with wheels of 5ft. diameter), and were originally tank engines built so as to be capable of conversion to narrow-gauge, but the trailing wheels have been removed, and a bogie frame put in their place and a tender added.—T. PERKINS.

[72727.]—**Telegraph.**—When the resistance of a sounder instrument is 20 ohms with a shunt coil of 500 ohms, where is the shunt coil placed, and what is its use? I understand such a sounder is used on a local circuit. Does this necessitate the use of a relay, or could relay be dispensed with, and sounder be used as a main-line sounder on, say, a line of 10 miles? If not, how can coils be altered to obtain this result, or so as to be used as both main-line sounder or local circuit sounder by switches or otherwise?—STUDENT.

[72728.]—**Varnish for Pottery.**—Can any reader inform me of any acid, varnish, or paint that can be so laid upon any glazed earthenware vessel, such as a jug or pot, as to leave a mark or design visible to the eye, and still resist any washing with water cold or hot?—A. VARLEY.

[72729.]—**Electric Bells.**—I wish to arrange nine bells to ring at the same time by a switch near the battery. No. 1 is 180ft. from the battery, No. 2 is 66ft. from No. 1, and Nos. 2 to 9 are each 12ft. apart; total length from battery to farthest bell 330ft. I also want to put an indicator at the switch to show that the bells are working. What is the best way to arrange them, in series or relays? What number of No. 2 Leclanché cells shall I require, and what is the best form of indicator?—W. J. P.

[72730.]—**Bicycle.**—Will some of your subscribers kindly tell me if I can drive my bicycle (an Irish Swift) with greater ease by getting a larger cog-wheel on the pedal axle? The wheel on it is only 6in. in diameter, and I think if it were 7 or 8in. it would give me more power. —R. A.

[72731.]—**Warts.**—Will any reader of "Ours" tell me the best way to get rid of warts? My little boy's hands are covered with them, and some are coming on his face. I have tried glacial acetic acid, but it has no effect on them.—A CONSTANT READER.

[72732.]—**Electric Lighting.**—How many cells of the Gassner dry battery (giving 1·60 volt each) would be required to fully light a 5c.p. lamp of low resistance (10 volts)? Also how long they will run at a time. Would 10 cells light two 5c.p. lamps if connected in parallel?—ELECTRIC LIGHT NOVICE.

[72733.]—**Dyeing Floss Silk.**—How can I dye floss silk?—A. B. A.

[72734.]—**Reducing Valve.**—Kindly give particulars of the valve for reducing the pressure of gas, as used on railway carriages. I notice that, notwithstanding the vibration, the flame is remarkably steady. Would the same valve do for compressed oxygen?—E. PARR.

[72735.]—**Barometer.**—A wide-mouthed bottle is filled with water to about ½in. from the top, and a Florence flask is inverted and placed with the edge of its mouth just below the surface of the water in the bottle. Why does the water rise and fall in the neck of the flask before an atmospheric change, as the upper part of the flask contains air?—F. W. C.

[72736.]—**Adjustments of Reflector.**—I have lately been endeavouring to perfect the adjustments of my reflecting telescope by means of the pinhole method. On looking through the eyetube everything appears concentric, as regards the position of the shadow of the flat in the large mirror; but I fail to see the small spot in centre of the large mirror, reflected in the centre of the flat. Is this because the light is not intense enough? On turning the telescope on a bright star with a moderately high-power, I get a lenticular shaped image both inside and outside focus; the major axis being at right angles when inside the focus, as compared with the same when outside. Revolving the eyepiece makes no change. Does this point to a buckling of the large mirror, or what?—G.

[72737.]—**G.E.R. Goods Tanks.**—Wanted, dimensions of above (class 323 or 545). Sketch would be much appreciated.—CAUCASUS.

[72738.]—**G.W.R. Locos.**—Wanted, sketch and dimensions of new passenger locos. (class 3211) built this and last year at Swindon.—CAUCASUS.

[72739.]—**Thermopile.**—Would Mr. Bottone kindly give directions for constructing a thermopile large enough to light a small 6-volt lamp?—T. P.

[72740.]—**Parkin.**—I am wishful to make some good old Yorkshire parkin, and have tried to make same from cookery books, but have failed each time. Will any kind reader give instructions to—GOOD OLD MARTHA.

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THE famous Adelsberg grotto, on the road to Trieste, was recently explored, when discovery was made of two other grottoes and a number of corridors communicating with the principal grotto.

THE oft-proposed tunnel under the Forth is again being discussed as a way for the Caledonian Railway Company to counterbalance the advantages gained by the companies controlling the Forth Bridge.

## ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

### HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Oct. 22, and unacknowledged elsewhere:—

CASSELL AND CO., Ltd.—R. J. Urquhart.—H. S. M.—Compound.—F. G. S.—E. T. B.—Bor.—Photo-printer. —B.Sc. Lond.—E. P., Liverpool.—J. Woodcock.—Charlton.—A. O. F.—A Fellow of the Royal Astronomical Society.—C. E. Stretton.—S. P.—J. R.—S. E.—H. C. Trimmell.—M. Walton Brown.—A Canadian Reader.—Cave Diamond.—W. Hastie.—Jack of All Trades.—Cymry.—F. A. M.—R. Taylor.

R. A. LAWSON. (Will you send us your present address? as we have a communication in reference to your note on a sunspot which we illustrated Sept. 19, last.)—GEORGE. (See the advertisement of Bailey's motors last week, and the indices of back volumes; but before any definite information can be given, you must say what pressure of water is available, and what is the cost of the supply.)—H. H. H. (The tube must be thoroughly cleaned, preferably with nitric acid; then the mercury is placed in the open end, which is closed with the finger, and the contents shaken over into the long leg. The tube is warmed from time to time to drive out air. It is not an operation to be performed at the first attempt, and unless you are determined to succeed, better hand it over to a professional.)—JAMES ELLIS. (The numbers are out of print—that is why we referred you to the volumes. All articles of that kind soon exhaust the large number of copies printed; but in nearly every volume you will find something about specula grinding, and may possibly in this number.) —J. R. SCANLEN. (No room at present, unless you can put it without so large a diagram, or, better still, without a diagram at all, for it is a mere examination question.)—J. H. B. (Have you tried the experiment with a clean kettle of tinplate or copper? The reason a kettle of boiling water can be held on the hand for a second or so is because there is a film of steam between the water and the metal, and also because the soot is a non-conductor of heat. But try the experiment.)—EBOR. (We think Messrs. Lancaster and Son, Colmore-row, Birmingham, give the sizes of lenses in a little sheet or pamphlet they publish; but you know, we presume, that an achromatic o.g. even of so small a size would be rather costly.)—SENSITAS. (Why not ask those who supply photographic materials—say some of our advertisers? They are amongst the largest firms.)—WHITE STAR. (New York is 4h. 56m. behind Greenwich time, and Queenstown 33m. behind. Knowing the longitude of any given places, it is easy to calculate the difference. Ship's time is Greenwich time practically amongst all navigators except the French.) —J. JONES. (A five candle-power might suit. Use a chromic-acid battery. See, however, many replies on the subject in back numbers. It is a rather expensive light.)—PENDULUM. (Scarcely understand you. Could print from copperplate only by engraving the lines, which would offer too much resistance. Might possibly be done by lithography. How many copies would be wanted, as possibly one of the copying apparatus might do?)—G. F. Y. (Address the secretary of the society named, Edinburgh. 2. Try Mr. Wesley, Essex-street, Strand, W.C.)—W. R. (Watt's "Art of Soapmaking," Crosby Lockwood and Son, Stationers' Hall-court, E.C., or Freeland's "Soapmaker's Private Manual," Trübner; but the latter is an expensive work. The last named publish also Dussance's manual.)—GANGER. (Do you mean tables, or what? Donaldson's "Platelayer's Tables," or his "Railway Switches and Crossings," E. and F. N. Spon, 125, Strand, W.C., may suit. You should go to the Patent Office Library, and see which work is most adapted to your wants.)—G. A. B. (Is there not sufficient in back numbers about fretwork? But all you have to do is to paste some patterns on the prepared wood, and cut out to the lines with a fret-saw. We have a useful one, which cost the large sum of one penny, and was sold by a street hawker; but any of our advertisers who deal in tools will supply you with a proper frame and a selection of saws for a moderate price, or, if you like, a treadle machine can be obtained for what is certainly not a very large sum.)—A. READER, Bolton. (All the numbers (16) in Vol. XLIX. containing articles on the Model Locomotive can be had, price 3s. The first article appeared in Vol. XLVIII., but that is out of print. It was only introductory, however.)—W. GOODACRE, Highgate. (Some of the papers are issued separately, and those that are so issued can be had from the secretary of the British Association, 22, Albemarle-street, W.)—W. E. MATTHEWS. (Please see the indices to back volumes. Of course steam is admitted at both ends of the cylinder.)—R. M. (The Royal Victoria Hall is in the Waterloo Bridge-road, S.E. (sufficient address), and Miss Cons is the hon. sec.)—SURVEYOR. ("C.E." is not a "title," and there is no examination or test of fitness. Anyone can put C.E. after his name and call himself consulting engineer; but he must not put M.I.C.E., or even Stud.Inst.C.E., unless he really is so. Entrance to the Institute can be obtained only by those who are properly articled, or have been articled, to the profession of civil engineers. The question has been frequently answered.)—J. BIRD. (Do you not understand that as the astronomical textbooks do not mention the point, the question has not been settled. The stars move in various directions.)—IGNORAMUS. (We cannot help you. The recipe for anointing the hands so that they can hold red-hot iron seems to be a "sell," and that is why you cannot obtain the "hematis.")—SAML. BROUGHTON. (Too full just now to raise discussion on the matter.)—AN OLD READER. (You must describe your machine and give dimensions, or communicate with Mr. Bottone direct. We have said repeatedly lately we cannot engrave machines of all sorts and sizes merely to ask how to complete them.) —J. B. (The case is simply one of ordinary stammering, for which remedies have been repeatedly suggested in back volumes, to which we must refer you.)—C. S. (Not at all unusual: you should read the "Story of the Heavens," reviewed a fortnight since, a very good astronomical textbook. You will there find all about the nature and origin of meteors and shooting stars.)—E. R. DALE. (We cannot make head or tail of the sketch sent.)—DRAINS. (Not of much good. A little permanganate of potash dissolved in a bucket of water is the best disinfectant.)—E. M. RICHARDS. (We have had enough for the time being of Joshua and his clerical and other friends.)

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**A Little Book** of considerable interest to invalids and sufferers is published (gratis) by the Medical Battery Company, Limited, 52, Oxford-street, London, W. It is carefully compiled, and contains much valuable information on "The Remarkable Curative Action of Electricity," with a special chapter on Harness' genuine Electropathic Belt Appliances. Those who cannot call should write at once to the above address before they forget it. A copy, with book of testimonials, will be sent post free on application.

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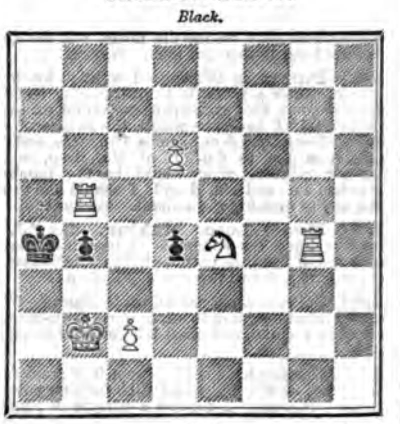
## CHESS.

ALL communications for this department must be addressed to "J. PIERCE, Knollside, Yawl, Lyme Regis, Dorset."

### PROBLEM MCCXXV.

*Black.*



*White.* [6 + 3

White to play and mate in two moves.

SOLUTION TO 1223.

| *White.* | *Black.* |
|---|---|
| 1. Q-Kt 7. | 1. Any. |
| 2. Mates. | |

Also 1. B-Q 7.

### NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1223 by W. L. Martin (2), F. W. N. Lambert (2), E. H. Ryan (author's), W. Sanger (second solution), A. A. (ditto), T. Fellows (ditto), [illegible] (ditto), Jill (ditto), Jack (ditto), W. Gleave (2), T. H. Billington (2), J. Kistruck (2), C. P. P. (2), A. Fellows (author's), Zeno (ditto), M. Kelly (ditto), Fr. Fernando (ditto), W. A. Clark (2); to 1222 by J. H. Rogers, White Knight, F. W. N. Lambert, and W. A. Clark.

LINK.—Yes, one fee covers both.

F. W. N. LAMBERT.—You can send it to the winner when the Tourney is concluded.

P. H. WILLIAMS.—Many thanks for the problem. We shall not be able to use it, however, until the Tourney is concluded.

W. J. GREENSTREET.—You have given, in your solution to 1223, B-Q 2: it should be B-Q 7.

A. BOLUS draws attention to the great similarity between 1222 and the following problem by W. A. Shinkman which appeared in the *Illustrated London News*, Aug. 29th, 1885. White: K-K B 7, Q-K R 5, B-K R sq, Kt-K Kt 2, Q-Kt 6, P-Q 2. Black: K-K 5, Ps-Q 5, and K B 3. White to play and mate in two moves.

MR. AND MRS. T. B. ROWLAND, 10, Victoria-terrace, Dublin, the editors of the "Chess Player's Annual and Club Directory for 1891," invite the following particulars of chess clubs:—Town, club name, year established, place of meeting, days, hours, number of members, annual subscription, laws, president, hon. secretary's name and address. Printed forms will be had on application. The work will be a ready book of reference on almost all subjects of interest to chess-players, and will be published by the authors; price 2s. 6d.

UNION NEW

English Mechanic
ORLD OF SCIENCE AND ART.
RIDAY, OCTOBER 31, 1890.

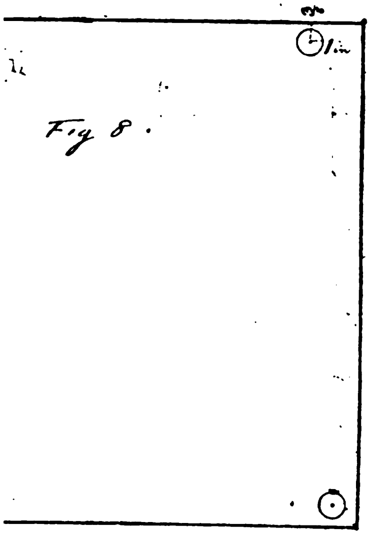
# TO CONSTRUCT A QUARTER CHIMING CLOCK.—II.

### 1.—The Frame.

frame consists of two brass plates, n. by 8in., and $\frac{3}{16}$in. thick. One of e back plate, has four pillars fixed the corners, which support the front

epare these, proceed as follows:— pieces of good hard sheet-brass of size, and rather over $\frac{3}{16}$in. thick to true surfacing. Hammer them out file as true as possible, using a edge. If they cannot be made quite his means, true them up with a steel or grind down with emery powder on polisher. When quite flat, square s and angles nicely, taking off the sharpness with a file. The best way e up the plates is to clamp both gether in the vice between two pieces

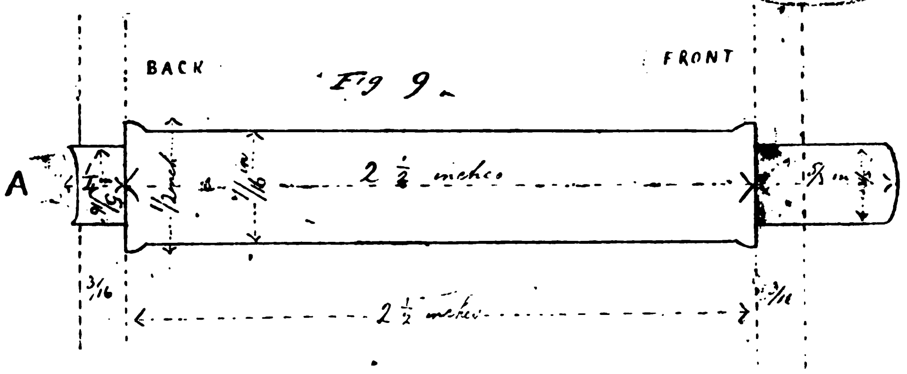
eeping them firmly clamped together, of the corners, $\frac{5}{8}$in. from the edge y, mark centres of holes for pillars. th hole is $\frac{5}{8}$in. from the top edge, from the side. Drill these holes



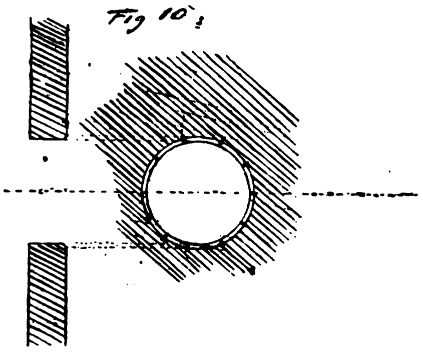
out carefully to $\frac{5}{16}$in. diam., right both plates. (See Fig. 8).

llars are made from $\frac{1}{2}$in. brass rod, ns, &c., as in Fig. 9. Great care taken to turn the shoulders fitting in e quite true and square. The ends eted into back plate, so should be t 1-16in. longer than thickness of d turned slightly hollow at the ends te riveting. The holes in back plate tly countersunk, and star cut on the o give the pillars a firm hold when p, as shown in Fig. 10.

rigidity of the whole clock depends pillars, the riveting must be ly sound. To avoid injuring pillars eting, fix them in vice close up to ders between pieces of wood. When have been done, file the backs off the plate, when the joins should be isible. If the pillars have been rue, and all the same length, and been injured in riveting, the top uld now drop on easily, but without shake, and rest equally on all four. must now be drilled through the g ends of the pillars, flush with the ce of front plate. Steel pins are inserted in these holes to keep the plate firmly in position.

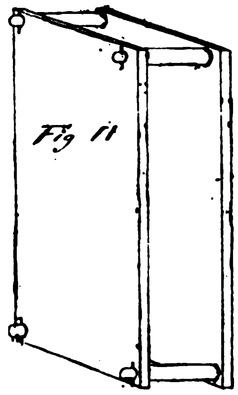


The frame should now present the appearance shown in Fig. 11. It will be noticed that the pillar set one inch from the side is in the right-hand top corner. Having now made the frame, the "going" train will be next proceeded with.



### 2.—The Barrel.

This should be made as deep as the frame will allow, and will accordingly be made 2in. outside measurement. It consists of a brass drum, mounted upon a steel axle (the barrel-arbor) upon which it revolves freely, and is made as follows:—Take a strip of sheet-brass, 2in. wide, 7½in. long, and ⅛in. thick, bend it round a wooden roller, and file edges that meet, quite true, adjust them till light cannot be seen between, then braze with spelter or silver solder. The latter is safer, as it runs rather easier than ordinary spelter, and as no great quantity need be used, the expense is not much. Hammer it over a piece of bar iron, both to true it up and to harden it again after heating. Then file the joint off smooth inside, and mount tight upon a wooden spindle turned to fit it; fix in the lathe, and turn up true on surface and edges. It should now be 2½in. in diameter, the hammer hardening having stretched it slightly.



If preferred, the barrel can be made at once from 2½in. solid brass tube, which can be bought at most metal warehouses, and only requires cutting to the requisite length. The bottom of the barrel must be made of good hard brass, and turned to fit groove in barrel, as shown in Fig. 12, then soft-soldered in.

The cover is turned in same manner as the bottom; but the edge is slightly bevelled off, as shown. The groove in barrel is also slightly bevelled, just sufficient to make the cover snap in tight. A semi-circular piece, of about ¼in. radius, is cut out of barrel cover, so that it may be prised off when required without injury. If the cover and bottom be carefully turned, the barrel will now run true when mounted on a spindle in the lathe.

The barrel-arbor can now be made. Rough forgings of these can be obtained for a few pence, which greatly reduce the labour. But, if preferred, of course, it can be turned out of the solid steel. [I may here say that these barrel-arbors, as well as any other rough part, or parts, mentioned in these articles, may be obtained through a local clockmaker, or from the dealers in clock materials in London, or see advertisement in front page of this issue and following.] The arbor must fit holes in cover and bottom without shake; but at the same time turn quite freely. It must, however, have a little "end-shake" between the bottom and cover. The end A must be squared to receive the ratchet outside front plate. The relative size and position of hook is shown in Fig. 13.

The barrel-arbor can be turned soft, then hardened and tempered to a blue. The shoulders upon which the barrel revolves, and those which pass through the plates, must be polished. If high finish throughout the clock is aimed at, the entire arbor should be polished.

The method of polishing is as under, and is done whilst still running in the lathe. Make a soft steel polisher of shape and section shown in Fig. 14. The side A must have a rather fine grain put upon it by a file in the direction of the lines in the figure. Charge this polisher with oilstone-dust and oil worked into a paste, and use as a file. When quite smooth, take another precisely similar polisher charged with "red stuff" and oil, and use in the same manner, frequently cleaning the polisher, putting on a fresh grain with the file, and recharging. This last will give it a high polish. Be careful to keep the oilstone-dust and "red stuff" polishers quite distinct from each other. This method will do for all pivots and shoulders. The flat surfaces of the square, &c., are polished by moving them about over a flat piece of steel or bell-metal, charged the same as the polishers before mentioned. This polishing will require some practice and a great deal of patience. The barrel is now complete, with the exception of fitting the mainspring.

The mainspring should be as wide as the barrel will allow, of medium strength, and of such a length that it will allow about one turn more in the barrel than is required

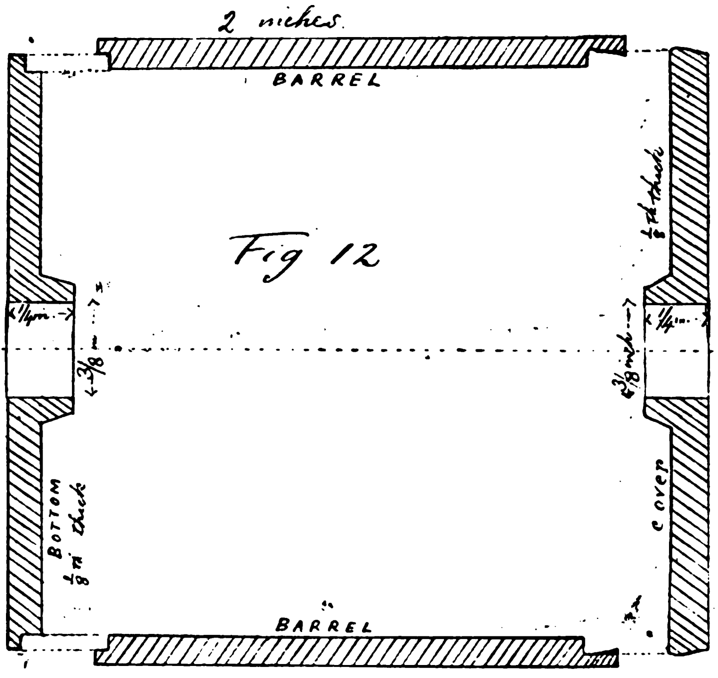


Fig 12

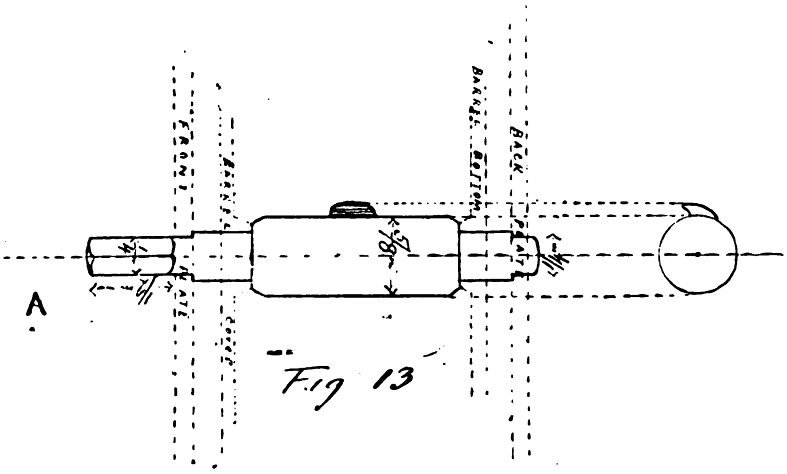


Fig 13

in winding the clock. When finished, the barrel had best be sent to a clock material dealer, and the selection of a spring left to him. The inside eye of spring is hooked on to the barrel arbor, as shown in Fig. 13. The outer end is hooked on to a stud fixed in the barrel, as shown in Fig. 15. This should be of steel, about a ⅛in. thick, screwed into the barrel from the outside, and riveted in tight, the inside edge being turned over by hammering on beak of anvil or something similar. Fig. 15 shows barrel with cover removed.

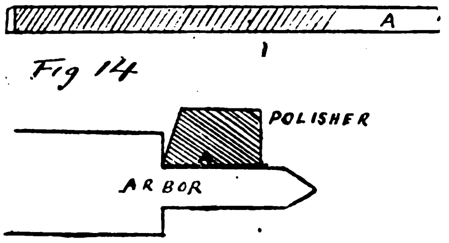


Fig 14

When the spring is fitted, and the barrel-arbor finished off and polished, the entire barrel can be put aside till all the going train is completed. Till then no holes must be drilled in the plates.

The endshake of barrel-arbor and all other pinions and arbors can be measured by placing the shoulders of the pivots upon the edges of the plates when they are pinned tightly together. All arbors *must have perceptible endshake* between the plates.

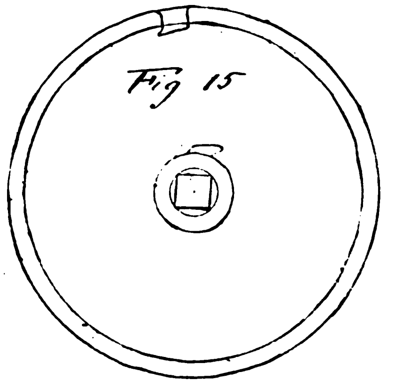


Fig 15

# GAS ANALYSIS APPARATUS.

By J. Jas. Morgan, F.C.S.

Figs. 1, 2, and 3 represent a simple apparatus arranged by Mr. Jno. Parry, F.C.S., for analysing Blast-furnace, Producer, Boiler-flue, and other gases.

The apparatus consists of:—

1. A measuring tube, A, of 200 cubic centimètres capacity, graduated in $\frac{1}{10}$th c.c., contained in a glass cylinder B, which serves a jacket. The lower end of A passes cork in the bottom of B.

2. A capillary tube, K, bent twice at ri and provided with a stopcock E. (

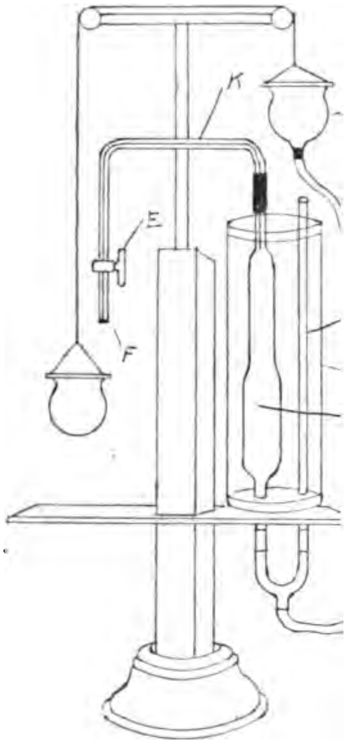


FIG 1

the tube is connected with the upper e measuring tube A.

3. A tube, C, which, like A, passes thi cork of, and is contained in, B. Th and C are connected with the glass b means of a Y-tube and indiarubber tubi

4. Absorption apparatus, Fig. 2. Thi

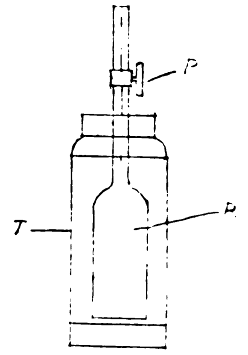


FIG 2

of a cylinder funnel, R, of about 200 cul mètres capacity (the stem of which is bore, and provided with a stopcock P), in a wide-mouthed bottle T.

To fill R with the absorption reage with the solution, open stopcock P ar suck up the liquid until it rises in the ste close P. The bottle T must still contain of the absorption solution to allow of immersed in it to at least a depth of an i

To use the apparatus, fill the cylinde water, pour water into D until A and C and apply suction at F until the wat when close E. Close the open end o a cork, lower D, connect F, by means rubber tubing, with the apparatus fro the sample of gas is to be taken, and re stopcock E, by which means the ga drawn over into the measuring-tube indiarubber tube connecting F with the a containing the sample, or the absorpti ratus, must be filled with water to pre entrance of air into the measuring-tube. the requisite volume of gas has been dra

, disconnect the apparatus containing the ng portion of the sample, uncork C, and :ho water levels in A and C by lowering ıg D as required, and having accomplished ote the volume occupied by the gas, corrections for temperature and pressure ate results are desired.

ıss the gas into the absorption apparatus, n of the cylinder funnel R, which has lled with the absorption reagent in the before described, is connected by means rubber tubing with F, the open end of l with a cork, D raised, and the stopcocks ? opened. When the whole of the gas ısed over into A (as determined by the oming past E) close P. To return the he measuring tube, lower D, release P, en the absorption liquid reaches to near E and disconnect the absorption apparatus. els in A and C are then adjusted in the already described, and the decrease in ıme of the gas, if any, noted.

ıdvisable to place a mark on the outside ube K, a little below the stopcock E, so water, in sending over the gas into the ion apparatus, and the absorption re- vhen returning the gas to the measuring- ay be always taken to the same point

3 represents the apparatus employed in

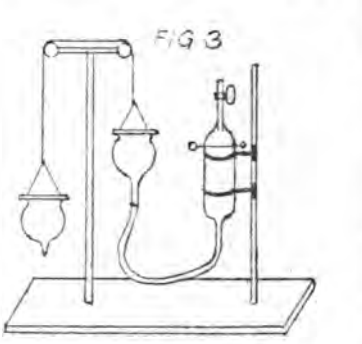


FIG 3

ırmination of the Hydrogen by explosion. )losion tube is simply a stopcocked pipette two platinum wires fused in near the top.

## W BOOKS ARE BOUND.—X.

By "PRACTICAL BOOKBINDER."

)ING the edges of books is a very nportant operation, requiring great care ery great deal of experience to produce a :ory result. I may give the description process in a very few words, and the bookbinder may, after he has read it, himself that he will easily accomplish it is not quite so very easy as it seems. workshops gilding is really a trade by specially in those larger shops, where a ıantity of gilding is done. Men are kept for this purpose; and, indeed, it is quite y, for there are a great many binders ıld not for their very life gild the edge of although they may have seen it done er time.

ıecessary tools are but few, and comprise n (Fig. 26) on which to spread the gold

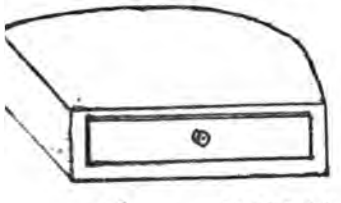


Fig XXVI

n it is desired to cut it; a gold-knife, s simply a painter's pallet-knife or an dinner-knife; an open dish for size, a jam-pot or wide-mouthed pickle-bottle; mel-hair brush; a few squares of hard uch as note-paper or hand-made account- per; some bole and blacklead, a hard shoe-brush, a number of burnishers and steel scrapers. The burnishers are the principal things, and are jealously guarded by the gilder; for if by any chance they get scratched, when he comes to use them upon a book-edge it will be spoiled, and will have to be scraped off—a thing that, besides costing time, he looks upon as a kind of a disgrace. A good gilder scorns to do his work twice over. These burnishers (Fig. 27) are

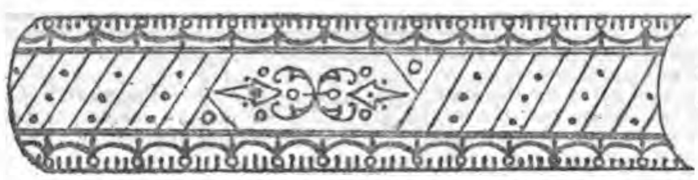


Fig XXX

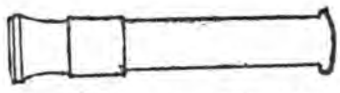


Fig XXVII

simply flat stones mounted in a brass ferrule having a wooden handle. Some gilders prefer one kind of stone, while others are partial to something else; but the kinds most commonly in use are Scotch pebble, agate, blood-stone, and iron-stone. The iron-stone is generally kept for finishing up, while the others are only used for rubbing down and the first burnishing. The scrapers are pieces of sheet steel of different shapes (Fig. 28); old saw blades make excellent

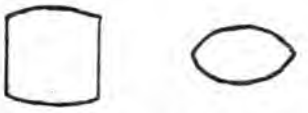


Fig XXVIII

scrapers. There is no hard and fast rule as to the number of those tools required for this work. I have seen gilders who, proud of their work and their tools, have had quite a dozen of burnishers, and scrapers innumerable, while others seem to get on well enough with a solitary one. If the amateur provides himself with a pebble or agate and an iron-stone, he will do very well.

As soon as the edges of books have been cut, they are ready for the gilder. They may be flat, or have been rounded, with the boards laced in; this is generally the case with the better class of books; but common books, or those that have to be bound cheaply, are generally cut round with the cutting machine, and are handed over to the gilder flat. Whatever be the state in which he gets them, he proceeds by flattening or knocking up the foredge on the end of his press, the flatter and evener he can get the edge, the better for himself. He places the book or books between a pair of gilding-boards, which are much the same as the backing-boards referred to already; he places them carefully into his lying press, and screws them up as tight as possible. If there are any irregularities upon the edge—which may sometimes be the case—he pares them off with a sharp knife, and having sharpened his scraper, he scrapes the entire edge until it is as smooth as glass. He now takes up his lump of bole, which is a friable, clayey substance, tinged with peroxide of iron, and his square of blacklead, and having scraped off a little of each, he wets a sponge, and taking up the blacklead and bole he rubs it over the edge, and with the shoe-brush he polishes it bright. And when this is done, he carefully measures in his mind's eye how much gold leaf he will require. Having satisfied himself, he takes it out of the book with the knife and spreads it upon the cushion, and for each leaf or part of a leaf he takes a square of paper, and, passing it over his hair, he presses it gently upon the gold leaf: by this means he can lift it from the cushion and lay it aside. When he has sufficient gold lifted in this manner to cover the entire edge, he gets his size-dish and brush (the size is made from the white of eggs, one part to three parts of water), and lifting as much as possible with the brush, he draws it quickly over the edge, and taking up one of the squares of paper with the gold leaf clinging to it, he gently lays the gold upon edge, withdrawing the paper. Leaf after leaf is placed in the same manner, and care must be taken not to shake or make cracks, as gold leaf is very easily destroyed by careless handling.

This has now to be left to dry, and the professional gilder has to look out for something else to do in the mean time. He generally fills another press, and by the time he gets the second as far on as the first, the first will be ready for the next operation, which is called rubbing down. To do this, he takes one of his commoner burnishers and a sheet of paper. He lays the paper down upon the edge, and burnishes the edge over on the top of the paper. If there have been any cracks in the gold during the laying-on process, he proceeds to mend them at this stage. He takes a little bit of gold, and, breathing strongly over the crack, he lays on the gold and rubs it down with his burnisher. After having again left it for some time, to insure it being dry

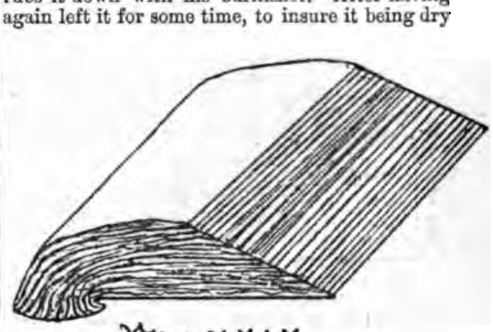


Fig XXIX

(the drying process, which takes a long time, is often hastened by the employment of hot plates of iron), he proceeds to burnish it this time without anything between the burnisher and the edge. Burnishing must be done very carefully, working across the edge from side to side. A great pressure, which must be evenly exerted, is necessary to produce the desired effect. The edge, when finished, must be very clear and bright, without a mark or scratch of any kind.

This is a description of the edge-gilding process, and I have taken pains to make it plain as possible, so that whoever reads may understand. I have often been asked for an easy method of gilding edges. There is no other method than that described. You may dust on bronze powder or paint with Judson's gold paint, if you choose so to do; but you will not have a gilded edge, no matter how carefully you may work, and how much you may desire to produce the effect by this means. Still, there is nothing to hinder the amateur binder from trying to do this part of the work himself. If he has time, money, and patience, he will succeed, as others have done, for I have seen books gilded by amateurs which were very creditable indeed.

There is a nice improvement upon gilt edges, which goes by the name of "red under gold," very much resorted to for the finer class of books. The edges are reddened before being gilded, but instead of reddening when the books are closed, the leaves are spread out a little (Fig. 29), so that the colour gets into the leaf, just a little way however—the edge of the edge, so to speak. After reddening they are scraped and gilded as usual; the red only shows when the book is opened. This style is adopted by Bible publishers very largely, and when carefully done it looks very nice.

Another improvement which is found upon antique bindings, and greatly used upon large and costly bindings at the present day, is what is termed tooled edges. In some cases the edge is tooled over after having been burnished with warm tools, a chaste design being wrought out with the tools (Fig. 30). In other cases different colours of gold are used, and when this is done the effect is perfectly gorgeous. To accomplish this the edge is first gilded with a pale shade of gold, say lemon gold, and the design is then wrought with the tools, and where the other shades of gold are wanted to appear, these parts are again sized, using a camel-hair pencil and sizing the design only, carefully, so as not to dim the other parts. After the size has become perfectly dry, the other gold is laid on and pressed firmly into the design with a piece of cotton wool; it is then gone over again with the tools, which must be hot. This causes the gold to adhere in the proper places, and when finished the surplus gold is wiped off. This really makes a handsome edge.

Gilding upon marble edges is also very fine, but it is not much done nowadays. Painting landscapes upon edges before gilding has been done in by-gone days, and although I have never seen this, I fancy it would look very nice. But we have to be content with less in these cheap times. However, it is well to know these things, and I can easily fancy the amateur, who cares nothing for time or money while in pursuit of his hobby, not only trying, but becoming quite expert in these dodges, and making his work look handsome indeed.

There are many other methods of treating book edges; but these are the principal which I have mentioned, the others may suggest themselves.

If anything special arises, I may make reference to it again.

## ASTRONOMICAL NOTES FOR NOVEMBER, 1890.

### The Sun.

| Day of Month. | Souths. | At Greenwich Mean Noon. | | |
|---|---|---|---|---|
| | | Right Ascension. | Declination South. | Sidereal Time. |
| | h. m. s. | h. m. s. | ° ′ ″ | h. m. s. |
| 1 | 11 43 40·05 A.M. | 14 26 34 | 14 31 1 | 14 42 53·99 |
| 6 | 11 43 43·88 ,, | 14 46 21 | 16 3 54 | 15 2 36·77 |
| 11 | 11 44 8 94 ,, | 15 6 29 | 17 30 6 | 15 22 19·55 |
| 16 | 11 44 55·34 ,, | 15 26 58 | 18 48 46 | 15 42 2·33 |
| 21 | 11 46 2·26 ,, | 15 47 48 | 19 59 3 | 16 1 45·11 |
| 26 | 11 47 28·69 ,, | 16 8 57 | 21 0 9 | 16 21 27·90 |

The method of finding the Sidereal Time at Mean Noon at any other station is explained on p. 353 of Vol. L.

Spots may be looked for whenever the Sun is visible, as solar activity is being now definitely re-established.

### The Moon

enters her Last Quarter at 4h. 13·1m. p.m. on the 4th, and is New at 1h. 37·6m. in the afternoon of the 12th. She will enter her First Quarter at 44·6m. after noon on the 19th, and be Full on the 26th at 1h. 22·8m. p.m.

| Day of Month. | Moon's Age at Noon. | Souths. |
|---|---|---|
| | Days. | h. m. |
| 1 | 18·5 | 3 15·9 a.m. |
| 6 | 23·5 | 7 20·0 ,, |
| 11 | 28·5 | 10 54·9 ,, |
| 16 | 3·9 | 3 29·7 p.m. |
| 21 | 8·9 | 8 4·2 ,, |
| 26 | 13·9 | *12 10·9 a.m. |

* Early morning of 27th.

The Moon will be in conjunction with Saturn (3° 46′ N. of him) at 7h. a.m. on the 7th; with Mercury at the same hour on the 11th (Mercury 2° 21′ S.); with Venus at 5h. p.m. on the 14th (Venus 4° 2′ S.); with Jupiter at midnight on the 17th (Jupiter 3° 25′ N.); and with Mars at 4h. a.m. on the 18th (Mars 2° 39′ N.)

At noon on November 1st the Moon is in Gemini, whence she passes into Cancer at 5h. 3·0m. a.m. on the 3rd, leaving Cancer in turn for Leo at 10h. p.m. on the 4th. She is travelling through Leo until 10h. p.m. on the 7th, at which hour she enters Virgo. She does not leave this last-named constellation until 11h. a.m. on the 11th, when she quits it for Libra. Having crossed Libra, she arrives at 7h. 30m. a.m. on the 13th at the Western edge of the Northern spike of Scorpio, and by 6 o'clock the same evening she has passed over this and come out in Ophiuchus. She leaves Ophiuchus on the 15th at 4h. a.m. for Sagittarius, and is in Sagittarius until 1h. p.m. on the 17th. She then quits it for Capricornus, as she does Capricornus in turn for Aquarius at 6h. 30m. a.m. on the 19th. At 9h. a.m. on the 21st her journey through Aquarius terminates, and she passes into Pisces. As she traverses Pisces, she arrives, at 10 o'clock on the night of the 21st, on the boundary of a part of Cetus, which she enters. She comes out again in Pisces at 1h. a.m. on the 23rd; but only to re-enter Cetus at 10h. 30m. p.m. on the 23rd. When she finally passes out of Cetus at 7h. a.m. on the 24th, it is to emerge in Aries. She remains in Aries until 2h. p.m. on the 25th, and then crosses into Taurus. It takes her until noon on the 28th to complete her journey through Taurus; and then, entering Gemini, she remains in the last-named constellation until 2h. p.m. on the 30th. She then passes into Cancer, where we, of course, leave her.

**Occultations of (and Near Approaches to) Fixed Stars by the Moon.**

| Day of Month. | Star's Name. | Magnitude. | Disappearance. | Moon's Limb. | Angle from N. Point. | Angle from Vertex. | Reappearance. | Moon's Limb. | Angle from N. Point. | Angle from Vertex. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | h. m. | | ° | ° | h. m. | | ° | ° |
| 1 | 5 Geminorum | 6 | 6 59 a.m. | Bright | 76 | 35 | 8 4 a.m. | Dark | 288 | 244 |
| 6 | 42 Leonis | 6 | 3 2 ,, | Bright | 160 | 200 | 3 46 ,, | Dark | 236 | 273 |
| 14 | 39 Ophiuchi | 6 | 4 33 p.m. | Dark | 68 | 42 | ‡5 34 p.m. | Bright | 303 | 271 |
| 14 | B.A.C. 5831 | 6 | †5 3 ,, | N by E | 6 | 337 | | | | |
| 18 | 33 Capricorni | 5½ | 4 42 ,, | Dark | 25 | 32 | 5 35 ,, | Bright | 295 | 294 |
| 21 | 33 Piscium | 5 | †3 43 ,, | N N W | 334 | 9 | | | | |
| 21 | B.A.C. 17 | 6 | 5 59 ,, | Dark | 34 | 55 | 7 5 ,, | Bright | 262 | 272 |
| 22 | 26 Ceti | 6½ | †8 22 ,, | NWbyN | 326 | 332 | | | | |
| 22 | 29 Ceti | 6½ | 11 0 ,, | Dark | 340 | 317 | 11 15 ,, | Bright | 315 | 290 |
| 23 | 35 Ceti | 6½ | 1 6 a.m. | Dark | 39 | 3 | 2 2 a.m. | Bright | 266 | 228 |
| 24 | 38 Arietis | 5 | †7 25 p.m. | NWbyN | 330 | 4 | | | | |
| 29 | B.A.C. 2154 | 6½ | 2 37 a.m. | Bright | 135 | 122 | 3 34 ,, | Dark | 225 | 197 |
| 30 | B.A.C. 2514 | 6½ | 6 27 ,, | Bright | 73 | 32 | 7 25 ,, | Dark | 312 | 269 |

†Near approach to. ‡The Moon has set.
An illustrated explanation of the above Table will be found on p. 353 of Vol. L.

**Jupiter's Satellites.**

| Day of Month. | Satellite. | Phenomenon. | H. | M. | S. | Day of Month. | Satellite. | Phenomenon. | H. | M. | S. | Day of Month. | Satellite. | Phenomenon. | H. | M. | S. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | *II* | *Oc D* | 5 | 10 | P.M. | 10 | *II* | *Sh E* | 8 | 28 | P.M. | 20 | I | Tr E | 6 | 3 | P.M. |
| 2 | III | Oc D | 8 | 1 | ,, | 11 | I | Tr I | 7 | 14 | ,, | 20 | III | Tr I | 6 | 24 | ,, |
| 3 | II | Sh E | 5 | 52 | ,, | 11 | *I* | *Sh I* | 8 | 32 | ,, | 20 | I | Sh E | 7 | 17 | ,, |
| 3 | I | Oc D | 8 | 7 | ,, | 12 | *I* | *Oc D* | 4 | 34 | ,, | 21 | *I* | *Ec R* | 4 | 32 | 52,, |
| 4 | I | Tr I | 5 | 17 | ,, | 12 | I | Ec R | 8 | 8 | 48,, | 22 | *IV* | *Sh I* | 8 | 16 | ,, |
| 4 | I | Sh I | 6 | 36 | ,, | 13 | I | Sh E | 5 | 21 | ,, | 24 | III | Ec R | 5 | 4 | 40,, |
| 4 | I | Tr E | 7 | 37 | ,, | 13 | III | Tr E | 5 | 52 | ,, | 24 | *II* | *Tr I* | 8 | 17 | ,, |
| 4 | *I* | *Sh E* | 8 | 56 | ,, | 13 | III | Sh I | 7 | 21 | ,, | 26 | *II* | *Ec R* | 7 | 59 | 4,, |
| 5 | I | Ec R | 6 | 13 | 31,, | 17 | II | Tr I | 5 | 35 | ,, | 26 | *I* | *Oc D* | 8 | 30 | ,, |
| 5 | IV | Tr E | 6 | 39 | ,, | 17 | *II* | *Sh I* | 8 | 8 | ,, | 27 | I | Tr I | 5 | 42 | ,, |
| 6 | III | Sh E | 7 | 3 | ,, | 17 | *II* | *Tr E* | 8 | 30 | ,, | 27 | I | Sh I | 6 | 52 | ,, |
| 8 | II | Oc D | 7 | 51 | ,, | 19 | II | Ec R | 5 | 20 | 45,, | 27 | *I* | *Tr E* | 8 | 2 | ,, |
| 10 | II | Sh I | 5 | 32 | ,, | 19 | I | Oc D | 6 | 32 | ,, | 28 | I | Ec R | 6 | 28 | 3,, |
| 10 | II | Tr E | 5 | 49 | ,, | 20 | *I* | *Sh I* | 4 | 56 | ,, | 30 | IV | Oc D | 5 | 35 | ,, |

Ec, Eclipse; Oc, Occultation; Tr, Transit of Satellite; Sh, Transit of Shadow; D, Disappearance; R, Reappearance; I, Ingress; E, Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight, or by Jupiter's proximity to the horizon.

There will be

### A Partial Eclipse of the Moon

on the 26th; but as the middle of the eclipse will happen at 1h. 33·9 p.m., and the Moon does not rise in London until 4·4 p.m., it will be wholly invisible in this country.

### Mercury

Is a Morning Star, in the sense of Southing after the Sun, during the first three weeks of November, but comes into superior conjunction with the sun at 4h. a.m. on the 17th, and at the end of the month Souths after noon. His proximity to the sun, and rapidly increasing south declination are greatly against the observer; in fact, it is only during the earlier part of the month that any reasonable expectation may be entertained of seeing the planet at all. The diameter of his disc subtends an angle of 5″ only on the 1st, and even this dwindles to 4·6″ by the 30th.

| Day of Month. | Right Ascension. | Declination | Souths. |
|---|---|---|---|
| | h. m. | ° ′ | h. m. |
| 1 | 13 51·1 | 9 55·2 | 11 8·3 a.m. |
| 6 | 14 22·0 | 13 11·8 | 11 19·5 ,, |
| 11 | 14 53·3 | 16 13·7 | 11 31·1 ,, |
| 16 | 15 25·1 | 18 56·0 | 11 43·1 ,, |
| 21 | 15 50·9 | 20 49·2 | 11 55·7 ,, |
| 26 | 16 30·3 | 23 7·7 | 0 8·9 p.m. |

Starting thus from a barren part of Virgo, Mercury will cross Libra and Scorpio, and will be found at the end of the month in Ophiuchus. He will not approach any conspicuous star sufficiently nearly to be in the lowest power field of a telescope with it. He will be in conjunction with Venus (10′ N. of her) at 7 p.m. on the 29th.

### Saturn

does not even rise until after 1h. 30m. a.m. on the 1st, and a few minutes after midnight at the end of November, so that we shall defer our ephemeris of him until next month; and

### Uranus

will be invisible for the purposes of the ordi observer until 1891.

### Venus

Has such tremendous South Declination (es ally at the beginning of the month) as to re the chance of seeing her very problematic deed. If caught at all in the telescope, presents an exquisite thin crescent, wit angular diameter increasing from 42·4″ o

′ 2·3″ at the end of November. She after the Sun throughout the month.

| Right Ascension. | | Declination South. | | Souths. | | |
|---|---|---|---|---|---|---|
| h. | m. | ° | ′ | h. | m. | |
| 17 | 1·3 | 27 | 59·5 | 2 | 18·0 | p.m. |
| 17 | 9·0 | 28 | 0·8 | 2 | 6·0 | ,, |
| 17 | 13·0 | 27 | 46·6 | 1 | 50·4 | ,, |
| 17 | 12·9 | 27 | 15·1 | 1 | 30·6 | ,, |
| 17 | 8·3 | 26 | 24·3 | 1 | 6·4 | ,, |
| 16 | 59·7 | 25 | 13·0 | 0 | 38·2 | ,, |

pendulum-like path lies in the confines of and Ophiuchus in that comparatively gion to the S.E. of Antares. The con- of Venus with Mercury on the 29th has erred to above under the heading of the ned planet.

### Mars

ble.

### Jupiter

o rapidly approaching the West that he looked at immediately it is dusk to be n moderately well. He sets before 10 p.m. st., and before 8.30 p.m. on the 30th, n his considerable South Declination is, e, practically unobservable at any great from the meridian. His angular equa- ameter diminishes from 36·6″ on the 1st, on the 30th.

| Right Ascension. | | Declination South. | | Souths. | | |
|---|---|---|---|---|---|---|
| h. | m. | ° | ′ | h. | m. | |
| 20 | 26.9 | 19 | 58·3 | 5 | 43·1 | p.m. |
| 20 | 29·2 | 19 | 50·0 | 5 | 25·7 | ,, |
| 20 | 31·8 | 19 | 40·7 | 5 | 8·6 | ,, |
| 20 | 34·6 | 19 | 30·3 | 4 | 51·8 | ,, |
| 20 | 37·7 | 19 | 18·9 | 4 | 35·2 | ,, |
| 20 | 40·9 | 19 | 6·6 | 4 | 18·8 | ,, |

upiter is travelling to the Eastward, to h of a little group of 5-mag. stars in nus. He will be in conjunction with N. of that planet) at 11h. p.m. on the ut, of course, will have set some con- e time previously.

### Neptune

vell visible during the amateur's working and may be seen fairly near to the n at a comparatively early hour. He nto opposition to the sun at 4h. p.m. on 1.

| Right Ascension. | | Declination North. | | Souths. | | |
|---|---|---|---|---|---|---|
| h. | m. | ° | ′ | h. | m. | |
| 4 | 18·2 | 19 | 42·0 | 1 | 37·0 | a.m. |
| 4 | 17·7 | 19 | 40·6 | 1 | 16·8 | ,, |
| 4 | 17·1 | 19 | 39·2 | 12 | 56·7 | ,, |
| 4 | 16·5 | 19 | 37·8 | 12 | 36·4 | ,, |
| 4 | 16·0 | 19 | 36·3 | 12 | 16·1 | ,, |
| 4 | 15·3 | 19 | 34·5 | 11 | 51·9 | p.m. |

rt retrograde arc indicated in the above ris lies a little to the N.E. of ε Tauri, the t-hand star of the "V" in the Hyades, an being the left upper one.

### ima of the Variable Star Algol

ur on the 3rd at 8h. 5m. p.m., on the 4h. 10m. a.m., on the 21st at 12h. 59m. the 23rd at 9h. 47m. p.m., and on the 6h. 36m. p.m., as well as on other occa- hen the phenomenon will be invisible.

### Shooting Stars

has long been known, conspicuous in er; and the story of the identification of eam which seems to radiate from the " in Leo on the nights 12th—14th with 's little comet (I. 1866) must be very to the majority of our readers. We iterate the caution repeatedly given in lumns to the student, that it is useless to is vigil until midnight on either of the specified (that of the 13th being the principal one), as Leo does not rise above our horizon until that hour. The second well-marked shower is to be loked for on the night of the 27th. Its components travel in the orbit of Secchi's comet (III. 1853), discovered by him on August 25th of that year. No very remarkable display of either of these showers, however, is to be expected during the current year. Watch should also be kept on the 1st and 2nd, the 19th, and the 30th.

### Greenwich Mean Time of Southing of Thirteen of the Principal Fixed Stars on the Night of November 1st, 1890.

| Star. | Souths. h. | m. | s. | |
|---|---|---|---|---|
| α Cygni.. | 5 | 53 | 49·54 | p.m. |
| α Cephei | 6 | 31 | 59·61 | ,, |
| ε Pegasi.. | 6 | 54 | 46·57 | ,, |
| α Aquarii | 7 | 16 | 4·22 | ,, |
| Fomalhaut | 8 | 7 | 22·65 | ,, |
| Markab | 8 | 15 | 3·67 | ,, |
| ι Piscium | 8 | 49 | 58·84 | ,, |
| α Andromedæ | 9 | 18 | 18·85 | ,, |
| α Cassiopeiæ | 9 | 49 | 48·38 | ,, |
| Polaris | 10 | 34 | 47·68 | ,, |
| α Arietis | 11 | 16 | 14·13 | ,, |
| α Ceti | *12 | 11 | 38·30 | a.m. |
| α Persei | *12 | 31 | 32·63 | ,, |

* Early morning of 2nd.

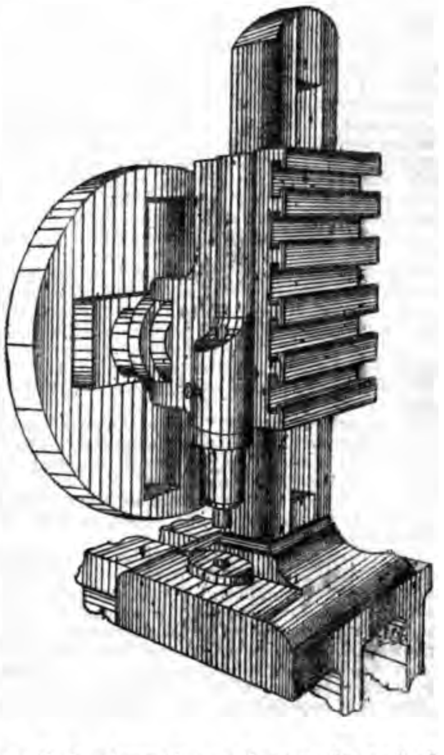
The method of ascertaining the Greenwich Mean Time of Southing of either of the stars in the above list on any other night in November, as also that of determining the Local instant of its Transit at any other station, will be found on p. 354 of Vol. L. It must, however, be noted that the rules given there are not rigidly accurate when applied to Polaris, or, in fact, to any close circumpolar star, although they will probably be found quite sufficiently so in actual practice.

## CALLENDER'S SUBSTITUTE FOR CELLULOID.

JUST as celluloid has been found a useful substitute for ivory, so a rival to that has been found in what is called "Lactite," patented by Mr. W. M. C. Callender. The patentee says the "Lactite" is produced by reducing casein (or the solids in milk) to a partly soluble or gelatinous condition, by means of borax, or ammonia, or by other suitable means, and then mixing it with a mineral salt dissolved in acid or water or acid and water, which liquid is subsequently evaporated. In carrying out the invention, he advantageously places ten kilogrammes of casein in a vessel, and incorporates it under heat with three kilogrammes of borax previously dissolved in six litres of water. When the appearance of the casein becomes changed he draws off the water, and the residue should then be of a consistency somewhat resembling melted gelatine. While in this state he adds one kilogramme of a mineral salt held in solution by three litres of acid. Almost any of the salts of iron, lead, tin, zinc, copper, or other mineral salts soluble in acid may be used. The acid employed depends upon the salt used, as only such acid should be used as will properly dissolve the salt. The salt employed depends upon the exact colour required in the finished material. In practice he has obtained good results by the use of acetate of lead and acetic acid. The solution of the mineral salt in acid must be thoroughly incorporated with the previous mixture of casein and borax; this is a matter of some difficulty, but can be accomplished in a mechanical mixer. When the mixture is effected the solid matter will be found separated from the greater portion of the acid and water, which should then be drawn off. The solid matter should be subjected to great pressure to drive out all possible moisture, and any moisture which may remain should be evaporated under great heat, or by other suitable means, the resulting product being the new material. The new material may either be supplied in the form of sheets or rods, or moulded in any form desired, and it can be coloured, as required, either by the admixture of pigments or by aniline or other dyes. The cost of the material may be lessened by the admixture of a certain proportion of other substances, such as precipitated lime or chalk, or other similar substances soluble either in the acids, in the casein, or in the borax and water. Instead of rendering the casein soluble or gelatinous by means of borax, the same result may be obtained by the use of ammonia, or by any other suitable means. The combination of the materials can be effected in many ways, as these can be varied according to the exact use for which the "Lactite" is intended; for general purposes, however, the patentee finds satisfactory results from the above-described process, proportions, and ingredients, and they sufficiently describe the subject of his invention.

## IMPROVED ATTACHMENT FOR LATHES.

THE apparatus shown in the accompanying illustration will be found a very useful adjunct to a lathe or any similar tool from which



a vertical reciprocating motion can be obtained. It consists of a standard which is bolted to the bed of the lathe, upon this slides a grooved face-plate, to which is secured the work to be tooled. This face-plate is moved up and down by a roller mounted upon a pin bolted to the ordinary lathe chuck-plate, which travels to and fro in the roller path formed upon the back of the slide, the length of stroke depending upon the distance of the roller pin from the mandrel centre. By placing a cutting-tool in the slide-rest, and operating the feed screws by hand or by means of self-acting motion obtained from the slide, metals may be planed, shaped, key grooves cut, and a variety of other tooling work accomplished with accuracy and rapidity. For the convenience of light-metal workers a punch and pair of shearing blades can be added for cropping plates and roughing-out material. The grooves upon the sliding face-plate can, when desired, be replaced by a vice for holding the work, or a vice can be bolted to the grooved face-plate. The illustration is taken from an attachment fitted to a 4in. centre lathe which has a stroke of 3in. A speed can be obtained of from 50 to 200 strokes per minute. The cost is very moderate. The attachment is patented, the inventor being Mr. F. M. Rogers, engineer, of 21, Finsbury-pavement, London.

## PREPARATION AND USE OF PLAIN PAPER IN PHOTOGRAPHY.*

TO me this paper is the most artistic of silver prints. It is not only artistic, but costs little to prepare it, both of time and money, and gives the most satisfactory results. By following closely the method given below, no one need go astray in its preparation. I have had such good results in my experiments that I recommend every amateur to try it, as it can be prepared in a very short space of time and with little expense. It is far from the lost art, as some are wont to claim, as some prints that are now before me show that brilliancy and softness in a high degree can be obtained.

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* By W. S. WATERBURY, in the *Photographic Times*.

One of the advantages of plain paper is its tendency to reproduce the finest detail, and to retain it during the subsequent toning and fixing. There have been many different formulæ given for its preparation, and after exhausting a number of them, I have finally settled on the method given below, which has given me the best results. Let us first consider the things necessary for its preparation.

1st. *The Paper.*—While any kind of good strong white paper can be used, each giving a result peculiar to itself, I claim that it is economy to use the Saxe paper, which is easily procured at any photographic supply house.

2nd. *The Sizing.* — Almost all formulæ advise gelatine, and while that will give excellent results, I have so much better success with albumen that I give it preference, as it gives clearer lights, and is much easier to coat.

My formula and manipulations are as follows :—

*The Salting Bath.*—Albumen, 1oz.; water, 16oz. Place in a bottle with some broken glass, and shake vigorously until all the flocculent matter is thoroughly cut up; then add ten grains of chloride of ammonia to every ounce of solution, and, after shaking well, strain through two thicknesses of fine muslin. This salting bath, although simple, will yield the best results. It will tone quickly and easily with but very little gold. With this bath a beautiful neutral tone can easily be obtained; or, in fact, any tone from a dark sepia to a positive black.

After filtering, pour your solution in a tray large enough for the sheets you intend to coat, being careful to remove all air bubbles. Now immerse the sheet in the solution for one minute, then draw out quickly by two corners and hang up by means of a clip to dry. After it has thoroughly dried, float the right side of the paper on the solution for two minutes.

The paper has a "right" and a "wrong" side, which can easily be distinguished after the first bath by the grain of the paper, the smooth side being the right one to float the second time. Now hang up to dry again in the same manner as before. You can salt any quantity of the paper, as it keeps indefinitely if kept in a dry place.

*The Sensitising Bath* should be an ordinary neutral bath, 50 grains to the ounce, and kept neutral by the addition of silver carbonate; it is prepared as follows:—Take the amount of water that you wish for the bath (I use about 10 ounces) and add silver nitrate until an "actinometer" shows it to be fifty grains to the ounce. Neutralise by adding enough of a saturated solution of carbonate of soda to form a slight precipitate (about 10 or 15 drops). The precipitate which is produced should be left in the bottle. Shake well, and after the bath has settled it is ready for use. You can either filter or decant the clear solution into your silvering tray.

Float the paper three minutes on this solution, using the same precautions as when floating albumen paper, being careful not to get any of the solution on the back of the paper.

It is a good plan to place one end of the paper on the bath first, then lower carefully until the entire sheet is in perfect contact with the bath, this will force any bubbles, should there be any, from under the sheet. While the sheet is in contact, raise the corners separately to see if there are any; if so, they should be broken with the finger or a glass rod.

The sensitising bath should be tested from time to time and kept up to the required strength by the addition of fresh nitrate of silver. It will be neutral as long as there is any excess of carbonate of silver in the bath.

After sensitising, dry the paper thoroughly and keep in a dark, dry place. If kept in a perfectly dry state it will keep for several days, but when it can be, it should be used at once to insure the best results. The sensitising operations may be safely carried on by lamp light.

*Printing.*—The best results are obtained by fuming the paper for twenty minutes over ammonia, after which expose the same as albumen paper. After fuming, the paper is extremely sensitive, and had better be exposed in diffused light, unless the negative is very dense. It is better to print somewhat deeper than you care to have the finished print, as it loses density during the toning and fixing.

*The Toning Bath.*—Make up a stock solution as follows: — Water, 7½oz.; chloride of gold and sodium, 15gr.

Take one half ounce of this solution and immerse a piece of litmus paper in it, which will turn red; now add, gradually, enough of a saturated solution of bi-carbonate of soda to restore the litmus to its original colour; now to 24oz. of filtered water add the neutralised gold, and a very small pinch of chloride of sodium (common table salt), stir thoroughly, and your bath is ready. For simplicity and excellence this cannot be surpassed.

The quantity given is ample to tone one dozen 5 by 8 prints. It can be strengthened from time to time by adding gold from the stock solution, being careful to neutralise it each time.

After washing the prints in two changes of water, they are immersed one at a time in the toning-bath; a dozen or more can be toned at the same time if you are careful to keep them in motion by changing them during the process of toning. Leave them in this bath until they assume a deep purple; if fixed at this stage the result will be a warm sepia, which will dry out a neutral tone; do not carry the toning until the prints lose their brilliancy. Generally about fifteen minutes is ample, but will vary according to the temperature and amount of gold in the bath.

Prints fixed without toning give a very artistic and pretty effect, producing a result not unlike a photogravure in tone and general effect.

*The Fixing Bath.*—The prints are fixed in hyposulphite of soda 1oz., water 8oz. for fifteen minutes. They should then be washed in running water for two hours.

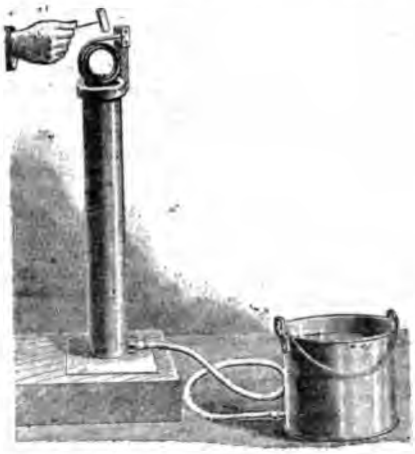
After drying, trim, then lay them one on the other, and place a heavy weight on them overnight, the next morning the prints will lie perfectly flat. Now procure some heavy, stiff, white paper—about the same as that used for the illustrations of the *Times*—and have it cut large enough to allow a good margin when mounted. For example, a 9 × 11 mount for a 5 × 8 print. Mount by simply sticking the corners.

I have tried in as clear and concise a manner as possible to describe my process, and am confident that if the foregoing is carefully followed out, success will attend the effort.

## AN EXPERIMENT IN RESONANCE.

By Geo. M. Hopkins.*

NEARLY everyone must have heard the cathedral clock gong. Some time since it was applied only to fine French and English clocks; but at present it is largely used in the better class of American clocks. There is, however, a great difference in these gongs and in the way in which they are mounted, and a corresponding difference in the sounds they emit when struck. A gong of uniform temper attached to a standard of suitable weight, securely fastened to a sounding-board of sufficient size and thickness, is capable when struck of producing a composite sound strongly resembling that of a very large, moderately distant, musical bell. To avoid a harsh, clanging, metallic sound, the hammer used in connection with a cathedral gong is provided with a comparatively soft striking face, consisting generally of a firm piece of sole leather. If one listens intently to the sound of one of these gongs, he will be able with little difficulty to detect a few of the many tones which form the very complex sound. He can readily distinguish a very grave, subdued note, also a sound of high pitch, and a discord; but no approximation to the number of sounds produced by the gong can be made without a resonator, which will select out the different sounds in succession. An instrument of this kind is shown in the annexed engraving. It consists of an upright tube closed at the bottom, open at the top, and furnished with a small lateral tube at the bottom for receiving a flexible tube for conveying water. In the present case the flexible tube is connected with an ordinary tin pail having a lateral tube at the bottom. The upright tube is elevated above the level of the table, so that its full length may be utilised as a resonator. The cathedral gong used in this experiment was a small one formed of a rod of steel $\frac{1}{4}$in. wide, $\frac{1}{16}$in. thick, and about 30in. in length, formed in a spiral of about three turns, the outer end being secured to an arm projecting upward from a heavy metal cap resting on the top of the resonator. The hole in the cap is somewhat smaller than the mouth of the resonator.



The gong being struck at a point near its fixed end by a small soft rubber mallet, is set in vibration. As the striking is repeated at frequent intervals, the pail containing the water is raised, causing the water to flow quietly into the resonator, gradually diminishing the length of the column of air contained by the tube. When the length of the air column is such as to respond to any particular note, that note is re-enforced so as to become prominent. In this manner one note after another is brought out until the last and highest is heard.

By lowering the pail and allowing the water to return to it from the resonator, the re-enforced sounds will be heard in reversed order. As many as eight tones will be heard prominently, while with more care still others will be heard, thus showing the complex character of the sound produced by the gong, and showing clearly the reason of the harmonious and pleasing effect which has made them so popular.

By skilfully using the mouth as a resonator, most of the tones may be separated out so as to be readily distinguished by the operator.

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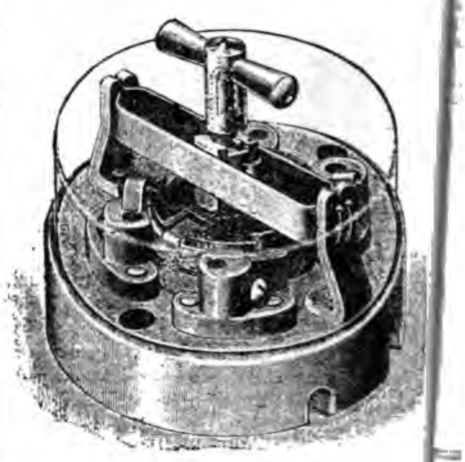
* In the *Scientific American.*

## THE PERKINS ELECTRIC SWITCH.

THE accompanying illustration shows a very ingenious and efficient type of snap switch, the invention of Mr. C. G. Perkins, of Hartford, Conn. As will be clearly seen from the cut, the central spindle of the switch has mounted upon it a square block of insulating material which is loosely pivoted to the spindle. This block is held firmly clamped between two parallel springs secured at their ends to posts carried upon the base. When the handle of the switch is turned, a pin through the centre of the spindle engages with a notch in the loosely-mounted block, and the springs are forced outward, allowing the block to turn between them. When turned a quarter of a revolution the contacts are suddenly made or broken, as the case may be, by the snap motion produced by the pressure of the springs against the side of the blocks and by the slight freedom of motion which the block has upon the spindle. These switches are made with porcelain bases, are simple, strong and reliable, and very efficient. They are made for use either with concealed or cleated work, and in capacities ranging from 10 to 100 ampères and in both single- and double-pole types.



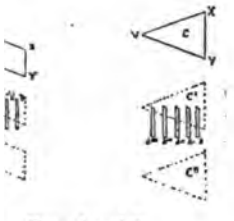
## RODMAN'S COMBINATION ELECTRIC SWITCH.

THE combination electrical switch shown in the accompanying illustrations has been devised by Lieut. S. Rodman, jun., U.S.A., and is thus described by him in the New York *Electrical World*. He calls it a continuous combination switch, and proceeds to say that, as it possesses certain characteristics different from other switches, I shall first go into a little preliminary detail in order to make clear its functions and working. Referring to Fig. 1, let A represent a strip of metal, and $b$, $b'$, $b''$, $b'''$, and $b''''$ metallic springs, so arranged that when A is moved up or down in the direction of the arrow, it will successively touch the metallic springs $b$ to $b''''$, until it reaches a position indicated by the dotted line inclosing A′, when it will touch all five of the springs, $b$, $b'$, $b''$, $b'''$, and $b''''$. Move the metallic strip now to the position indicated by the dotted lines inclosing A″, and it will be seen that it will slide past the metallic springs in the same order that it moved on to them. So, taking the movement in detail, we have the metallic strip first touching the

UNION

$b$ and $b'$ ; then $b$, $b'$, and $b''$ ; then $b$, hen $b$, $b'$, $b''$, $b'''$, and $b''''$ ; then $b'$, then $b''$, $b'''$, and $b''''$ ; then $b'''$ and id finally sliding past all of them.

ig. 2, let C represent another strip , $b''$, $b'''$ and $b''''$, as above, metallic ve C in the direction of the arrow to ed by the dotted lines inclosing C' ill be seen that it will successively lic springs from $b$ to $b''''$, and will



FIGS. 1 and 2.

in exactly the reverse order from ; this second example in detail we : strip C first touching the spring $b$ ; hen $b$, $b'$, and $b''$ ; then $b$, $b'$, $b''$ and ', $b'''$ and $b''''$ ; then $b$, $b'$, $b''$ and $b'''$ ; ; then $b$ and $b'$ ; then $b$, and finally f them.

erent shapes to the metallic piece and off the springs, other different ould be brought about; but the ses given will show that for aken there are nine different com- tact between the metallic piece and king the more general case, and ot the number of metallic springs, t combinations of contact between e will be represented by the general .

ase to show how such an arrange- escribed will apply as an electrical efer to Fig. 3, which represents a

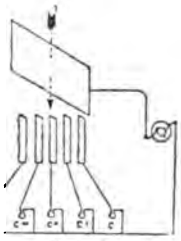


FIG. 3.

ole of which is connected to the d the other to one terminal of each e lamps, the other terminal of the connected to one of the metallic as in Fig. 1. Now, suppose A to direction of the arrow-head, and a $b$, lamp C will burn ; then, from d $b'$, lamps C and C' ; then, from and $b''$, lamps C, C' and C'', and so moved past the springs, and no g. By this arrangement, then, we , 4, 3, 2, and 1 lamps burning—or, ve have varied the intensity of the and continuously. The example continuous gradation of light is simplest case. Many other appli- nade, substituting for the single oils of a shunt-wound dynamo or of lamps.

f metallic springs chosen in the ut it can readily be seen that by ze of the metallic strip A, Fig. 1, almost any number of metallic ccommodated, and also a greater nits controlled continuously and

a to those interested in the subject, the use of such a switch in con- unt-wound motor on electric cars, e current from the main dynamo into the motor coils successively, ally the number of ampère turns rcoming the difficulty and strain rting a heavily-loaded car from a d lessening the number of burnt- By the use of such a mechanism e necessary, but the increments of plied successively by a simple gement.

mechanism above described into ch, I simply make one mechanical rs, to transform the motion of metallic piece A, Fig. 1, and C, ion of rotation about an axis, and the following description of the switch will be sufficient explanation:—

A cylinder of insulating material having a metallic axis is first made. A thin flat metal strip shaped like A, Fig. 1, or C, Fig. 2, is then cut out and wrapped around the cylinder, the sides V W and X Y of A, and the point V and the side X Y of C, coinciding with the two opposite circular edges of the cylinder, thus forming a helical plate. The plate is secured to the cylinder by metallic screws which project through to a good contact with the axis. The latter revolves in a metal bed or bushing, and is held firmly by the caps. The whole arrangement is set in a box of peculiar construction,

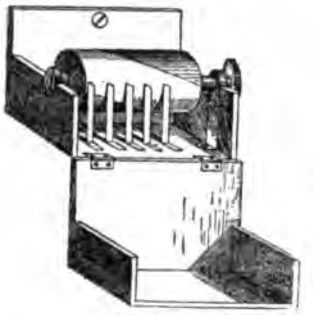


FIG. 4.

as shown in Fig. 4. The metallic springs are attached to the bottom of the box, and press firmly against the cylinder. On the under side of the box are binding posts, one to each metallic spring. The terminal of the dynamo is led in through the bottom of the box and screwed to the metallic strip shown on the right side of the box. This strip is maintained in metallic connection with the helical plate on the surface of the cylinder by means of the metallic bushing, axis, and screws connecting the helical plate with the metallic axis. The screw seen at the top of the box is intended to fasten the whole arrangement to the wall. It will be seen that the box can be readily closed and opened without removing it from the wall; also that by taking off the caps over the axis of the cylinder the latter may be removed and the switch thereby rendered inoperative, so that the connection of the wires will not be attended with any danger. I think, at least, it can be claimed that the whole apparatus is very simple for one which combines so many different functions in so small a space.

## USEFUL AND SCIENTIFIC NOTES.

THERE is really but one place in the world where violins are made extensively. That place is Markneukirchen, with its surrounding villages. There are altogether about 15,000 people living there who do nothing else but make violins. The inhabitants, from the little urchin to the old grey-headed man, the small girl and the old grandmother, all are engaged in making some part of a fiddle.

**Sterilised Milk.**—So-called "sterilised milk" by no means always deserves its name, in some cases being much fuller of germs than ordinary unboiled milk fresh from the cow. Herr Kohlmann of Leipsic, on subjecting two specimens of milk sold as sterilised to examination, found that one of them really was so, no germs being discoverable; while the other specimen contained 350,000 germs per cubic centimètre. For the purpose of comparison other examinations were made, and it was found that a sample of fresh milk bought in the street contained about 160,000 germs per cubic centimètre —that is to say, less than half the number of the second sample of so-called sterilised milk. Milk boiled in the kitchen contained 158 germs per cubic centimètre; distilled water, 1,064; and water from the Hofbrunnen 12,000. Her Kohlmann suggests that the failure of whatever process was used to sterilise the milk may have been due either to water having been mixed with the milk before the process was commenced, or perhaps to too long a time having been allowed to elapse between milking and sterilising. This last point exercises a very great effect, as is shown by Freudenreich's observations. He found that milk which when received contained only 9,300 germs to the cubic centimètre, after being kept for three hours at 60° Fahr. contained 10,000; after six hours, 250,000; and after twenty-four hours no less than 5,700,000. It would therefore appear that our knowledge of the conditions under which milk may be really sterilised is at present somewhat insufficient, and that reports of the results of the feeding of infants with milk which is reputed to be sterilised must always be received with a good deal of scepticism unless specimens of the milk have been frequently examined by a competent person.—*Lancet.*

# SCIENTIFIC SOCIETIES.

## THE BRITISH ASTRONOMICAL ASSOCIATION.

THIS Association held its first general meeting on Friday, the 24th inst,, in the Hall of the Society of Arts, John-street, Adelphi.

Mr. W. H. Maw, F.R.A.S., temporary treasurer, occupied the chair at the outset of the proceedings, and called upon Mr. E. Walter Maunder, F.R.A.S. (to whom, with his brother, they were much indebted for the work they had done in the formation of the Association), to read the report of the Provisional Committee.

Mr. Maunder read the report, and stated that the Association consisted of 283 members. About £15 had been incurred in initial expenses, and there was a balance in hand of £185.

The report was unanimously adopted.

Mr. Edwin Dunkin, F.R.S., submitted the report of the scrutineers of the ballot for the Council, showing that the following had been duly elected:—Miss Agnes M. Clerke, Arthur Cottam, F.R.A.S.; P. F. Duke, F.R A.S.; A. M. W. Downing, M.A., F.R.A.S.; Edwin Dunkin, F.R.S., F.R.A.S.; N. E. Green, F.R.A.S., Sir Howard Grubb, F.R.S., M.I.C.E.I., F.R.A.S.; W. Huggins, LL.D., D.C.L., F.R.S.; Mrs. Huggins, Wm. B. Hutchinson, F.R.A.S.; H. Ingall, F.R.A.S.; S. T. Klein, F.L.S., F.R.A.S.; E. Walter Maunder, F.R.A.S.; W. H. Maw, F.R.A.S.; W. H. S. Monck, M.A., F.R.A.S.; Capt. W. Noble, F.R.A.S.; Isaac Roberts, F.R.S., F.R.A.S.; the Earl of Rosse, B.A., LL.D., F.R.S.; Herbert Sadler, F.R.A.S.; G. M. Seabroke, F.R.A.S.; W. H. Wesley, A. Stanley Williams, F.R.A.S.

Mr. W. H. Wesley next presented the report of the election of the officers of the Association by the Council:—Capt. W. Noble, F.R.A.S., was elected president; Mr. A. M. W. Downing, M.A., F.R.A.S.: Mr. W. Huggins, LL D., D.C.L., F.R.S.; Mr. Isaac Roberts, F.R.S., and the Earl of Rosse, B.A., LL.D., F.R.S., vice-presidents;—Mr. W. H. Maw, F.R.A.S., treasurer; Mr. Arthur Cottam, F.R.A.S., and Mr. P. F. Duke, F.R.A.S., secretaries; and Mr. E. Walter Maunder, F.R.A.S., editor.

The President, in taking the chair, thanked the members very sincerely for the honour they had done him in electing him the first president of the Association, which he hoped, and believed, would leave its mark upon British astronomy, and do yeoman service for English science. He could only say that he would endeavour to deserve the confidence they had placed in him.

The meeting then confirmed the appointment of the following directors of sections, who had kindly consented to serve:—Mr. D. Booth, Meteoric; Miss Brown, Solar; Mr. T. G. Elger, F.R.A.S., Lunar; the Rev. T. E. Espin, B.A., F.R.A.S., Spectroscopic and Photographic; Mr. W. S. Franks, F.R.A.S., Coloured Stars; Mr. J. E. Gore, M.R.I.A., F.R.A.S., Variable Stars; Mr. K. J. Tarrant, F.R.A.S., Double Stars; and the Rev. W. R. Waugh, F.R.A.S., Jupiter.

Proceeding to discuss the draft copy of the rules,

Mr. Wesley said the proposed title of the society, "The British Astronomical Society," had been selected by the provisional committee; but as it had not come before the society itself, he thought it his duty to express a few objections which he felt, and which he had already mentioned to the committee. In the first place, he thought the name was a somewhat pretentious one; but his principal objection was that it bore too close a resemblance to the name of the Royal Astronomical Society. He would not go so far as to speak of it as a colourable imitation, but he thought it presented a very close resemblance, and it evidently covered the same ground. He had heard the Royal Astronomical Society called the British Astronomical Society by foreigners to indicate its nationality; but it seemed to him that a more serious inconvenience would arise from the fact that people, in speaking of these societies, were apt to abbreviate the names. For instance, the Royal Astronomical Society was most frequently abbreviated by people simply calling it the Astronomical Society. He believed the name British Astronomical Society would inevitably be abbreviated in the same manner, so that great confusion would arise. He, therefore, begged to propose that the name of the society be the "British Astronomical Association." He heartily endorsed the remarks made by the chairman as to the future of the society.

Dr. Huggins, F.R.S., said that, although he did not quite agree with the reasons given by the mover of the resolution, yet he agreed with his conclusion. He scarcely thought that the title "Society" was too pretentious for a body which already numbered nearly 300 members, and he hoped the idea on the part of any member of the society adopting that name as a colourable imitation of the Royal Astronomical Society was an erroneous one. Still he knew that amongst many Fellows of the Royal Astronomical Society there was a prejudice to the name, and that it would remove friction, and be more pleasant all round if they saw their way to adopt the name "Association." It appeared to him that the word "association" was quite as honourable, and, indeed, as pretentious as "society." He begged, therefore, to second the motion.

Mr. Dunkin supported the proposition, remarking that as a very old member of the Royal Astronomical Society he would like to have this society totally distinct in name. As an illustration of the confusion that might arise if they adopted the proposed title of "The British Astronomical Society," he stated that in the list of meetings that day the *Times* had got the Royal Astronomical Society.

The Chairman said that many titles were colloquially abbreviated, and they stood a chance of being accused of trying to be mistaken for the older society. He was inclined to believe that the word "British" would colloquially be dropped in the British Astronomical Society as "Royal" was dropped in the Royal Astronomical Society, and in that way they would have two Astronomical Societies.

It was agreed by a large majority to adopt the title of "The British Astronomical Association."

The objects of the Association are:—"The association of observers, especially the possessors of small telescopes, for mutual help, and their organisation in the work of astronomical observation. The circulation of current astronomical information. The encouragement of a popular interest in astronomy."

Ladies are eligible for election as members, and they are not to be debarred from exercising any right or privilege of the Association, or from filling any office to which they may be elected.

The President said he was young enough to hope that he might live to see a lady occupying the office to which he had the honour of being elected that day.

It was referred to a committee, consisting of the hon. secretaries and the treasurer, to procure, if possible, the use of a meeting place on the last Thursday of each month during the session for the ordinary meetings of the Association, which were fixed to take place at 5 p.m.

The meeting also agreed that the annual general meeting of the Association should take place in the month of June in each year, for the purpose of receiving and adopting the balance-sheet and report of the Council, and for the election of the Council, &c.

Mr. Dunkin proposed that the thanks of the Association be given to the Provisional Committee for the care and attention which they had shown in the preliminary work of the Association. The fact that they had already nearly 300 members at the first meeting of the Association, made one feel almost astounded to think that the science in which he had spent all his life should be so well supported as he had seen it that day.

Mr. Bayly seconded the resolution.

The Chairman said those behind the scenes knew how well earned that vote of thanks was. As far as Mr. Maunder was concerned, the Association would owe him a perennial debt of gratitude.

The resolution was cordially adopted.

Similar compliments were paid to the scrutineers of the ballot for the Council, to the editors of London and provincial newspapers who had given prominence to the formation of the Association, and to the chairman for presiding.

The President, in reply, said he had devoted his whole life and a good deal of his fortune to the pursuit of science, and astronomy had been his favourite study from his boyhood. Any slight service he could render would be more than amply repaid if he found that during the time he was allowed to occupy the chair the Association prospered, and promoted astronomy in England.

The proceedings then terminated.

## ROYAL MICROSCOPICAL SOCIETY.

THE first meeting of the session was held on the 15th inst., at 20, Hanover-square, W., Dr. C. T. Hudson, F.R.S., President, in the chair.

Attention was called to a donation of special importance, consisting of 200 slides of Marine Bryozoa, from Miss E. C. Jelly, who had recently published a catalogue of Bryozoa

A work on photo-micrography, in German, by G. Marktanner-Turneretscher, by whom it was presented to the Society, was referred to by Mr. J. Mayall, jun., who said the author had dealt somewhat fully with descriptions of the various forms of heliostats, commencing with that designed by Meyerstein. This heliostat was, he thought, one of the simplest and least expensive in commerce, and he exhibited one and explained its construction. The modification required in the construction in order to meet Mr. Comber's suggestion, contained in his paper on a new heliostat published in the August number of the *Journal* of the Society, was to substitute for the existing mirror—which was simply of glass silvered at the back, and consequently gave two reflections—a more perfect reflecting surface. Mr. Comber recommended a plane mirror of speculum metal; but as such mirrors were difficult to obtain and costly, and, moreover, required great care in handling, it had occurred to him that possibly a right-angled prism of white glass might be applied with advantage. Such a prism might be freely handled, and the internal reflection from the hypothenusal face would be extremely bright and free from colour. Another such prism might replace Mr. Comber's fixed speculum mirror for deflecting the light from the heliostat mirror into the axis of the microscope, supposed to be horizontal. Probably the most efficient way of dealing with the matter practically would be to bring it to the notice of the mechanician who supplied Meyerstein's heliostat, which he (Mr. Mayall) would endeavour to do.

Mr. Mayall also directed attention to the donation of 12 photo-micrographs by Dr. Giorgio Roster, of Florence, some of which appeared to him excellent specimens of work produced with Zeiss's apochromatic objectives, using sunlight with an achromatic condenser in the axis. The inspection of these photographs reminded him that in discussing the production of such work recently with Mr. Comber, they were agreed upon the advantage of using sunlight, as compared with the oxy-hydrogen lamp, in the fact that when the image of the sun was focussed on the object by a properly-constructed achromatic condenser, the illumination was perfectly even over the whole field from centre to margin; but with the oxy-hydrogen light, focussing the illumination really resulted in the projection upon the object of an image of the incandescent spark and its immediate surroundings in the lime-cylinder, which image always consisted of a brightly luminous point encircled by a more or less mottled or cloudy appearance, representing the adjacent parts of the lime-cylinder that were not so highly luminous, on which the gas-jet was not so active. Doubtless, in the hands of a skilled manipulator the difficulties in the use of the oxy-hydrogen light were corrected as far as practicable; still, there always remained an element of uncertainty in its use, demanding incessant watchfulness; the light would vary in momentary intensity, or would flicker and become decentred, and the resulting photograph would embody not only an image of the object, but very frequently this would be mixed up with irregular mottled appearances which were in reality projections of the ever-varying condition of the source of light—the more or less incandescent parts of the lime-cylinder. The evenness of the solar illumination was well shown by Dr. Roster's photo-micrographs, though he thought in some of them—notably in that of *Surirella gemma*, the condenser was not quite accurately centred. The greyness in some of them was probably due to errors in the photographic manipulations.

Mr. G. F. Dowdeswell's note on "A Simple Form of Warm Stage" was read, with the apparatus exhibited. It consisted of a thin, flat, quadrangular plate of copper, having a projection of about 6in. at one of the front corners; an aperture was made in the centre to correspond with the aperture of the microscope stage, and a copper tube was soldered across the surface near the back edge, in which a clinical thermometer could be inserted. In use the copper plate was to be clamped on the microscope stage, and a spirit-lamp adjusted to heat the metal projection, and, by conduction, the preparation on the stage.

Prof. C. Stewart inquired if the copper plate was intended to rest upon the metallic stage of the microscope? If so, he thought there was likely to be a considerable loss of heat by conduction.

Mr. G. C. Karop said that a piece of flannel or cloth was usually placed between the two. He thought the great fault of all such things was that no means existed for controlling or maintaining the temperature at any given point, so that when the observer was looking closely at some object of great interest he was very apt not to notice the rise of temperature, and the result was that it got so hot that the thermometer would break, to say nothing of what became of the object. What was wanted was a self-regulating warm stage, which would maintain a given temperature, supplied at a price within the reach of the bulk of medical students.

The President said he had, with great regret, to record the deaths of two honorary Fellows of the society—Dr. Kitchen Parker and Mr. Ralphs. The former gentleman was so well known to them by the work which he accomplished, and for the enthusiasm with which he entered upon his researches, as well as from having been at one time president of their society, that it was unnecessary for him to refer to him at any length on that occasion. They would all feel that, in losing him, they had lost a very valuable friend and fellow worker. Mr. Ralphs was elected an honorary Fellow of the society only a short time ago, and, in fact, died before he had received an intimation of his election. In place of these two gentlemen, the council had nominated as honorary Fellows—Dr. Henry Brady, F.R.S., and Prof. Williamson, F.R.S. These names would be suspended during the month, and would be submitted for election at the next ordinary meeting.

Referring to the explanation he had given at the June meeting regarding the new objective of 1·6 N.A., presented to the society by the firm of Carl Zeiss, of Jena, Mr. Mayall said he must ask the indulgence of the meeting to enable him to clear himself from possible ambiguity. In notifying the fact that at the first photographic trials of the objective, the visual and actinic foci were found by Mr. Nelson and himself to be not coincident, and that when the objective was returned to Jena immediately after, Dr. Czapski, of the firm of Zeiss, found the foci were coincident, the explanation of the extraordinary divergence on the point seemed to him of the nature of a puzzle, which, for the moment, appeared inexplicable. He had, therefore, hazarded what he had imagined would appear a mere playful admission of the state of general puzzlement of both sides by suggesting that *the transit of the objective from London to Jena had somehow got rid of the "chemical" focus*. That sentence had unhappily been construed, both in England and abroad, into a reflection upon the good faith of Dr. Czapski, or upon Dr. Abbe, or upon the firm of Zeiss. Whatever blame was due to himself for the ambiguity of the expression, he must of course accept. At the same time he thought the society would be interested to learn that upon his conveying his explanation to Dr. Czapski and Dr. Abbe, those gentlemen had expressed their complete satisfaction with it. The interchange of correspondence on the subject had led him to consider closely the whole circumstances, and he believed the existence of the "chemical" focus was probably due to a slight difference in the adjustment of the front lens, the mounting of which was partially unscrewed from the body of the objective when it first reached his hands, and which he might not have set exactly in the normal position in which it left Jena. On his suggesting this explanation of the difficulty to Dr. Abbe, its possibility was at once admitted, especially, as Dr. Abbe pointed out, in view of the fact that with an objective of such large aperture the colour-correction was, as it were, "balanced on a needle-point" in the matter of an alteration in the distance of the front lens from the posterior combinations; and that a very minute alteration in that distance, though producing no perceptible difference in the visual image, was quite competent to lengthen or shorten the focus of the violet rays to such an extent as to exhibit a "chemical" focus non-coincident with the visual focus when tested photographically. It appeared that when the objective was returned to Jena, it was not examined optically in the precise condition in which it was received, but was first put on the lathe and all the lens cells unscrewed and separately examined, which was the usual course adopted when an objective was returned for inspection. In setting the objective up again the foreman intrusted with the task would, no doubt, screw the lens cells together again exactly as they were originally when the objective was first despatched from Jena, and it was in that condition when Dr. Czapski tested it and reported that the visual and actinic foci were coincident, which was subsequently confirmed by the second photographic trials made with it in London. Mr. Mayall read portions of the correspondence he had had with Dr. Abbe and Dr. Czapski relating to the subject; but he thought the matter would hardly require extended publication. The point of interest to the society was to be informed of the progress of the report of the committee on the new objective. The committee had not been able to meet during the vacation, and he regretted to have to state that the new slide forwarded by Dr. Van Heurck, in June, had become partially opaque like the one originally received with the objective. Dr. Van Heurck had recently found that the flint cover-glass became injured by the prolonged exposure to the great heat required in mounting the objects in the dense yellow medium, and he had promised to forward another slide prepared with a different kind of flint cover-glass, with which he anticipated less difficulty in securing permanency in the mounting. Until the arrival of the new slide, the committee could not usefully proceed with the examination of the new objective.

The President gave formal notice that a special general meeting would be held in the library at 5 p.m. on Wednesday, the 22nd inst., for the purpose of considering alterations in the by-laws, the terms of which he read.

Mr. G. C. Karop exhibited and described an improved student's microscope, made, at his suggestion, by Swift and Son. The new instrument embodied Nelson's "horse-shoe" stage for convenience of readily seeing the condenser, and for estimating by the touch the approximation of the focus on the slide, and on which the Mayall mechanical stage was easily applied, together with a centring sub-stage focussed by sliding on the tail-piece, the whole of superior workmanship and design, and supplied at a moderate outlay.

Mr. E. M. Nelson entirely approved of the aim of the design of the instrument. The general strengthening of the bearings throughout the mechanism was an important element in a microscope for the use of the students. He thought the plan of focussing the condenser by sliding it on the tail-piece was not good; but should be replaced by a rack and pinion, which would add little to the cost.

Mr. T. F. Smith said that all his own work in photo-micrography had been done with a similar instrument; but he thought that for high powers some rather more delicate kind of focal adjustment for the condenser would be essential.

Prof. J. W. Groves communicated a note by Mr. Percival C. Waite "On a New Method of Demonstrating Intercellular Protoplasmic Continuity." A specimen in illustration was exhibited. He remarked that though most microscopists were anxious to get rid of air from their specimens, Mr. Suffolk, who had looked at this one before leaving the meeting, said that he had found its presence in some cases desirable, and for this purpose, having prepared his section, he placed the slide upon his hand and, after allowing the air to enter, he mounted it in Canada balsam. Specimens like the one exhibited could by this process be multiplied *ad infinitum*.

Mr. J. D. Aldous exhibited some early forms of microscope slides made of box-wood, similar to those which were formerly made of ivory with the objects between pieces of talc. In those shown, cylindrical cavities were cleanly bored in the box-wood slip, and the objects stuck upon paper at the bottom of the wells so made. Some of the objects were excellent specimens, a beetle being particularly well set up.

The President called attention to some original drawings of a new Rotifer by Mr. W. B. Poole, of South Australia, who was present at the meeting. He also mentioned that a specimen of *Œcistes mucicola* was exhibited by Mr. G. Western. This rotifer had also been found by Mr. Parsons. With regard to *Trochosphera* he might say that it was really an Œcistes and that it had been found in Australia together with the male. These things had such a way of appearing in different parts of the world that, as had been the case with some others, now that it had been found in Australia, it would doubtless be found in London before long.

Mr. E. M. Nelson exhibited upon the screen a series of 31 photo-micrographs, which he described.

The President felt sure he should be right in expressing to Mr. Nelson the great pleasure which it had given them to see these beautiful illustrations, accompanied as they had been by his vigorous explanations.

Mr. H. B. Brady's paper "On a New Type of Foraminifera" was taken as read, as it was published in the current number of the Society's *Journal*.

Dr. Maddox's paper "On the Structure of Spermatozoa" was postponed until the next meeting, in consequence of the lateness of the hour.

The President took the opportunity of congratulating the Fellows upon the improvement which had taken place in the appearance of the room since they last met, and expressed a hope that it might be taken as an earnest of many pleasant meetings to come.

## THE LANTERN SOCIETY.

THE first meeting of the season was held at 20, Hanover-square, on October 13th, when Mr. Andrew Pringle gave an address on "The Modern Applications and Appliances of the Lantern." After briefly alluding to the early history of the lantern, the lecturer proceeded to consider the various parts of a lantern, taking in order the body, where he dwelt on the advantage of portability, showing a small iron lantern, which, whilst capable of doing all that a lantern of ordinary construction would do, packed with all its parts complete into a box a quarter the size of an ordinary one; the condenser, describing the various forms which have been designed and used at different times; the lens, comparing the ordinary "lantern objective" with portrait and other types of lenses; and the luminant, describing the early form of limelight, as designed by Drummond and Beechey, and going into the essentials of a good lime jet; also showing a Brockie inclined arc-lamp for use with the lantern. He then went on to discuss the uses and advantages of the lantern from an educational and scientific point, and showed several experiments on the screen with a projection microscope, &c. The screen used by the lecturer was a portable one designed by himself, with a view of being made as handy as possible for travelling. Amongst other things, Mr. Pringle showed a scientific biunial, designed for showing diagrams, &c., on the screen before a class, and a projection microscope of a most simple construction, designed by himself. Several pieces of lantern apparatus were exhibited, amongst them being a lantern constructed by Mr. J. H. Steward for using an incandescent lamp of 100c.p.

THE French Minister of Marine has ordered the construction of a submarine vessel which will be larger than any hitherto attempted in any country. This vessel is to be called the *Sirène*. Its length is to be 131ft.

# SCIENTIFIC NEWS.

THERE is no longer any doubt as to the identity of Barnard's comet (*d* 1890) with D'Arrest's periodical comet, discovered first in 1851, and observations made at different places point to the assumption that perihelion did not occur until Sept. 16. Observations made at Strasburg, moreover, show that Barnard's comet must be that of D'Arrest.

The committee which has in charge the photographic chart of the sky is to meet at Paris on March 31 next year, when the last details as to the method in which the work is to be done will be settled, and the international scheme will be commenced as soon as possible afterwards.

A good photograph of the Ring Nebula in Lyra has been obtained by MM. Trépied and Rambaud, of the Algiers Observatory, and a positive copy from the negative enlarged sixty-four times has been presented to the Paris Academy of Sciences. Admiral Mouchez has some comments on the subject in the *Comptes Rendus*, in the course of which he says that the ring is filled with matter difficult to see; but the existence of which is demonstrated by the photographic plate in a sense. The central nebulous star attains an intensity in the "proof" about equal to that of the feeblest maximum of the ring. M. Baillaud has obtained a photograph of the region of the nebula from Toulouse Observatory, which exhibits more than 4,000 naked-eye stars (photographic) in an area of three square degrees. The "exposure" amounted to nine hours.

The death is announced of the Rev. Dr. Joseph A. Galbraith, for more than half a century connected with Dublin University, where he graduated so long ago as 1840. Distinguishing himself as a mathematician, he was soon elected to a Fellowship, and in 1854 he was chosen, along with Dr. Haughton, Erasmus Smith Professor of Experimental Philosophy, and in conjunction with Dr. Haughton published several manuals. He was Registrar of the University, or, as some call it, Trinity College, Dublin.

Mr. Edward Chambers Nicholson, F.C.S., who died last week, aged 63, was a practical chemist, to whose remarkable talent in developing into successful manufacturing processes intricate methods applied originally by the scientific investigator to the preparation of new, rare products, this country owes, in very large measure, the high position which it held in the industrial world in the early days of the coal-tar colour industry. One of the first students at the Royal College of Chemistry in 1845, Mr. Nicholson was selected, together with his fellow student Sir Frederick Abel, by the eminent founder of that school, Prof. von Hofmann, to assist him in the pursuit of his earlier brilliant researches in organic chemistry. After a few years, Nicholson became associated with the conduct of a small chemical manufacturing business, which speedily developed and acquired, through his work, a very high reputation for the production of rare chemical compounds upon a manufacturing scale. Directly after the foundation of the coal-tar colour industry had been laid by the researches of Hofmann and the brilliant discoveries of Dr. Perkin, Mr. Nicholson produced, upon a large scale and of a high degree of purity, certain tinctorial tar derivatives, which speedily acquired great importance.

At the annual meeting of the London Mathematical Society, which will be held on Nov. 13 next, the following changes in the Council will be proposed:—Prof. Greenhill, to be president; Dr. Larmor, Major Macmahon, R.A., and Mr. J. J. Walker, to be vice-presidents; Dr. Hirst and Messrs. Lachlan and Love, to be new members in succession to Profs. Burnside and Cayley and Sir James Cockle, who retire. The subject of the address by the retiring president, Mr. J. J. Walker, is "The Influence of Applied on the Progress of Pure Mathematics." Mr. Walker will also present the De Morgan Medal (which was awarded by the Council in June last) to Lord Rayleigh, Sec. R.S., for his writings on mathematical physics.

The Council of the Institution of Civil Engineers invite original communications on subjects set out in a list they have prepared, which can be obtained by anyone. To approved papers they will award premiums, and will give more than one if there are several papers on the same subject deserving of such recognition. In adjudicating no distinction will be made between outsiders or members, between natives or foreigners, except in the case of the Miller and Howard bequests, the terms of which are strictly defined by the donors. The address is 25, Great George-street, S.W.

The trustees of the estate of Dr. Henry Muirhead, of Lanarkshire, hope to be able shortly to announce the arrangements they propose to make. The estate is supposed to be of the value of £30,000, when certain trusts are satisfied, and it was directed to be used in the establishment and maintenance of Muirhead College for the education of women in medical and biological science, and instruction which would fit them to become medical practitioners, dentists, electricians, chemists, &c.

The institution known as the Normal School of Science and Royal School of Mines is in future to be called the Royal College of Science, London.

Recently at a meeting of the Paris Academy of Sciences, a paper by M. Schutzenberger was read, describing a method of making a sulphocarbide of platinum. Dry nitrogen charged with bisulphide of carbon is passed over spongy platinum contained in a tube, heated to 400° C., when the bisulphide of carbon is completely absorbed, and the platinum is converted into a finely-divided black powder, very dense and homogeneous. It is unaffected by anything except aqua regia, and even that has little action, but heated to redness in dry oxygen the powder burns, when the carbon and sulphur are driven off and pure platium is left.

The *Lancet*, in an "annotation" on the Railway Brakes return, says:—"The residuum of four per cent. of unfurnished stock should shortly disappear from the return, and we hope that the same industry which has been manifested in recent years in replacing imperfect forms of brake will continue to be exhibited by the railway companies. In that case a very few years hence will see the transformation complete, and every railway passenger in the British Isles enjoying the valuable guarantee of security which an automatic and continuously acting brake can alone afford." We do not want a "continuously acting" brake, but a brake that the driver can make sure of finding efficient when he does want it. Let us hope the "few years hence" will see the work complete.

It is stated that carbonic acid (or rather carbonic anhydride) is now employed as the refrigerating agent in vessels engaged in the frozen-meat trade. Brine is cooled by the expanding gas, and is circulated through pipes. The steamer, *Highland Chief*, which is fitted in this way by Messrs. J. and E. Hall, of Dartford, has recently arrived in the Liverpool Docks from the River Plate with a cargo of 39,000 carcases of mutton, all in splendid condition, and it is stated that the coal consumption for working the refrigerating machinery amounted to one-fifth of what it would have been under the old system.

**A Novel Percussor.**—Dr. Kabierski, of Breslau, has invented a novel percussor in the form of a tuning-fork with a cylindrical stem, which is held between the finger and thumb, and thin prongs with rounded free extremities for striking the surface of the body. He claims for this instrument that it distinguishes smaller areas from one another than the ordinary method of mediate percussion can do. He has mapped out by its means the varying movements of the apices of the lungs, and believes that he has shown that the boundaries of cardiac dulness as usually given require to be somewhat modified.—*Lancet*.

**Duration of Life.**—The inferior animals, which live, in general, regular and temperate lives, have generally their prescribed term of years. The horse lives twenty-five years, the ox fifteen or twenty, the lion about twenty, the dog ten or twelve, the rabbit eight, the guinea-pig six or seven years. These numbers all bear a similar proportion to the time the animal takes to grow its full size. But man, of all the animals, is the one that seldom comes up to his average. He ought to live one hundred years, according to his physiological law, for five times twenty are one hundred; but, instead of that, he scarcely reaches, on the average, four times his growing period; the cat six times, and the rabbit even eight times the standard of measurement. The reason is obvious—man is not only the most irregular and the most intemperate, but the most laborious and hard worked of all the animals.

# LETTERS TO THE EDITOR.

*[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]*

*All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

*All Cheques and Post-office Orders to be made payable to* J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

## TABLES OF LOGARITHMS—MOTIONS OF THE NEBULÆ IN THE LINE OF SIGHT—A PROLIFIC COMET—ANGULAR MEASUREMENT OF THE PLANETS—LIGHT AND DARKNESS ON THE EARTH—THE PROPER MOTIONS OF THE STARS—55 PISCIUM—MARS—THE ORIGIN OF LUNAR RAYS—THE PRODUCTION OF LIFE.

[31735.]—Reverting to query 72563 (p. 132), I can now definitely inform "T. B. S." that Dr. Glaisher was my authority for the statement made with reference to Sang's Logarithms in letter 31597, on p. 80. He says (op. cit. p. 60): "Sang 1871. Ten-figure logarithms from 1 to 1,000, and seven-figure logarithms from 20,000 to 200,000, with differences and multiples (not proportional parts) of the differences throughout." Since writing the letters referred to above, I have received a bookseller's catalogue from G. A. Van Trigt, of 6, Rue du Trone, Brussels, in which I find: "Namur A., et Mansion P. Tables de Logarithmes à 12 décimales jusqu'à 434 milliards, avec Preuves. Brux. 1877 8°, 2 francs," a work of which I never heard before. In connection with Gaussian logarithms, I may make a further quotation from Dr. Glaisher, who speaks very highly of a fine table by Wittstein, published in 1866; and goes on to say: "Gaussian logarithms are very useful in the solution of triangles in such formulæ as cot. $\frac{C}{2} = \frac{a + b}{a - b}$ tan. (A − B). This is obvious enough, but as a matter of fact and practice they are not in common use among astronomers. [I had written and posted this to our Editor prior to seeing reply 72563, on p. 191.]

I have just finished reading one of the most important and interesting papers on cosmical physics that has appeared for a long time. It is by that well-known observer, Mr. J. E. Keeler, of the Lick Observatory, and is "On the Motions of the Planetary Nebulæ in the line of sight." The remarkable researches, whose results are embodied in the essay before me, would appear to have had their origin in a request by Dr. Huggins to Mr. Keeler that he would determine the position of the brightest line in the spectrum of the Orion nebula with reference to the lower edge of the magnesium fluting which falls in its immediate neighbourhood, with the aid of the 36in. equatoreal, and also that the character of the nebular lines should be examined. In conducting this examination some sixteen or seventeen nebulæ in various parts of the sky were observed, with the enormously powerful optical means at Mr. Keeler's disposal, and he soon became aware that the brightest nebular line showed a distinct (but of course different) displacement in each of the objects studied; or, in other words, that they exhibited unmistakable evidence of motions of approach and recession. It will be remembered by all interested in the subject that Dr. Huggins himself read a paper before the Royal Society some sixteen years ago on the motions of the Nebulæ towards or from the earth; arriving, however, at a merely negative result. It must, however, be borne in mind that Dr. Huggins's allegation was not (as Mr. Keeler apparently erroneously supposes) that the Nebulæ had no motions of approach or recession; but that such movements could not exceed, or, in fact, equal 25 miles per second, including the earth's motion at the time, the dispersive power employed by Dr. Huggins not admitting of the determination of any displacement referable to a less velocity than this. It is noteworthy that in only one single instance do Mr. Keeler's measures indicate anything in excess of Dr. Huggins's limit; and we have no proof that the motion of this Nebula (H IV. 37) was the same in 1874 that it is in 1890. It is much to be wished that Mr. Keeler's essay could be widely circulated among all interested in spectroscopic investigation. Incidentally, I may mention that it must silence at once and for ever a now notorious paper presented to the Royal Society as an answer (?) to that by Dr. and Mrs. Huggins; in fact, so effectually are the allegations made in that paper refuted by Mr. Keeler as to render it absolutely certain that his reply will not be franked by the Science and Art Department, and that "Frank Rede Fowke" will *not* be "directed by the Solar Physics Committee to transmit" it "for your (or anybody else's) information."

Another curious and valuable contribution to our knowledge of the structure of the bodies occupying space has reached this country from Mount Hamilton, in the shape of an account by Mr. E. E. Barnard of his Physical and Micrometrical Observations of the Companions to the Comet 1889 V (Brooks), made with the 12in. and 36in. refractors at the Lick Observatory. The breaking-up of Biela's comet in 1845-46 used to be referred to in popular works on astronomy as a unique phenomenon; but in 1860, and again in 1881, comets were observed with companions travelling with them *pari passu* in their orbits; and in the case of the one to which Mr. Barnard's observations refer, it was accompanied by no less than four attendants. For a detailed account of the curious physical changes which occurred in these four *comites*, culminating in the total disappearance of the two called "B" and "C" by this observer, his memoir itself must be consulted. In following the comet through the sky with the Great Lick Equatoreal, nebulæ in large numbers were naturally found in the various fields of view—in fact, Mr. Barnard concludes by saying: "I have no doubt but that the great telescope would readily reveal more unknown nebulæ than the entire number now contained in the latest catalogue of Dreyer." It may not be uninteresting to remark that the comet of which I have been speaking is quite possibly identical with Lexell's of 1770, which came within 1,400,000 miles of the earth.

I do not know whether Mr. Moore (query 72643, p. 175) ever attempted to measure the angular diameter of a planet with a micrometer. If not, I can only assure him that it is one of the most difficult observations in practical astronomy. According to our present knowledge, the angular semidiameters given on p. vi. of the *Nautical Almanac*, instead of being "far from right," as alleged by my querist, are really very tolerably correct. I have, however, for his benefit, recomputed them from the latest accessible data—and here they are:

| Planet. | Equatorial semidiameter at the Earth's Mean Distance from the Sun. |
|---|---|
| Mercury............ | 3·358″ |
| Venus............... | 8·350″ |
| Mars ............... | 5·580″ |
| Jupiter ............ | 98·719″ |
| Saturn ............ | 83·758″ |
| Uranus ............ | 34·464″ |

It would be simply impossible to change the data for the various ephemerides to which Mr. Moore refers, with every fresh measure. As for *Knowledge*, it seems pretty evident that, in the case of Mars, "16″" on May 1st was a misprint for 19″. The Jupiter erratum is not quite so easily explicable; unless Mr. Sadler took out the planet's semidiameter for a subsequent day in the month. No one knows better than I do how easily such a slip as this may be made.

I presume (but, of course, do not know) that Mr. H. J. Hook is referring to the concluding portion of Keith's Problem XXII. in query 72648, on p. 175. If this be so, the mention of the wooden horizon of the globe is needlessly confusing. All that my querist need attend to is this: that only one-half of the sphere is illuminated by parallel rays from the distant sun. If, then, the earth rotated round an axis which was perpendicular to the Ecliptic, its poles would be *on* the circle dividing the light half of the world from its dark half, and we should have 12 hours day and 12 hours night at any given place all the year round. But, as a matter of fact, the axis of the earth is inclined some 23° 27′ to a perpendicular to the Ecliptic; so that, at the summer Solstice, the whole of the diurnal path of a place less than 23° 27′ from the pole is described in sunlight and vice versâ at the winter Solstice. When the sun is, technically, in the first point of Aries, he is *on* the equator, and the boundary of light and darkness at apparent Noon is the meridian passing through the VIth and XVIIIth hours of longitude. All places situated between the XVIIIth and the VIth hours then, with the First Point of Aries on the Meridian, must be obviously in darkness, whether above the wooden horizon of the globe or not.

In reply to Mr. Payne (query 72674, p. 176), our knowledge of the cause or causes of the proper motions of the stars is practically nil. Some of them have been referred, more or less plausibly, to the proper motion of our own system in space; while others are directly opposed to it. One most remarkable circumstance is, that groups of stars, whose components must be separated by the most stupendous intervals in space, move in a common direction. For example, while $\alpha$ and $\eta$ Ursæ Majoris are travelling in one direction, $\beta$, $\gamma$, $\delta$, $\epsilon$, and $\zeta$ in the same constellation are going as a group in a precisely contrary one. Mr. Payne's next question is absolutely unanswerable. To reply to it, it would be necessary to know the distance, relative masses, &c., of the components of the system of one of the members of which his imaginary object was a satellite.

In connection with query 72625 (p. 176), I should call the *comes* to 55 Piscium rather a small 9th-magnitude star. There is nothing surprising in this being seen with 1⅝in. of aperture. By hiding its primary, it ought to be seen with less.

I gather from the San Francisco *Examiner*, for which I am indebted to a friend, that that charming writer and master of the romance of Astronomy, M. Camille Flammarion, has been somewhere advancing the idea that changes (real or imaginary) which have been observed upon the surface of the planet Mars must have had their origin in the work of sentient beings like ourselves. Inasmuch as Prof. Holden, not unnaturally, demurred to so startling an allegation as this, M. Flammarion seems to have telegraphed a kind of rejoinder to his reply—a rejoinder which has elicited a pretty crushing retort from the eminent head of the Lick Observatory in the journal referred to. I do not propose to follow Prof. Holden through his sustained argument. Suffice it to say here that he conclusively shows that of the real physical structure, the Areography, and Areology of our neighbour in space we *know*—exactly nothing. Whether the markings we observe on the surface of the planet are really land and water or not, and whether Mars is as densely populated as China, or as tenantless as the Moon, we are as ignorant as we are of the condition of space outside of the visible universe.

While I am quite in accord with Mr. Peal (letter 31721, p. 186) that there are very great difficulties in the acceptance of Mr. Ranyard's theory of the lunar "rays," it would seem very far from certain that his own hypothesis affords the only alternative to it. I must reiterate that what Mr. Peal really postulates is an immutable condition of electrical tension over certain areas of the Moon's globe, a condition of things of which, so far as I am aware, we have no terrestrial experience. Surely your clever and indefatigable correspondent cannot be ignorant of the way in which the very magnetic poles of the earth are in a state of chronic shifting, yet he asks us to believe that a relatively exceedingly narrow streak on the surface of the moon, like the great ray from Tycho, some 2,000 miles long, is, and always has been, in a different electrical condition to those parts immediately contiguous to—in fact, bounding it! I think that both Mr. Peal and Mr. Ranyard will have to try again.

I think that if "J. S. C." (query 72698, p. 199), will consult the current scientific literature of the period during which Mr. Crosse's experiments were made with silicate of potash, he will find that when proper precautions were taken to sterilise the fluid, and to prevent the access of ova from the external air, that insects did *not* emerge from either pole of the battery, negative or positive. Modern bacteriologists are more skilful in preventing the intrusion of germs than Mr. Crosse was.

**A Fellow of the Royal Astronomical Society.**

## NOTES ON THE SPECTRA OF CERTAIN STARS BETWEEN + 10° AND − 15° DECLINATION.

[31736.]—Perhaps it may be useful to give the spectroscopic observations of those stars which Major Markwick (letter 31706, p. 166), finds to differ from the magnitude assigned to them by Gould. Some of the stars I have been unable to identify, having only a rough MS. copy of the "U. A." It is unfortunate that your correspondent has not given the places of the stars. The following observations of the colour and spectra are taken from the spectroscopic zones of Vogel and Konkoly. I trust, if I can find time, to observe the stars not found in either of these works. I give the places from the "D.M.," and the "Südl. D.M.," so that your readers will be able to identify the objects. I have not brought the places up, and so the Epoch is 1855.

+ 2·37° 0h. 12m. 41s. + 2° 14·5′. Mag. 8·0 LL. 349. This is probably identical with Es-Birm. No. 5, a star with a spectrum of bands, found by Pickering.

+ 8·183. Ih. 3m. 19s. + 8° 46·4′. Mag. 7·2. LL. 2097 Vogel; yellowish white; I*a*.

− 4·207°. Ih. 18m. 31s. − 4° 40·8′. Mag. 6·8. LL. 2598. Konkoly; mag. 6·5; yellowish white. II*a*.!

+ 7·213°. Ih. 20m. 47s. + 7° 12·2′. Mag. 7·2. (The Declination in Gore's Suspected Variable Stars is printed with a minus instead of a plus sign.) LL. 2677. Vogel; yellow; II*a*.

− 7·256°. Ih. 26m. 25s. − 7° 45·7′. Mag. 6·1. LL. 2798. Konkoly; mag. 6·5; whitish yellow; II*a*.

+ 6·324°. Ih. 58m. 12·1s. + 6° 20·6′. Mag. 7·0. LL. 3856. Vogel; white; I*a*.

ı°. Ih. 58m. 34s. + 7° 33·0. Mag. 7·0.
. Vogel; yellow; III.!
. IIh. 5m. 24s. – 3° 4·3′. Mag. 5·9.
, mag. 5; whitish yellow; IIa.
0°. IIh. 40m. 56s. – 4° 14·1′. Mag. 7·3.
, mag. 6·5; white; Ia.
1°. IVh. 18m. 23s. + 4° 2·4′. Mag. 7·2.
eddish yellow; III (IIa).
31°. VIh. 17m. 13s. + 1° 21·1. Mag. 7 2.
ellowish white; Ia.
35°. VIh. 28m. 19s. + 4° 37′. Mag. 7·5.
hite; Ia.
38°. VIIh. 21m. 33s. + 6° 52·5′. Mag. 7·2.
ellowish white; IIa?
33°. VIIIh. 8m. 16s. + 3° 13·7′. Mag. 7·5.
l; white; Ia.
32°. 7m. 59s. + 3° 16·1′. Mag. 8·0.
l; white; Ia.
30°. VIIIh. 35m. 53s. – 9° 17·2′. Mag. 6·3.
; mag. 7·5; white; Ia.
94°. IXh. 18m. 14·7s. – 5° 46·9′. Mag. 7·8.
; 6·5; whitish yellow; IIa. LL. mag. 7·5.
46°. IXh. 34m. 58s. + 0° 21·8′. Mag. 7·2.
hitish yellow; Ia (?) IIa.
031°. IXm. 49m. 30s. – 12° 46·7′. Mag. 6·8.
; mag. 7·5; yellow; IIa.
31°. XIVh. 39m. 44s. + 1° 34·8′. Mag. 7·2.
ellowish white; Ia.
226°. XVh. 33m. 12s. – 13° 29·8′. Mag. 7·2.
; mag. 7·5; white: Ia.
33°. XVIh. 5m. 56s. – 7° 44·6′. Mag. 7·0.
; mag. 8; I. continuous.
30°. XVIh. 21m. 19s. + 0° 23·6′. Mag. 7·2.
hitish yellow; IIa.
90°. XIXh. 26m. 37s. + 5° 9·3′. Mag. 6·9.
hitish yellow; IIa.
52°. XIXh. 25m. 58s. + 4° 43·4′. Mag. 7·2.
llow; IIIa?
77°. XIXh. 24m. 34s. + 5° 27·9′. Mag. 7·0.
ellowish white; Ia.
09°. XIXh. 29m. 5s. + 5° 41·7′. Mag. 7·0.
hitish yellow; IIa.
. XXh. 23m. 45s. + 1° 43·2′ Mag. 7·1.
hitish yellow; IIa.
09°. XXh. 24m. 24s. – 5° 43·8′. Mag. 6·8.
mag. 6·5; whitish yellow; IIa.
3°. XXIIh. 18m 45s. – 3° 31·1. Mag. 7·2.
; mag. 7; whitish yellow; Ia.
XXIIIh. 57m. 4s. – 11° 18·8′. Mag. 5·5.
yellow; IIa! **T. E. Espin.**
w, Darlington, Oct. 23.

## ASTRONOMICAL.

]—It is to be regretted that "Tenebris"
ply to the queries of "Bramley" as to
l also I should have been glad if he had
estimation of position.

had the opportunity of examining this star
¼in. Linscott mirror, and had no difficulty
the companion on the two occasions only
as been steady enough to look at difficult
ate. I do not here give the P.A., for I
e to see if those who claim to see it with
approximate to the right place. At the
, it was so well seen in a 12¼in. on a far
l night, that I should think a 6in. would
in a good position.

ebris" still finds his focal images deficient
s, let me advise him to test his flat. I
ery likely many reflectors fail because the
erfect. I have found such imperfections
anifest with high powers by the stars
ing up to a good disc; but, just before
ached, appearing to splash out, and also
ent wings either one way or another,
adjusting will get rid of. These imper-
e not obvious with low powers, but even
ir performance. **H. E.**

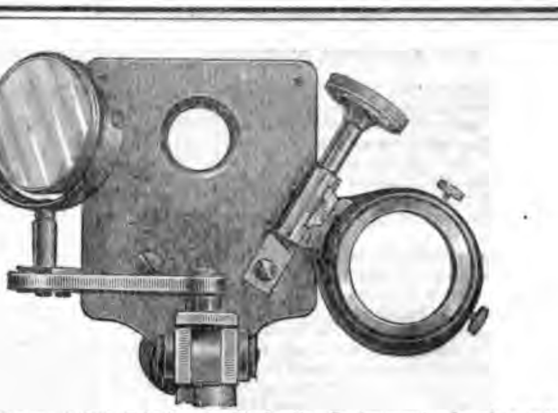
## R'S SATELLITES—POINTS OF THE COMPASS.

—I should like to know if any observa-
piter were obtained on Oct. 19. Rev. A.
F.R.A.S., found that a conjunction of
. would take place at 6h. 21m., and as
moving in the same direction, towards
was quite probable that a partial occulta-
by IV. might occur. The sky here was
ith clouds as well as in other places where
have been otherwise looked for. Last
njunction of I. and III. took place, I.
transit, and III. coming from occultation
lipse.

view was got about 8h. 18m. or 8h. 20m.,
being bad. I. appeared to be directly
III., and apparently barely separated.
y insignificant apparent size of I. com-
at of III., from the time when first seen
as surprising.

on of using a watch as a compass, which
ommented on by some writers in these
is an ingenious one. A person who is
or voyaging rapidly through degrees of
should, however, keep his watch con-
is local time, which is constantly varying.
from the southern hemisphere we had,
day when slightly south of the Equator, the sun exactly overhead, and from whatever point of the horizon the angular distance of the sun from the horizon was taken, that distance was the same.

Hendon, Oct. 27. **P. F. Duke.**



Underpart of Stage, "C" Edinburgh Student's Instrument, showing mirror set at an angle for oblique illumination, and Sub-stage turned aside.

## THE TAIL OF A COMET.

[31739.]—The difficulty of accepting the reasons generally given for the fact that the tail of a comet is always streaming away in a direction opposite to the sun, especially during its perihelion passage, has led me to form an opinion on the construction of comets different to those usually received.

Let us suppose a comet to be a body *completely surrounded* by a luminous gas or atmosphere; which, were it not for the rays of the sun, would be visible as a ball of light, attenuated towards the outside, but brighter in the centre; and the nucleus would shine brightly or not, according to the varying conditions of these little-known bodies.

Now introduce the sun, and what happens? The light of the sun outshines and obliterates the fainter light of the gaseous atmosphere, except on the opposite side, where, owing to the density of the nucleus, and the central portions of the gaseous envelope, the sun's rays are not able to penetrate, and a shadow is cast in which the luminous gas is able to shine; this, projected against the dark sky, forms the tail as we see it.

If this argument could be allowed, the phenomenon of the tail always showing away from the sun would be explained, and it is also a far more simple matter to suppose the shadow to fall on different parts of the comet's atmosphere during the perihelion passage, than to suppose an attenuated tail sweeping round through space, to take up its new and unaccountable position in advance of the nucleus, on its journey from the sun.

It is reasonable to consider that a comet thus constituted has, in common with all other heavenly bodies, a rotation about its own axis, and this offers an explanation for the curve of the tail.

The rays of light that are often observed shooting out in directions other than that of the tail may owe their visibility to shadows of the nucleus, &c., cast on the luminous atmosphere by the light of planets, such as Venus and Mercury, when near enough.

Comets, no doubt, are composed of many different gases or vapours, which would produce a variety of different effects under similar circumstances; and in cases where the atmosphere (as I call it) shines partly by reflected light, all manner of complications may be expected; but the general condition that I wish to contend for is that the nucleus is *entirely surrounded* by a luminous envelope, of which the tail is a cone of vaporous light shining in the darkness of the comet's own shadow.

**J. S. L. L.**

## THE WATCH AND THE COMPASS.

[31740.]—I have met with another interesting way of finding the north and south line with a watch from a shipowner, which your readers may like to see.

If the observer places his watch in the sun, he will notice that a short shadow is cast on the face by the pivot on which the hour and minute hands are fastened. Bring this shadow half-way between the hour-hand and 12 (it will be opposite to it). The 6 and 12 will then point north and south. This is founded on the same principle as the other. The sun is south at 12 o'clock, and the hands of the watch move twice as fast as the sun.

Fordingbridge. **T. Westlake.**

## SUBSTAGES FOR THE STUDENT'S MICROSCOPES.

[31741.]—In your issue of the 24th inst., in the report of the Quekett Microscopical Club meeting, a gentleman expresses his surprise and regret "that the better class of students' instruments should not *always* be provided with something more scientific and practical than the common substage fitting," and particulars are given of the adaptation of a substage to a student's microscope. We would call your attention to the fact that, recognising this necessity over 2½ years since, we fitted a compound substage to our "C" and "D" forms of Edinburgh Student's Microscope, the original design of which was suggested by Dr. Alexander Edington, lecturer on Bacteriology, Edinburgh University. This substage has spiral rack-and-pinion focussing adjustment, and screws to centre accurately; also, it is so mounted that it may be lifted completely aside with the apparatus contained in it and replaced, when desired, as shown in illustration herewith.

The mirror being on a swinging arm, can be set aside when direct lamplight is required.

We believe this is the only form of student's microscope that has hitherto been fitted with so complete a substage; but as we have made it for so long a time, such an adaptation can hardly now be brought forward as a novelty.

**W. Watson and Sons.**

313, High Holborn, London, W.C.

## THE TELESCOPE.

[31742.]—The articles which have lately appeared in these columns, with regard to the question of reflector v. refractor, have left it pretty much where it was before. The following may be called a fair sum-up of all the opinions that have been expressed:

1. Of reflectors, the Newtonian form is the best.

2. That, in point of light, it requires a larger aperture in the reflector, especially if small (say 9in. and under), to equal the refractor; but that, if the silver is properly laid on, and in good condition, the difference is less (say 6 : 5) than was formerly supposed. Also, as the apertures increase, the difference between them in this respect becomes less.

3. The first cost of the reflector is less than that of the refractor; but the reflector requires its films renewed from time to time. It is said, however, that the interest on the difference in the first cost between the two is more than sufficient to pay for the renewal of the films.

4. That, with regard to the instability of the image due to air-currents, the refractor is preferable, on account of its tube being closed at each end. There can be no doubt there are occasions when the refractor performs well, while the reflector will only work with its aperture reduced. But there do not seem to be any occasions when the reflector will work, while the refractor will not.

5. With regard to definition, when the air is perfectly steady, and with telescopes of equivalent aperture (i.e., on the 6 : 5 scale), and with the ratio $\frac{\text{aperture}}{\text{focus}}$ equal, preference must be given to the reflector. (Hitherto the trials of refractor v. reflector seem to me to have been carried on on terms most unfair to the reflector—thus, a 9in. mirror of 6ft. focus is often compared to a 7in. refractor of 8ft. focus. The only fair way of making a comparison would be either to reduce the focus of the refractor to 4ft. 8in., or to lengthen that of the reflector to 10ft. 3in. In cannot be but that the, as yet, unremoved secondary spectrum in the refractor must cause an imperfect concentration of light in the focal image, and therefore, on theoretical grounds alone, the reflector ought to define better than the refractor.)

6. As to colour correction, there can, of course, be no doubt as to the superiority of the reflector.

7. For convenience of observation, preference must be given to the Newtonian reflector. Please bear in mind that, with the exception of the theoretical considerations in parenthesis in No. 5, none of the above statements are mine. Not having worked with a reflector, and having only used small refractors, I cannot give an opinion of my own. Having, however, carefully read both sides of the question in the English Mechanic and else-

where, I have merely made a fair sum-up of the evidence.

The general conclusion we can come to is, therefore, that with the exception of No. 4, "instability of image," the balance of the advantages is with the reflector. The question naturally arises, Will it always be so? In 1886 the microscope was apochromatised; and in 1890, the first apochromatic camera lens was made; but the instrument which was the first to be achromatised has curiously been left out in the cold.

If only the same benefits could be procured for the telescope as have been for the microscope, it would be merely a matter of time before the Newtonian reflector was only to be found in a museum.

I would suggest that something of the form of a dialyte be first tried for the apochromatic telescope. Thus, the object-glass might be a single crossed convex lens about 6 : 1, having of course its more convex surface towards the object; and a little short of its focus, that is between the object-glass and its focus, might be placed a negative corrector, a cemented triple, consisting of a biconcave between two convex lenses.

The mere thought of seeing a brilliant, sharp, and colourless critical image in a dioptric telescope is sufficient to make one's mouth—I mean eye—water.

**Edward M. Nelson.**

## CONTINENTAL LOCOMOTIVES.

[31743.]—I quite agree with "D. W. L." (letter 21733), and think it a pity that almost no notice is taken with regard to Continental, and, I may add, American, practice. Surely it would be satisfactory to be able to compare our Scotch and English locos. with those across the Channel and the Atlantic, and judge for ourselves about their respective merits?

I would like to add that considering what rapid strides are being made nowadays in another branch —viz., "Marine Engineering," it might not be out of place to say that I think it would be of general interest to our readers to have a few sketches, and get some information about marine engines, for, so far as I am aware, this subject has never been taken up in "ours." **J. A.**

## LOCOMOTIVE HISTORY.

[31744.]—It has always been well known that the heavy coal traffic which had to be conveyed between the Swannington incline, Coalville, and Bagworth incline, necessitated the use of powerful engines in the very early days of the Leicester and Swannington Railway Company. One of these was delivered "in steam" at the West Bridge Station, Leicester, on 2nd April, 1835, by Messrs. Tayleur and Co., of the Vulcan Foundry, near Warrington, being No. 10 in the lists of the makers, and No. 8 in the books of the Railway Company, and was named "Vulcan."

Through the courtesy of the Vulcan Foundry Company in furnishing me with certain particulars, and as a result of my own search amongst other official records, I am now able to place before your readers the complete details of this interesting link in the chain of locomotive history. The official documents show the dimensions to have been as follows:—

| | | |
|---|---|---|
| Diameter of cylinders | 0ft. | 16in. |
| Length of stroke | 0 | 20 |
| Diameter of six-coupled wheels | 4 | 6 |
| Length of boiler barrel | 8 | 6 |
| Diameter of boiler (inside) | 3 | 11¼ |
| Number of tubes | 154 | |
| Diameter of tubes | 1⅝in. | |
| Heating surface of fire-box | 64sq. ft. | |
| Heating surface of tubes | 585sq. ft. | |
| Total | 649 | |

Working pressure of steam, 60lb. per square inch, afterwards increased to 70lb.

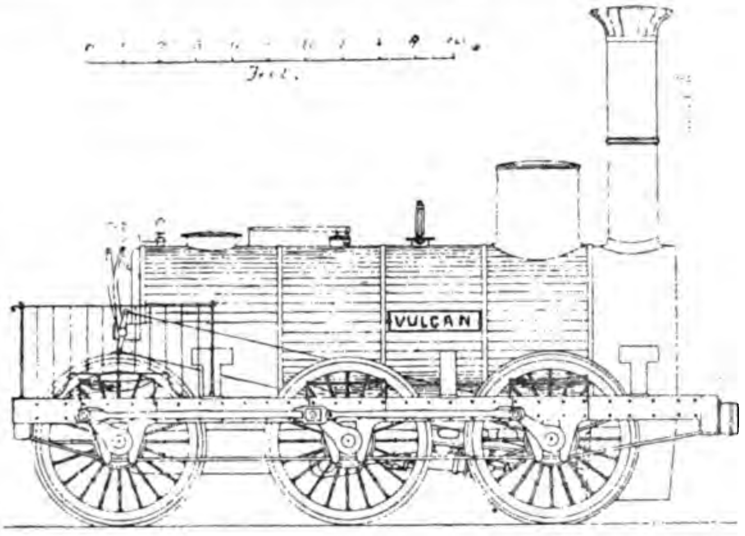
| | | |
|---|---|---|
| From front of frame to leading wheels | 4ft. | 5in. |
| From leading to driving wheels | 5 | 6 |
| From driving to trailing wheels | 6 | 1½ |
| From centre of trailingt o back of frame | 2 | 10 |
| Total length ot frame | 18 | 10½ |
| Length of wheel base | 11 | 7½ |

The cylinders were placed low down, the piston-rods passing under the leading axle.

| | |
|---|---|
| Distance from rails to top of frame | 3ft. 4in. |
| | tons. |
| Weight of engine in working order | 17 |
| Weight of tender fully loaded | 5 |
| Total | 22 |

The driving wheels were without flanges.

The valve-gear was of the loose-eccentric type, there being but one eccentric for each valve loose upon the driving axle. Motion was communicated to the eccentrics by means of studs or drivers which engaged with slots in plates attached to the axle. By means of a treadle on the foot-plate the engineman shifted the eccentrics from side to side and caused them to engage with the forward or backward stud. Another handle enabled the engine-driver to lift up the small or gab ends of the eccentric-rods, after which he was able to start or reverse by means of the two hand-gear levers shown on the foot-plate. When started, the driver allowed the eccentrics to drop into gear, and they continued to actuate the valves.



The "Vulcan" was stationed, when new, at Coalville, and worked satisfactorily for many years, and became the property of the Midland Company in 1846, when the Swannington line and its rolling-stock was purchased.

**Clement E. Stretton, C.E.**

Leicester, Oct. 21.

## A RAILWAY-ENGINE PROBLEM.

[31745.]—It is known to your readers that the able president of the Institution of Mechanical Engineers, Mr. Tomlinson, lately gave an address including much information upon locomotives. As a result, much discussion is raised in railway circles upon some questions of dates.

Who invented the first locomotive engine with four eccentrics? We have always learnt that it was Hawthorn in 1835; but now it seems, according to Mr. Tomlinson, that it was not till 1840, or a very considerable difference of five years.

Will any reader who may know kindly say when the Lord of the Isles was built for the Great Western, also Midland, 648, 784, Caledonian 8ft. 2in. single engine; Great Northern, 776; and Midland, 1738 class? These dates would set at rest two points raised by the address referred to.

**A Railway Man.**

## RULE FOR ELECTRIC BELL AND ALARM WIRING.

[31746.]—In the fitting of electric bells, signals, fire and burglar alarms, &c., and more especially in repairs, renewals, or additions, it is of great importance to be able to distinguish "battery wires" —i.e., wires leading direct from or to the battery— from "connecting wires," i.e. wires running between pushes and indicators, indicators and bells, alarms and bells, &c.

I have devised a rule (see page 56, "Practical Electrical Notes," 2nd ed. Spon), the adoption of which enables "connecting wires" to be distinguished at a glance from "battery wires," and what is more, "+ battery wires" and "− battery wires" are clearly indicated.

My rule is as follows:—

"All wires leading from the + pole of the battery to any push, &c., should be of a plain, bright colour (say white, yellow, or red); all wires running between apparatus—connecting wires— should have a covering in which two or more colours are blended, and all wires leading direct back to the battery should be of a plain, dark colour—preferably black."

The adoption of this rule by electric bell-fitters would, I beg to suggest, save much valuable time which is now wasted in what is generally termed "testing."

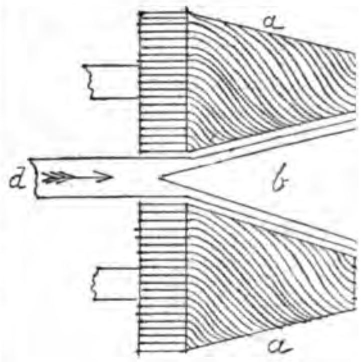
**W. Perren Maycock, A.M.Inst.E.E.**

## SEAMLESS TUBES FROM SOLID BLOCKS OF METAL.

[31747.]—The sketch which appeared in the "E. M." of Oct. 17, page 163, *re* above, is somewhat misleading, and I think you will find one inclosed more correct. *a a* are the rolls, *b* is the mandrel, *c c* the expanded tube, and *d* the solid bar.

I also send cutting from local paper after the visit of Government inspectors. I can correctness of sketch, having seen process:—

The principle upon which Mannesman process is based is a most simple one; it drawing the skin of a metal cylinder in descent condition, as it were, over its cylindrical rod confined between tw revolving in the same direction is, as knows, simultaneously advanced and The law, according to which these move place, forms part of the branch of science kinematics, which teaches us that the motion may be increased by arranging driving wheels so that their axles are in certain angle to the axis of the metal oblique rolling process). From the rollers in this manner the rod or bar, in addit forward motion, receives rotary motion, sequently it moves helically. This form- action of the pressure of the rotary hard will be understood, mainly affects the layers of the material, especially when th been softened by heat—an operation to submitted the cast-steel cylinders in th instance. Now Messrs. Mannesmann's consists in providing each of the roller direction of which the cylinder is introduce them, with a conical projection which, by the space between them, acts as a brake, w enables the outer layer or shell of the inc cylinder—that is to say, the part sustai of the pressure, and most of the moving pass between the rollers, while it retains portion or core. This brake action ma produced by means of a rod or mandre between the rollers and adapted to prevent layers of the metal—i.e., the core of the c block, from being carried along with layers forming the shell. The functio mandrel used not to be exactly realised, been compared with that of a drill and while its action is really that of a brake the ends of the cylinder or block are so pro as to be capable of passing between the rol out pressure, the result is a curiously sha closed at both ends, and somewhat simi cocoon of a silkworm. The distribution of cules of the metal thus acted upon is quite they take up a helical position, the inclin convolutions being steeper in the inner st in the outer ones. Thus a regular fabric fibres is obtained, and the result is a s worked material five or six times stronger tubes hitherto manufactured. Mr. Pri



UNIC NEW YO

Tedding has found by inspection through a ope that between the fibres there are formed bes which, however, do not extend to the l surface of the pipe. The walls of the ppear to possess no pores and to remain ious even under the highest pressure: an ance which iron treated by other methods t present. Upon the inner wall of the pipe at the ends small crystals have been found , owing to the peculiar molecular displace- A perfect vacuum does not exist in the bore, it be supposed, for Prof. Finkener has found e filled with a mixture of 99 per cent. of en, and one per cent. of nitrogen and other This liberation of hydrogen adds a novel teresting element to the steel theory. The valled tubes or "blanks" with narrow bores d by the process briefly described above, may finished by being passed through a second rollers, in which they are driven on to a mandrel, and thereby made to acquire the width of bore. There have already been d to America tubes measuring as much as a diameter. Tubes of the size of a pencil looked upon as dwarfs in comparison to lmost gigantic tubes.

, Neath-road, Landore. **E. T. B.**

## INTER-PLANETARY AND INTER-STELLAR MEDIUM.

18.]—Some time before the last long-con- "Ether" discussion commenced in your s I had been at work upon a paper upon the , endeavouring to form some theory of this ed "ether" which could account for most puzzles and anomalies connected with the ission of light and electricity, and was, after gone some little way with my subject, led to "thought" in my category. Pressure of s put a stop to my completion of the paper tion; but I thought it might perhaps serve a useful discussion if, instead of giving the for my deductions *in extenso*, I give as as possible the deductions themselves with a e that (if deemed of sufficient interest, and ill kindly allow space in your valuable s) I will give in a future number some of the ad reasons which have led to my conclusions. premise that astronomical phenomena have good deal to do with the matter, and that of these which have hitherto been a puzzle, to admit of an easy explanation if the truth of these speculations be admitted. To assist essing myself with brevity I have adopted a tic style of assertion which would otherwise been avoided in statements open to such ence of opinion.

nter-stellar space is (partially) filled with a elastic medium consisting of uncondensed in its ultimate state of sub-division—the atom—having an inherent repellent force, ticles consequently not in contact, and there- oving without friction, but subject to the ion of gravitation.

very planetary and stellar body forms a centre action for this medium, which is consequently at its surface, decreasing in density in in- roportion to the square of the distance from ody. To illustrate my meaning, our sun form a centre from which the density of this n would decrease gradually until it reached condensation system" of every other star to us. The planets would, however, form ary "condensation systems" within that of .

Then two suns are so distant from one another portion to their mass that the limits of their ive centres of condensation do not meet each nd no other body intervenes to supply the caused, such bodies become absolutely l from one another, light does not pass, and ly also the influence of gravitation is unable xerted.—Query: Will not this account for f the variable and temporary stars?

his inster-stellar medium is capable of trans- energy in two entirely distant modes—by ropulsion and by wave motion.

ght is transmitted by wave motion, and with t intensity through the densest portions of dium.

his medium pervades all matter moving with r less freedom between the molecules of ; but when associated with matter, only when impelled to do so by some force.

current of electricity is transmitted along uctor by propulsion of this ether—similarly urrent of air through a tube, different con- s offering varying resistance to such trans- , either from a difference in the shape of nolecules or their closeness together, such g resistance producing by friction of the particles a greater or less amount of heat, f the resistance is very great, preventing her its motion between the molecules.

ich a motion in the ether particles in a tor may be produced either by forcing addi- particles into one end and providing a means r escape at the other, or by altering the chemical composition of one end so as to lessen or increase its capacity for retaining the ether atoms in association—e.g., in a battery, the element forming one pole of the conductor is dissolved, thus tearing asunder, so to speak, the molecules retaining the ether atoms, and its capacity being thus reduced, the ether atoms are forced along the conductor, forming a current of electricity in the reverse direction to that assumed by the usual theory; or, if we assume that each liberated molecule as it dissolves carries with it more than its proper proportion of ether atoms, we have a current moving along the conductor in the positive, or, generally accepted, direction.

9. It seems reasonable to suppose a wave motion taking place in a solid conductor and transmitted along a conductor at the enormous velocity of an electrical current, and it seems far more reasonable and more consistent with observed facts to attribute an electrical current along a conductor to a forward or recessional movement by a small amount of the whole of the ether particles in such conductor.

10. A current of electricity, or perhaps more correctly, a manifestation of electricity, also occurs when any body moves from a rarer to a denser portion of this medium, or vice versâ, as in comets, the length of tail in these bearing, generally speaking, a proportion to the size of the nucleus and the velocity of its motion. This theory also accounts for the curvature of the tail in comets. The nebulous and ill-defined appearance of the asteroids, which move in very elliptical orbits, may be attributed to this cause, as also in a less degree the nebulosity surrounding the planet Mars, and which extends to a much greater distance around the planet than an atmosphere of similar nature to that surrounding our earth could do.

11. The zodiacal light and corona may be supposed to be this ether, condensed into ultra-gaseous molecules, offering little resistance (if any) to the motion of a solid body; but yet sufficiently condensed to reflect the rays of sunlight under favourable conditions. This condensation extends beyond the orbit of Venus; and it has often seemed to me almost certain that the red sunsets of six years ago were caused by a tide in this condensed matter, causing it to come within the sphere of our earth's attraction. This tide was probably caused by the combined action of the planets Jupiter, Saturn, and Mars with the earth. Photographs of the corona taken in total eclipse seem to indicate a condition similar to what I have suggested. This same tidal action is also probably the chief factor in the periodical activity of the sun, the tolerably regular eleven or twelve year period being doubtless due to the combined tidal attraction of the larger planets, the irregularities being due to the action of the minor planets.

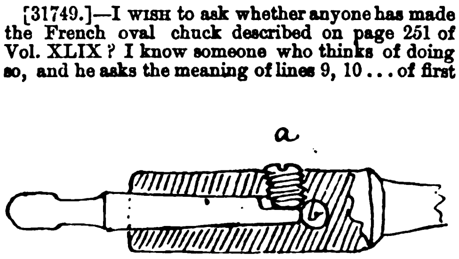
12. Each atom of the ether connected with our system is revolving in an orbit around the sun, and, of course, obeying the universal law of gravitation. It necessarily follows that the mean motion of the atoms lying in the orbit of any planet will be identical with the motion of that planet, so that even if a certain amount of friction were to exist in the passage of a solid body through this medium, it could not sensibly retard the velocity of that solid body if moving around a common centre of gravity.

There are a great many other phenomena, which may be easily explained by admitting the perfect elasticity and repellent force of the ether atoms and their individual obedience to the laws of gravitation, upon which, if you will kindly allow me space in a future number, I should like to gather the opinion of some of your readers. **W. S. P.**

Wellington, October 27,

## THE FRENCH OVAL CHUCK.—DRILLING SPINDLE.

[31749.]—I wish to ask whether anyone has made the French oval chuck described on page 251 of Vol. XLIX? I know someone who thinks of doing so, and he asks the meaning of lines 9, 10 . . . of first column: "This recess is bored through the centre with a conical hole." Now in Fig. 1 the recess appears to be bored in the mandrel, and hardly at all in the body of the chuck as stated in the description. The translation is quite correct, and I noticed the same thing in reading the original work. I incline to think it will make no difference to the working of the chuck which way it is made.



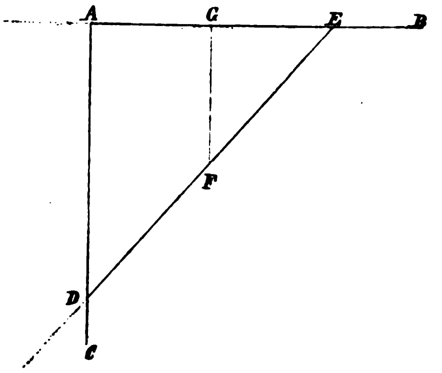
I think we should be much obliged to "C. C. E." for giving us the results of his experiments, and I beg to say I hope the writer on the drilling spindle, etc., has some more papers in store.

Fig. 1 shows a plan I have hit upon for fitting drills into a drilling spindle, which ha[illegible]vantages, and is more easily made than the ordinary way. (*a*) is a screw with flattened end which prevents the drill from turning, and can be used to fix it; a nip with screw-driver prevents the possibility of drill working loose, and does not throw it out of centre. (*b*) is a little hole to push out drill. I find it very easy to fit the drills into this holder, because you can withdraw (*a*) and fit to the hole only, then for the little flat on drill you fit it into the drill holder of the goniostat. It is much more difficult when you have both fittings to attend to, and do not know which bears. **F. A. M.**

## COPYING DRAWINGS TO A REDUCED SCALE.

[31750.]—Referring to "J. R. C.'s" letter, 31718, I give a diagram and explanation of a method I employ, and which has been in use for 20 years in the office in which I am engaged. For example, suppose that the drawing is to be reduced to three-fourths, draw a straight line A B of any length. From any point A drop a perpendicular A C at right angles to A B. Lay off on A C a convenient distance A D. Then with D as a centre and radius of a length of which A D is three-fourths the original drawing, cut A B in E, join D E and the diagram is completed.

If any dimension E F from the original drawing is with compasses applied from E along E D, then F G will be the reduced dimension.



It is not necessary in practice to draw the line F G, as, by oscillating the point of the compasses, the point of perfect contact will be easily got, and will be the required reduction. The lines A B and D E may be produced in the direction of the dotted lines, thereby enabling the draughtsman to measure longer distances than that for which the diagram was at first constructed, should occasion require. **William Hastie.**

162, Hospital-street, Glasgow.

## SMOKE-CONSUMPTION.

[31751.]—I have often thought it possible that fire may be made to burn in a circle by a mechanical arrangement of draught. If this could be accomplished, all the gaseous parts of coal would be effectively consumed, leaving only the earthy residuum, and thus the consumption of smoke would be achieved, and a great saving of fuel effected as well, and, in addition to these benefits, a larger amount of heat would be secured.

**J. R. S. E.**

## ETHER: CORRIGENDA FOR COMPOSITORS AND CRITICS.

[31752.]—I was exceptionally unfortunate as to errors of the press in my letter 31720, p. 187, probably because I wrote it at a pace exceeding even my usual rapid writing, and had no time to look it over before posting. A little intelligence in the readers will see the errors; but I cannot count upon that from some of my critics, who are quite able and willing to found some sort of condemnation upon such matters. Col. 1, p. 182, line 7, "*pressure* of matter" should be *presence*. A few lines lower should read, "there is some reason *to* believe." The 3rd line from end of penultimate paragraph should be, "the reader should understand that *these* are private, friendly letters."

It is quite natural for a mere casuist to falsify his opponent's statements and arguments, to enable him to beat these "men of straw," as these creations are called, when the real arguments are beyond his power to answer. But, to say nothing of the breach of the command "Thou shalt not bear false witness against thy neighbour," such a course does in no way advance the argument, nor does it conduce to respect in the minds of intelligent readers. It only gives a temporary triumph to the casuist personally, and a shadowy sense of victory in the minds of the unintelligent or prejudiced reader.

"W. C. E." is an old reader and contributor, and knows perfectly well that, whether my views as to the ether are correct or not, I am neither a fool nor an ignoramus writing without knowledge of my subject; therefore he has no right to impute to me statements or ideas which none but a fool or ignoramus would set forth. If he will not take the trouble to read what I say with sufficient care to understand my meaning, he has no right to criticise me at all. If he has so warped his mind that he is unable to see anything except from his own special aspect, his criticisms would be of no importance. But at least he should refrain from making me say things of which no indication even can be found in my words.

His letter 31730, p. 188, consists of four paragraphs, every one of which is a deliberate mis-statement of my position, and in every one is an attempt to make me appear ridiculous in the light of that mis-statement. He says: "Momentum does not in any way depend upon gravitation; but 'Sigma' appears to have his own definitions." I challenge "W. C. E." to point out where I have used any words which can even be twisted into giving a colouring of truth to this suggestion. But momentum is one of the elements of dynamics, and in letter 31696, p. 142, when replying to "W. C. E.," and explaining my objection to applying the dynamics of ordinary matter to the ether, I said: "How can the laws of motion, the facts of momentum, be applied to a substance having no weight and resistance to motion." Instead of answering that legitimate question, "W. C. E." falsifies my words and sneers at me. Readers will probably doubt whether he can answer.

"W. C. E." says, "shall require (with 'Sigma') two ethers." He knows that my whole argument is that the facts of electricity require no ether at all, and that ordinary matter is their whole source. He says I am bound to give an explanation of gravitation phenomena, which as yet no one has done, though "W. C. E.," posing as a prophet, says one is "looming." Well, when the American matron wanted her daughter to pass free into the show of Artemus Ward on the ground that she was a gushing child of nature, that scornful showman replied, "Let her gush." So I say, let it loom. I have often seen the "loom of land" which turned out to be cloud-land.

"W. C. E." says I prefer to travel solus first-class, while he goes third with the common ruck of mathematical physicists. I am not quite so solitary as he fancies. But Milton describes one solitary angel revolting against the leading of Lucifer. Well, I should prefer the rôle of the faithful Abdiel, clinging to truth instead of following great names, and so going with the multitude to do evil.

"W. C. E." says: "As to some of the facts, the mathematical physicists of the world, who are also skilled experimentalists, say they do exist. 'Sigma' says they do not." Every clause is either an absurdity or a falsification of my position. It can only refer to my denial of the existence of magnetism and electricity in interplanetary space. Have these "skilled experimentalists" tested space? Have they adduced a single fact as to what occurs in space? Where do I deny the *facts?* What I deny is simply an *inference* from facts which I admit, and explain differently. Will "W. C. E." accept my long-standing challenge to these skilled mathematicians? Will he attack my two propositions?—1. That the sun is not a magnet, because its temperature vastly exceeds that at which magnetic force ceases to exist 2. That electric and magnetic lines of force cannot exist in space concomitantly with the unchanging attractions of gravitation. Until these propositions are disposed of, the theoretical inferences of mathematical physicists and skilled experimentalists are mere idle words.

**Sigma.**

## ELECTRICITY AND ETHER.

[31753.]—The remark of "W. C. E.," p. 188, "Those who reject action at a distance are, to be consistent, bound to give another explanation of gravitation phenomena," savours, I think, rather much of the time-honoured resort of baffled bumptiousness—"If it's not what I say, then what is it?" Why are they "bound to give another explanation" of anything they see reasons for doubting? I am not speaking for or against the ether hypothesis—I don't know enough about it to do so; but I admire fair-play and some show of reason in a discussion. Most of us have, I suppose, to take the ether temporarily on trust; nevertheless, I confess I should feel more kindly towards it if its supporters showed more of the qualities just named with less contemptuous dogmatism and mere empty cynicism than has been displayed by some of "Sigma's" former opponents. Such tactics are usually those of a logically weak cause, whether the ether be so or no, and such attacks were unworthy of any scientific discussion; they simply caused pain, perhaps less to their object than to those who have appreciated for so many years "Sigma's" contributions to these pages. As a non-mathematical physicist myself, I lay this flattering unction to my soul and commend it also to all sneerers, covertly or openly, at non-mathematicians. Faraday is said to have laughingly observed that he never made a mathematical calculation except when he turned the handle of Babbage's machine. I have an idea mathematics might have spoiled him. Now who among subsequent physicists may be compared with him?

Belfast. **J. Brown.**

## VIOL D'AMOUR.

[31754.]—I beg to thank C. J. Tahourdin for his drawings and measurements of the above instrument, and I feel encouraged to presume on his good nature to ask him to answer the following:—What is the reason we hear so little of the viol d'amour? Has it some defects which cause the violin to be preferred? Perhaps the difficulty of tuning may be against it, as I suppose that is more difficult.

In making one, would it be advisable to take the thickness of back and belly, &c., from the measurements given for a violin? That is in proportion to size, as the viol d'amour is much larger than the violin; it would thus be much thicker. What difference does the flat back make? I should think, if the arched back is preferable for the violin, it would be so for the viol.

Now the strings, what gauge are they? If the lowest note on the viol is D, will the D-string of the violin do for the thickest string, and A and E stand for the others? And, also, what gauge are the steel strings? I don't understand the sentence, "It is tuned in thirds and fourths, so as to give the common chord in two octaves"; but if you say what note each string is tuned to, I can manage.

Liverpool. **E. P.**

# REPLIES TO QUERIES.

*⁂ In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[71902.]—**Centrifugal Pumps.**—The experiments of General Morin with a so-called Appold centrifugal pump gave the following results:—

| No. of trial. | Litre per minute. | Height in mètres. | Rev. per minute. | Us. effect. |
|---|---|---|---|---|
| 4. | 5832 | 5·69 | 792 | 0·685 |
| 5. | 5610 | 5·897 | 788 | 0·68 |
| 6. | 5676 | 5·897 | 800 | 0·65 |

Morin says the trials show conclusively that the Appold pump is capable of yielding a U.E. of from 65 to 70 per cent., if placed in the suction water and rotated at suitable speed. The pipes are of such sizes as to allow of a water velocity of very nearly 1 mètre (3·28ft.) per second. Some trials at Berlin with a centrifugal pump capable of lifting 20,750 litres per minute (4,567 gallons) 6·75 mètres high, gave 1 effective horse-power in water lifted per 1·639H.P. indicated. Assuming the engine to consume 1·5kil. (3·3082lb.) of coal per I.H.P. per hour, the work done would be 100 cubic mètres of water lifted 1 mètre high with a consumption of 1kil. of coal, or 5,780c.ft. 1ft. high with 1lb. of coal. Marienberg.

[72086.]—**Model Locomotive (U.Q.)**—I do not think any small model injector can ever be made to work continuously, because the nozzles become choked with the solids held in suspension in the water. J. H.

[72168.]—**Electric Bell and Battery.**—As a bell-fitter of some experience, I may perhaps be allowed to state my views on the above subject. Although I have been engaged in fitting electric bells for the last ten years, I have never troubled which terminal of the battery I have connected to the main push wire. In my opinion, the reason why one terminal should be used in preference to the other is only because of the greater convenience given by a universal rule. Of the many electric bell-fitters I have come across, one makes a practice of connecting up zinc, and another carbon. Myself, I usually connect just which is handiest after the battery is in position. I feel quite satisfied in my mind that if good wire is used, it does not matter which terminal of the battery is employed.

C. Grahame.

[72168.]—**Electric Bell and Battery.**—Perhaps Mr. Edwards will get over his surprise when I tell him that I write what from experience I have found to be the case, and not what is suggested or indicated to me by others. Probably Mr. Edwards has had a large experience; but there are others who have had quite as much, if not more. I have had to do with quite as many installations as he mentions, and I will be bound of a more varied character. I should hardly have the assurance to write a book on electric-bell fitting did I not think I had had enough experience to allow me to speak authoritatively on the subject. No one, I think, who has read "Practical Electric-Bell Fitting" will accuse me of advocating "jerry" work; but will acknowledge that, if anything, I have erred on the right side. Mr. Edwards's remarks about zinc being put to push in order to enable the job to hold out till paid for are too ridiculous, as the bells would cease to ring were there any serious leakage; and, moreover, it is customary nowadays with all respectable contractors to guarantee their work—at least, I do mine, both in electric-lighting and bells.

F. C. Allsop.

165, Queen Victoria-street, E.C.

[72168.]—**Electric Bell and Battery.**—While agreeing with Mr. Allsop that from a practical point of view it is quite immaterial which pole of the battery is connected to the push wire, I should certainly recommend that if we are to take into account the "electro-dissolution" of copper which (theoretically) occurs, the zinc pole of the battery be connected to push, and not "carbon to push," as advised by Mr. Moseley. The reason for this is very simple. It is admitted that in all ordinary cases the total length of push wire is far exceeded by the aggregate lengths of the indicator wires. If, then, we assume that the leakage (and therefore the electrolytic corrosion of the copper) takes place more or less uniformly over the conductors connected to the copper pole, the greater their length the less will be the action at any one point; consequently the wires last longer before a breakdown occurs. On the other hand, if we take the more probable case of a break due to a bad leakage at some one or two points only, surely it is preferable that the communication from one push should be interrupted rather than that one of the main wires should go and the whole system be brought to a standstill. But, after all, how often do breakdowns due to "electrolytical corrosion" take place, or anything worthy of the name of wiring? One can imagine that with paraffined cotton-covered wires imbedded in damp plaster it might happen, and the sooner the better; but not otherwise, for we must remember that the E.M.F. of the battery seldom exceeds five to ten volts. It is hardly necessary to recur to the point which Mr. Allsop keeps on emphasising—apparently to deaf ears—namely, that no leakage can take place without at least two faults on wires connected to opposite poles of the battery, and therefore if the shorter of these is thoroughly well insulated, it reduces the wear and tear on the other and more poorly insulated wire just as effectively, no matter whether it is connected to the C or Z pole.

E. J. Wade.

[72246.]—**Solenoid.**—Will Mr. Bottone please say if the plunger or piston is required to be of a diameter just to pass in and out of 2in. diam. core tube, and should it be of solid iron? I don't know if I made it quite clear when I asked my question. It is not that I want to pull from 2lb. to 4lb. into the coil, but that I want it to pull a lever with a weight on to that amount on it. Is the chromic-acid battery what is known as a bichromate, made of bichromate and sulphuric acid, and is it one cell of 5 pints, or 5 cells of one pint each in series? I shall want it in circuit for six or seven hours at a stretch. How often (about) would they want recharging? I think 2lb. will be enough to do what I want. R. Taylor.

[72311.]—**Driving Mechanism for Tricycles.**—I thank "Nun. Dor." for his reply to my (I must confess) obscure query. I wished to know if there were any good tricycles made on the principle I indicated. My own device is a double-rack geared with two pinions on the driving-wheel axle. The rack-lever has two arms connected with the pedals. A pressure of 84lb. on the pedals through 12in. gives 112lb. in the rack, through about 8in., sufficient to drive a 40in.-wheeled machine over the circumference of its wheels. In the whole affair I do not think more than 7 or 8 per cent. would be lost in friction. There is nothing for dust to lie on or stick to. The power could not be more directly applied, and every pound on the pedals tells through every inch of its course. The movement of the pedal is an up-and-down one. The contrivance would also lend itself readily to the direct application of steam—or smoke, does "Nun. Dor." say? If "Nun. Dor." feels interested, and would advertise an address, I would recoup the charge and send him a sketch. Cycloid.

[72361.]—**Power of Elastic Springs.**—I mean indiarubber or anything else that is more powerful than steel springs, weight for weight.

Inventor.

[72369.]—**Resin Oil.**—Will you kindly allow me to explain more fully what I mean? I mean the oil that is obtained by the distillation of common resin after the crude turpentine has come over.

E. C. M.

[72393.] — **Magic Squares.** — In reply to "Z. Y. X." ("E.M.," p. 190), "**nasik**" is, in itself, a word without meaning, and is used in no science, and therefore not very likely to find its way into dictionaries. Nevertheless, it is an adjective that has been employed for thirty years or more to denote a property of certain magic squares that have been under discussion. The reason of its adoption lay in the circumstance that the Rev. William Frost, who was the first to call attention ind of magic square, called them "Nasik" ıfter the place where he resided—Nasik, a [ndia. The article on magic squares in the ·œdia *Britannica* was written by him, and ıares are alluded to in it. T. S. B.

.]—**L. and N.W. Express Compounds.** ıerist will find all the information he re- ı back volumes, and no doubt Mr. Webb would oblige him with the dimensions he , or he can find them in the engineering )esides the "E. M." The Teutonic, No. ıs illustrated on June 14 and again in the for July 26 last year, so that one or the the numbers will surely be in print. The may also be referred to pp. 80, 99, Vol. . and to the indices generally. VIDEO.

.]—**Problem in Heat.**—There is an error in this question; but as it is of little ıybody, the querist may be recommended ıre the difference in diameter at the different tures by means of a pair of calipers or a rth measuring machine. C. L.

).]—**Wall's Bleaching Process.**—Does :ist mean Watt's bleaching process, or what oes mean? Some kinds of "fat" are not eached, even with sulphurous acid, and yet ıre asked to explain to a man who does not himself. S. R.

.]—**M.S. and L.R.**—There is a sketch of the locos. on this line on p. 192 last but dimensions are not given. Fail to special features—in fact, the sketches ams, or whatever they are, of locomotives pace that might be better filled. In this the Midland have had locos. of exactly pattern running for some years.

T. M.

.]—**Autumn Leaves.**—Dry the leaves ıly in blotting-paper, and then soak in ›araffin wax—just melted, no more. Drain , and if necessary rub gently with a bit of -paper or a soft cloth. S. R.

.]—**Bookbinding.**—Some simpler method g books than by machine—that's the query. ere is nothing of the kind; but books can be ıeans of a sharp knife run against a glass a guide. A steel block will do, such as the the press; but it takes a very sharp knife to , and all that need be attended to is to tting the guide. C. M.

.]—**Black Glaze.**—"W. J. P." has ›ought or found a "pup," as it is called in s. Whence did he obtain his recipe?

L. R.

.]—**Analysis of KOH.**—I have most of books on analysis published in English, and " can point out the information I require, ›blige. I have not been able to find it.

J. H. BOOTLE.

.]—**Colliery Working.**—You are prob- ing about 400H.P. of work. You would about 140,000c.ft. of compressed air (at er hour, and this quantity could be obtained *louble* sets of air compressers and engines, 24in. by 40in. stroke, making 60 revolu- r minute. Four might possibly suffice; but tion of a fifth is safer, and always desirable erve in case of repairs, &c.

MARIENBERG.

.]—**Fountain.**—I should like to see a f a "perpetual" fountain, and shall feel if "Caldemone" will also explain the object wer reservoir (connected with tubes in the described) in his reply to the above query.

E. P. J.

.]—**Medical Battery.**—While thanking tone for his reply, I must confess I do not ıderstand it. Could he aid me with an ion, or tell me where I could get a reliable the subject, and one that would give me want? I was treated some time back for s, &c., from a 20-cell battery, and which ıt did me much good. I now want to fit a battery for my own use if I can. The strengths of current were drawn off by an arm to different studs with the number n use marked on them. This seems to me, I can understand it, a much simpler way ng the plugs, &c. I should like, if I could, it up a current reverser, so that the current e reversed without touching the arm or the electrodes. The fitting of the Faradic think, I could manage. Any information gladly accepted, for I found three months' ıt with electricity do more good than two rugging. I may add that my knowledge of natters (such as it is) was picked up while eatment. CHARLTON.

.]—**Giffard's Carbonic-Acid Gun.**— gazine or reservoir beneath the barrel is with carbonic-acid gas, which is forced in liquefies or condenses with the great . The trigger mechanism opens a valve ırily, and allows a single drop to escape into the duct leading to the rear of the projectile in the barrel. The drop of acid then immediately expands into gas—as it was before being liquefied—with such force as to propel the projectile with great velocity. R. J. URQUHART.

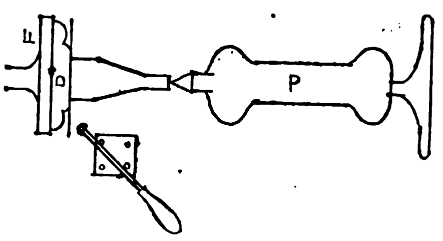
7, St. Ann-street, Manchester.

[72627.]—**Sheep-Dip.**—For some years I have used Jeyes' Perfect Purifier, at 5s. per gallon—non-poisonous, cleansing, and mixing instantaneously with water; as a solution, leaving no stain, and killing insects effectually, besides healing bites or sores. Directions are given with the bottle or jar. I should think the above quantity would suffice for 100 sheep. EOS.

[72636.]—**Striking Force.**—In falling a distance of 1ft., a ton will acquire a velocity of 8·02ft. per second, due to the force of gravity. Therefore the momentum (not force) at the moment of contact with the ground of the mass is 8·02 tons-ft. per second.

Edinburgh. B.Sc.

[72639.]—**Talc and Metal Spinning.**—Cannot say about talc. To spin metal, fasten die true on face-plate of lathe; place your metal against it, and hold it in position with a piece of timber pressed with poppet-head. CYMRY.



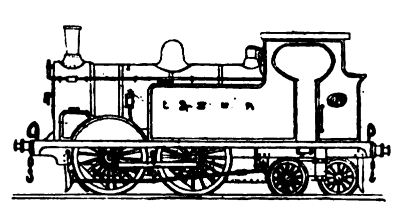
[72646.]—**Charging Primary Batteries.**—The small battery you have will run a 6-volt 2c.p. lamp for about one hour if charged with a good solution. These small batteries are mostly used by medical men for the small surgical lamps. The principal thing to remember when mixing bichromate solution is that it must be thoroughly saturated with bichromate of potash (the depolariser); it is a difficult matter to get the water to take up sufficient of this unless the water is made very hot. I find the best way to mix this solution is by putting 3oz. of bichromate of potash in a stoneware vessel, pouring on to this 1 pint of very hot water, then stirring with a glass rod; leave until cold, stirring now and then. When cold, pour slowly into this 3oz. or 4oz. of sulphuric acid, stirring meanwhile; then wait until quite cold before using. Some add a pinch or two of bisulphate of mercury to keep the zincs amalgamated.

H. H. HEADWORTH.

191, High-street, Poplar, E.

[72655.]—**Railway Curves.**—The inner rail is laid lower than the outer in the original construction of the railway. It is not depressed by the motion of the train. The reason of this difference of level is owing to centrifugal force. The depression of the inner rail is such a difference in levels with the outer rail, and so designed that when the train is moving round the curve at the average speed intended, the pressure on the two rails is equal. When, however, a greater speed is made, the pressure on the outer rail is greater, and if a less speed than that intended, the greater pressure is on the inner rail. R. J. URQUHART.

[72657.]—**S.W.R. Tank Engines.**—In reply to "Caucasus," I beg to send a sketch of one of the L. and S.W.R. Co.'s new tank-engines, with trailing bogie, No. 180, built at Nine Elms this year. I am sorry I am unable to give particulars.



H. C. TRIMULLE.

[72673.]—**Pump.**—I have a pump ⅜in. diameter, ½in. stroke, and could not get it to work. After a deal of trouble, I reduced the play of the valves to $\frac{1}{16}$in.; it now works splendidly at 600 revs. against 90lb. pressure. MENKARA.

[72673.]—**Pump.**—You require, I think, a back-pressure valve inserted in the feed-pipe near entrance to boiler. I have a 1¼in. bore engine fitted with a smaller pump than yours, and it gives entire satisfaction, feeding the boiler perfectly for hours together; so that if these pumps are properly made they are certain in action. J. A.

[72673.]—**Pump.**—If the force-pump acts well when the boat is stationary, it should not be the fault of the valves. I would suggest fixing an ear to the aft side of suction-pipe mouth, or, better still, turning the mouth of said pipe forward to some extent, to allow the water to rush in.

R. J. URQUHART.

[72665.]—**Rope and Drum.**—The following formula will enable "Collier" to determine what he wants:

Let $r$ = diam. of rope in inches.
,, $l$ = length of rope in fathoms.
,, $d$ = diam. of drum in inches.
,, $n$ = number of revolutions of drum to wind up given length of rope.

Then,

$$n = \frac{\sqrt{23\,lr + (\frac{1}{2}d)^2} - \frac{1}{2}d}{r}$$

In case given we have $l = 100$, $r = 1\frac{1}{2}$, and $d = 12$. Hence, by substituting these values in the formula, we get $n = 35·36$. LYONS.

[72677.]—**Force.**—In a short, bent tube, if force is transmitted through liquid which is itself stationary, the pressure does not tend to move the tube bodily. If, however, liquid is forced through a short, bent tube, there is resistance at the bend tending to straighten the tube, more especially if the nozzle on outlet of the tube be throttled, or there be greater resistance thereat.

R. J. URQUHART.

[72688.]—**Pumping.**—The best way would be to find the cubical capacity of your pump; but you do not mention what sort of pump it is.

CYMRY.

[72688.]—**Pumping Water**—Measure the capacity of your pump cylinder in cubic inches, deducting the volume of piston rod, for return stroke if a double-acting pump. 277·274c.in. = 1 gallon. Multiply by number of strokes per minute, and you have gallons per minute. Can't understand your 3in.-deep business? Don't see what it has do with the question. SM.

[72688.]—**Pumping Water.**—Why not actually measure the quantity of water by allowing it to flow for a given time into a receptable. This would give more correct results than any theoretic way of ascertaining it. You can, in fact, only properly determine the work and duty of your pump by so doing. Tresca carried out his experiments at the Conservatoire des Arts et Métiers at Paris in this way. If the water is flowing along a regulator channel you might get at quantity approximately, by multiplying cross-sectional area of the channel in square feet, by the observed velocity in feet by 0·84. MARIENBERG.

[72689.]—**Model Loco. Making.**—I should have figured the length of suspending link, Vol. LI. p. 504, 2in. instead of 1¾in. This will make it right. J. H.

[72690.]—**Silvering Brass Clock-Faces.**—To fill in the dial, heat over a lamp and flow black sealing-wax over the whole. Grind this off level by means of a piece of flat pumice-stone and water, leaving the engraving filled in black. Clean the dial thoroughly, and finish off with a clean rag dipped in salt and water, to charge the surface thoroughly with salt. It is then silvered with a paste of silver-chloride and cream of tartar, rubbed on with a flat cork, using a circular motion to give it an even grain. To prepare the chloride paste proceed as follows:—Dissolve silver in nitric acid and water, add sufficient hydrochloric acid to precipitate it in a white cloud. Let this settle, then pour off the acid and wash thoroughly with water, and then dry. Mix this into a paste with cream of tartar. When done, the dial must be washed with plenty of water, and finally warmed over a lamp to give a gloss to the sealing-wax.

F. J. GARRARD.

[72691.]—**Current.**—A single chromic-acid cell, with zinc-carbon plates, gives an E.M.F. of about 2 volts for a pretty considerable time—certainly for 3 hours. Hence, two such cells joined in series will give the required four volts. Now, the resistance of freshly made up cells, with elements about 4in. square and 3-16in. apart, is very low—not more than ·08 of an ohm per cell; therefore the resistance of the two cells would be about 0·16, and the current on the short-circuit nearly 25 ampères; but the battery would soon run itself down if run at this rate. If, however, the total resistance of the outer circuit (comprising the leads and the work to be done) were made up to 1·84 ohm, a current of 1 ampère would flow, and this would be maintained pretty constant for 3 hours; more especially if the liquid could be stirred or agitated occasionally.

S. BOTTONE.

[72692.]—**L. and N.W. Locos.**—No. 955, Charles Dickens, is one of the "Precedent" type, illustrated in the "E.M." for August 22, 1890. Principal dimensions are: Diameter of driving-wheels, 6ft. 7½in.; leaders, 3ft. 7½in.; cylinders, 17in. by 24in. She differs in a few respects to the rest of her class. Built February, 1882, "Teutonic" class: 1301 Teutonic, March, '89; 1302 Oceanic, May, '89; 1303 Pacific, June, '89; 1305 Doric, May, '90; 1306 Ionic, June, '90; 1307 Coptic, June, '90; 1309 Adriatic, June, '90.

North-Western.

[72693.] — **Soap-Bubbles.** — If your bubbles break, your soap solution is faulty. Use it fresh, and use good soap. Coal-gas will do; it is handier than hydrogen. Sm.

[72693.]—**Soap-Bubbles Filled with Hydrogen.**—A little glycerine added to your soap solution will put matters all right. It increases the tenacity of the film, and this is all that is requisite for success. B.Sc., Edin.

[72693.]—**Soap-Bubbles Filled with Hydrogen.**—The fault is, perhaps, in the solution used. A good one, given by Mr. Boys, of South Kensington, is oleate of soda (pure), ½oz., dissolved in one pint of cold distilled water, to which is afterwards added one-third of its bulk pure glycerine. After standing a week in stoppered bottle, the clear liquid is to be siphoned off from scum and sediment. With this, beautiful bubbles 8in. or 10in. diameter can be easily blown, and if a small proportion of hydrogen or coal-gas be added to the air in them they may float about for some time. A number of exceedingly pretty and interesting experiments with bubbles were described by Mr. Boys in the *Phil. Mag.* about three years ago. If the oleate cannot be conveniently obtained, Marseilles or Castille soap in rather larger proportion may be tried; but I understand it is not nearly so good.

Belfast. J. Brown.

[72696.]—**Velocity of Flue Gases.**—The pressure can be found in the way described. $\frac{9}{16}$in. of water = 2·93lb. per square foot, which is somewhat in excess of the usual pressure for Lancashire boilers. The velocity in feet per second may be found, approximately, by the following rule:—

$$64{\cdot}4 \times \sqrt{\text{head in inches.}}$$

Thus— $64{\cdot}4 \times \sqrt{{\cdot}5625} = 47{\cdot}657$ft. per sec.

The more usual pressure is 0·4in. of water, and the pressure per square foot corresponding to this is $\frac{144 \times 0{\cdot}4}{27{\cdot}68} = 2{\cdot}08$lb.; 27·68in. of water column being equal to 1lb. per square inch.

Marienberg.

[72697.]—**Electric Search Lamp.**—You do not specify the type of dynamo you are using, but I should imagine from its behaviour that it is series wound. In this case, the burning of the commutator is most probably due to the fact that the resistance in circuit is too low. S. Bottone.

[72699.]—**Indicating.**—For correct estimation of pounds of water per indicated H.P. from indicator diagrams, we must have more particulars than "Young Engineman" gives—viz., the initial pressure, the steam clearances for each end of stroke, a complete set of diagrams with the scale, and the point of exhaust closure for compression, so as to estimate what amount of fresh steam is needed to fill the clearance at each stroke, a very essential matter, for a l.p. cylinder with large clearances will soon make an extensive inroad upon the steam supply. I should judge, from the cards given, that the engine in question was a large sinner in this respect. But taking the figures given and ignoring clearances altogether, we have H.P. cylinder

$$\frac{18^2 \times {\cdot}7854 \times 54'' \times 120 \text{ strokes}}{1{,}728\text{c.in.}} = 954{\cdot}3\text{c.ft.},$$

or the quantity of steam to exhaust point; but 16lb. pressure from atmospheric line = (16 + 14·7) = 30·7lb. from pure vac. line, 1lb. of which occupies 13·173c.ft., so—

$$\frac{954{\cdot}3}{13{\cdot}173} = 72{\cdot}44\text{lb. per minute}$$
$$= 4346{\cdot}4\text{lb. per hour,}$$

and— $\frac{4346{\cdot}4}{155\text{I.H.P.}} = 28{\cdot}04$lb. steam per I.H.P. per hour.

A large allowance; but the l.p. cylinder exceeds this greatly.

$$\frac{29{\cdot}5^2 \times {\cdot}7854 \times 54'' \times 120}{1{,}728} = 2{,}563\text{c.ft.}$$

10lb. pressure from pure vac. line = 37·84c.ft., so—

$$\frac{2{,}563}{37{\cdot}84} = 67{\cdot}73\text{lb. per minute}$$
$$= 4{,}064\text{lb. per hour,}$$

and— $\frac{4{,}064}{118\text{I.H.P.}} = 34{\cdot}44$lb. steam per I.H.P. per hour,

$\left.\begin{array}{l}\text{but } 4346{\cdot}4\\ \text{less } 4064{\cdot}0\end{array}\right\} = 282$lb. of steam lost between the two cylinders by condensation or otherwise, besides, the l.p. is indicating much under its duty.

I would recommend Jamieson's textbook on the steam-engine for an easy and capital work on this matter.

Liverpool. W. S.

[72700.] — **Plaster Casting.** — Use glue two parts, and treacle one. Town glue or Russian.

Jack of All Trades.

[72700.]—**Plaster Casting.**—To get a flexible mould in glue or gelatine, make up a mixture of equal parts of glue or gelatine (which, after having been weighed, must be allowed to soak in cold water till swollen), and treacle. Melt. Well oil your model, to prevent adherence. Pour the melted composition over the model, with a safe-edge round it, as in the case of wax. If the model is a bust, or very much undercut, it may be advisable to cut the resulting flexible cast, in order to remove it easily; but as it is very flexible, this is rarely necessary. Allow 24 hours to elapse before attempting to remove from the model. When removed, soak the gelatine cast for a few minutes in a weak solution of tannin, about 2 tannin to 100 of water; this will toughen it very considerably. S. Bottone.

[72701.]—**Pantograph.**—"E. J. L." should get Heather's "Mathematical Instruments," 1s., published by Crosby Lockwood and Son, he will find all he requires about the pantograph. H. A.

[72702.]—**Induction Coil.**—Proceed as with an ordinary shocking coil, and it does not matter which way the secondary is wound. No special precautions need be taken as regards the insulation.

F. C. Allsop.

[72702.]—**Induction Coil for Telephone.**—The exact number of layers of wire in the secondary is not of any great moment; it should be increased as the distance increases. A very good proportion for medium distances is about 2oz. of No. 24 for the primary in two layers, and about ¼lb. No. 36 in about 14 layers for the secondary. The best insulation is thin paper, well paraffined by dipping in hot melted paraffin wax. S. Bottone.

[72703.]—**Cotton Belting.**—You can use equal parts of good glue and green treacle, and size it with it; or you may use linseed mucilage and treacle to advantage, which, in my opinion, is better than tar, paint, or grease.

Jack of All Trades.

[72704.] — **Microscopy.** — I quite agree with "Microbe" that a few articles on collecting, mounting, and manipulation would be a great boon to many readers of the "E. M." I, for one, would gladly lend a hand to this; but the branches of microscopy (physiological and pathological), to which I devoted special attention in Continental laboratories, are not interesting to the general body of English microscopists, Diatomaceæ being their special fad.

Plymouth. B.Sc.

[72704.] — **Microscopy.**—This suggestion is a good one. "Microbe" will, however, find a vast amount of useful information in a half-crown book of "Elementary Microscopical Manipulation," by Mr. T. Charters White, which any bookseller will procure. I searched in vain for years for the special information required by beginner, which at last I found there. It is exactly the book wanted, being crammed full of valuable hints. R. M. S.

[72704.] — **Microscopy.** — To "Microbe."—Don't waste your time in preparing your own objects. Learn to mount first, and buy own objects already prepared. Look over the Sixpenny Sale Column, where you will find advertisements referring to the above. I have mounted many, and find Mason's, Park-road, Clapham, the best, and he always sends instructions with each packet. Adopt this plan to commence with, and you will soon have quite a collection of slides to be proud of. Then, when you are *au fait* at mounting, try your hand at preparing. I would suggest botanical sections first. If you find any difficulties, write again.

Truro. Charles Barrett.

[72704.]—**Microscopy.** — If diatoms occur in chalk, which is not to any great extent, dissolving the surrounding calcic carbonate would liberate them in a much more perfect condition than scraping or brushing. Unfortunately, however, the chief constituents of chalk are foraminiferæ, and not diatoms at all; and these foraminiferæ, consisting as they do chiefly of calcic carbonate, are freely dissolved by acid. If you refer to Vols. XX. and XXI. of the "E.M.," you will find a very exhaustive series of papers on the Microscope: its Construction, Use, and Mode of Mounting, Objects, &c., which I wrote under the *nom de plume* "M. Q. C." Beginning at p. 313, of Vol. XX., and continuing through 23 papers, up to p. 422, of Vol. XXI., the series touches on nearly everything of practical use to the microscopist. I shall be very happy to assist by giving other papers, if desired. But the last few volumes teem with information on matters microscopic. S. Bottone.

[72705.]—**Coloured Light.**—I thought naphtha was used, and not petroleum, in flaring burners. Alcohol will dissolve calcium nitrate, lithium chloride, sodium hydrate, and copper chloride. Probably naphtha will do so likewise. They will give red, crimson, yellow, and green flames.

Sm.

[72705.]—**Coloured Lights.** —I do not think you will get anything to combine with the oil for the purpose. Jack of All Trades.

[72707.]—**Telephone.**—The transmitter almost in general use in America is the Blake, a description of which will be found in the series: "Telephones: their Construction and Fitting." There are many different forms of transmitters that have been devised from time to time—many of which have been designed specially for long-distance work. The receiver used is the Bell. Perhaps the most successful example of long-distance telephony is that between Paris and Brussels, where the Van Rysselburghe system is used. F. C. Allsop.

[72708.] — **Blacking Engine Fire-Box.** — Get some drop black and gas-tar, and mix with it turps. The tarred boards you will do nothing with, except hot lime-wash.

Jack of All Trades.

[72711.]—**Slate Cistern.**—Red or white lead should never be used; but putty and boiled oil. A little powdered rosin in it.

Jack of All Trades.

[72712.]—**Electro-Magnet.**—As there is no such a thing as a current measured in volts, I cannot say how an electro-magnet should be wound to work with a 1½-volt current; 1½ volt may give a current of from ·001 to 1,000 ampères or more, just according to the resistance in the battery. I can only say if the resistance in the battery itself is high, wind the core of the magnet with fine wire to treble the original diameter, choosing wire of such a gauge that the resistance of the wire on the core should be as nearly as possible equal to the internal resistance of the battery; on the other hand, if the internal resistance of the battery be low, choose a wire of such a resistance and such a diameter that when wound on, so as to triple the diameter of core, its resistance should be the same as that of battery.

S. Bottone.

[72713.]—**Indian Ringworm.**—Cut an onion in half. "Strike" the ringworm with it three times one way and then three times the other way; repeat every day. This has cured ordinary ringworms; but I don't know about "foreigners." Try it.

G. A. Battes.

[72713.]—**Indian Ringworm.**—I suffered for five years from this obstinate form of "herpes" in India, and when I was a boy at school in the South of England, I had a bad type of this eruption, necessitating the shaving of my head for some months. It only yielded to a poisonous solution. I advise a trial of Jeyes' Perfect Purifier, at 1s. per bottle, on which directions are printed. This is non-poisonous and colourless when dissolved in water. First, thoroughly cleanse the hair and skin of your scalp with suds of soft-soap and hot water; then wash it away with plenty of lukewarm water; lastly, brush the roots of the hair well, and with a small sponge rub in this lotion night and morning, particularly on the sore spots. *Liquor Potassæ* (an acrid poison remember) is given in a diluted form, as prescribed by physicians for this class of eruptions, the blood being deficient in potash. You may have to resort to shaving your head, and if so, I will give you the formula of a potent ointment—very stinking and very staining in its properties—nevertheless, I cured a case of twelve years' standing with the same. Eos.

[72713.]—**Indian Ringworm, or Washerman's Itch.**—Gol powder is generally used with good results. I have known the following to effect a cure when other means have failed:—Take a sheet of white note-paper, light it so that it will smoulder without flame, place it on a clean plate; the smoke will condense on the plate, and leave a brown, oily matter on the plate. Rub this oily matter on the parts affected. R. N.

[72714.] — **Sucking Solenoid.**—The sucking solenoid used in the voltmeter described and figured in reply 72440, consists essentially of a brown-paper tube, slightly flattened after being made, and wound with German-silver wire, silk covered. The gauge and amount of wire to be used will depend on the voltage to be measured: it is usual to allow 50 ohms resistance for each volt to read off on the scale. Hence, an instrument to read up to 50 volts should be wound with wire presenting a resistance of 50 × 50 ohms or 2,500 ohms, or about 1oz. of No. 40 German-silver wire, ·0058in. in diameter. S. Bottone.

[72715.]—**Lithanode.**—If "P." cares to call upon me any evening—6 to 7—I will show him lithanode cells that have been working a lamp intermittently for 18 months, and may also be able to give him some information about this (to me) invaluable product. Chirurgo.

7, Mornington Crescent, Hampstead-road, N.W.

[72715.]—**Lithanode.**—The lithanode is not dissolved, but the peroxide of lead therein is gradually reduced to a state of lower oxide, and finally to the condition of metallic lead, by the reducing effect of the polarised hydrogen. There is little or no local action when the plates are not in use, and the

battery serves as well as any, and better than many, for electric-light purposes. It is not desirable to have loose mercury at bottom of cell: better have a cup-shaped lug at top of zinc kept full of mercury.
S. Bottone.

[72716.] — **Photo-micrography.** — I do not wonder at your difficulty—viz., "waviness or corrugations caused by the cutting-machine." You will never cut sections of lung fit for use in photo-micrography by imbedding in paraffin wax. I have seen many fine sections of lung cut by hand in Waldeyer's and Recklinghausen's laboratories; but such dexterity is seldom attained in England. What you require is a freezing microtome, and the best one for the purpose is a small, shallow tub filled with ice and salt, covered with plate glass having a hole in the centre (1½in.) In this hole, a little below the level, a roughened piece of brass is supported; on this the piece of lung is placed, having previously lain in thick gum-arabic for a few minutes, and it gets hard immediately. The microtome is on the principle of a joiner's plane. The frame is of brass, of a triangular or demi-oval form; the knife goes below, and is fixed to the frame near the base, at a proper slant, by two screws on each side. The frame is raised or lowered to the level of the piece to be sectioned by three large screws with fine threads (same as used to adjust the level in theodolites); two are in the back of the frame and one in front, at what may be called the apex. When the knife is at the level, make a section by sliding the microtome over the plate glass, depress the apex by turning the front screw half a turn, and your next section will be the thinnest possible. I would not take up so much space in describing this microtome if I thought one could be bought ready-made; but I have never seen or heard of one in England except my own, and one which I am told is in the possession of Prof. Klein.
Plymouth. B.Sc.

[72717.]—**Small Boiler.**—Make boiler of thin sheet copper: Barrel, 7¼in. by 2¾in.; outer fire-box, 3¾in. by 2¾in. by 5¼in.; inner firebox, 3½in. by 2¼in. by 4¼in.; fire-door, 1¼in. by ¾in.; put in only one fire-tube, 7¼in. by 1½in.; braze all the joints; stay inner to outer fire-box; make a spirit-lamp burning ten wicks—five in a row—to push in underneath and burn in inner fire-box, so that it will not be seen from the outside; put in no ash-pan, but have a clear space on both sides of ⅜in. between fire-box and spirit-tank, and in this way you will get sufficient steam to drive a four-couple loco. For further particulars refer to "A Model Traction Engine," Vol. L. No. 1285, p. 218 of this paper.
J. A.

[72718.] — **Optical Screw-Cutting.** — Centre brass flange on face plate, turn out hole to proper size, and cut thread with chasing tool having the desired number of threads per inch. Sm.

[72718.]—**Optical Screw-cutting.**—There is no difference in doing this job than any other. Chuck your job, and bore out the size of bottom of the male part, and chase out to fit with an inside chaser or comb. Jack of All Trades.

[72719.]—**Defective Eyesight.**—By all means consult a professional oculist. You may do much harm by tampering with such a case. Consult the best man you can find: in the end it will be by far the cheapest. H. A.

[72721.]—**Electro-Motor for Boat.**—A Manchester type motor, with armature 4⅜in. diam., 3in. deep, series wound with No. 22 throughout, would give good results if driven by 50 cells of Fuller type; or 50 accumulator cells, if you have any facility for getting these charged when run down. S. Bottone.

[72722.]—**Paint for Model Loco.**—You do not say what you want to paint—iron, brass, copper, or what, or if bright. If brass or copper, clean off all grease, and wash with vinegar; then, when dry, wipe well off with a clean cloth. Mix your colour with 1 part of japanners' gold size and 2 parts of turps; this should dry dead. When thoroughly dry, give it a coat of good copal varnish. It will want at least two coats of paint.
Jack of All Trades.

[72723.]—**Copper Bronze.**—Put some iron rust or old nails into the acid you dip in; then make a paste of Venetian red and beer, and paint, and when dry brush well up with a dry brush and lacquer. Jack of All Trades.

[72724.]—**Photographing Polished Silver.**—Rub the article over with an oiled rag: this will deaden the lustre and can easily be removed.
H. A.

[72724.]—**Photographing Silver.**—Stipple the surface with whiting. Sm.

[72724.] — **Polished Silver.** — To "Photographer."—Let the querist have a kettle of boiling water handy, and steam the articles all over the moment before exposing. This will dull the extreme brightness and prevent halation, besides rendering the figuring more perfect.
F. J. Garrard.

[72724.]—**To Photograph Polished Silver.**—Having arranged and focussed the article to satisfaction, so as not to have to touch it again until it has been photographed, remove camera, &c., and raise a dust of fine wheat flour by sweeping it about the room in the proximity of the article to be photographed. The flour dust settling thereon will dull it effectually, and yet not too much. The dust can afterwards be blown away with a pair of bellows.
S. Bottone,

[72727.]—**Telegraph.**—The shunt-coil, which is doubly wound, is placed between the terminals of the sounder. The extra current from the sounder, instead of sparking at the tongue of the relay, traverses the shunt coil, and thus the sparking is done away with and speed increased. Such a sounder can be used on a main line of 10 miles, so that it is unnecessary to interfere with the shunt. If it was necessary to do so, it would be a simple matter to arrange to switch it out. Hy. W.

[72728.]—**Varnish for Pottery.**—Why not paste a stencil pattern on them, and either subject them to the action of hydrofluoric acid or sand blast? Jack of All Trades.

[72728.]—**Varnish for Pottery.**—If neither oil, soap, nor soda be used, Brunswick black will do, as it stands water both hot and cold. Copal varnish, coloured with any desired metallic oxide, stands soap, but not oil or soda; while amber, dissolved in chloroform, will stand a considerable immersion in hot water and soda before it becomes detached. It is important not to put too much colouring matter in these varnishes, as the colour certainly weakens the power of resisting soda, soap, or oil.
S. Bottone.

[72729.]—**Electric Bells.**—The best way of effecting your purpose is by means of the bells arranged in parallel, using coarser wire for the more distant bells. The next best way is by the aid of a shunt arrangement on the ordinary bells connected in series, as described in my book "Electric Bells," p. 163. To show that the bells are working you will find Mackenzie's sounder indicator as good as any. Nine cells, arranged in parallel, would give excellent results.
S. Bottone.

[72729.]—**Electric Bells.**—Put all the bells in parallel, and use a battery of six to eight cells of the six-block agglomerate Leclanché. The bells nearest the battery will require to be balanced with some resistance, the amount of which must be determined by experiment. You can use an ordinary indicator on circuit to show if the bells are working. For more information see my book on "Practical Electric-Bell Fitting," p. 92.
F. C. Allsop.

[72730.]—**Bicycle.**—If "R. A." has the cog-wheel 7in. in diameter, he will require more force to turn it one revolution, since it will drive the machine farther; but he will require as much force to drive the machine a hundred yards (whatever the gearing may be). How is it possible to say what is the most convenient size for cog on pedal axle if it is not stated what is the size of other cog?
Siebert C. Hart.

[72730.]—**Bicycle.**—It would certainly not be easier: it would require a greater exertion to drive on at the original speed. Cymry.

[72730.]—**Bicycle.**—"R. A." will not be able to put any more "power" into his bicycle than his legs and lungs will allow him; but as to driving with greater ease by having a larger cog-wheel on the pedal axle, that is the wrong way about altogether, unless querist means that he has plenty of strength and prefers slow strokes of the pedals to quick and easy ones. Nun. Dor.

[72730.]—**Bicycle.**—No. The larger the cog-wheel on the pedal axle in proportion to that on driving-wheel the less power you have; but, as fewer revolutions of the crank are needed, you get more speed. I will give "R. A." some practical information. I ride the "Swift" also. My first machine was geared up to 57in., the usual gearing put on these bicycles. I found it practically useless for going any distance on muddy roads. I was getting a "second horse" a short time since, and again selected a "Swift," but I got it geared down to 50in. by reducing the wheel "R. A." refers to, and can now ride through the mud with ease; and, moreover, owing to the greater facility for hill-climbing due to the extra power, I find I can make as good time on dry roads as on the 57in. machine. The high gearing does splendidly on dry, level roads when you are only using the bicycle for an afternoon's amusement, but where you require it for real work, as I do, the lower gearing is preferable, for it is of more consequence whether you come in fresh or tired, than whether you can travel eight miles an hour or ten miles an hour.
Doctor Med.

[72731.]—**Warts.**—I cured several on my hands, after having tried glacial acetic acid, by simply "spitting" on them the first thing in the morning after getting out of bed. G. A. Battes.

[72731.]—**Warts.**—Try concentrated nitric acid.
Sm.

[72731.]—**Warts.**—Oxide of iron and the milk from the juice of the dandelion are sometimes effectual. Cymry.

[72731.]—**Warts.**—When a boy I was much troubled with these. I tried all kinds of nostrums, but finally got rid of them by a steady application (night and morning) of common yellow soap.
H. A.

[72731.]—**Warts.**—Salicylic acid. Extract of Cannabis indica and collodion applied with a brush is often successful. Most chemists keep it made up for application to corns. If that does not succeed, try chromic acid. I may add that acetic acid or any other solvent requires to be perseveringly applied to be effectual. Doctor Med.

[72731.]—**Warts.**—I have found the following treatment very satisfactory on my own person; whether it will prove equally so in your son's case experiment only can prove, since some cases are much more amenable to treatment than others. Get a lump of salammoniac, split it with a knife into long pieces, point them like pencils with a pen-knife. Two or three times a day rub over the warts with one of these pencils dipped in water. You may have to continue this treatment for a month or even two; but it generally proves an effectual cure. S. Bottone.

[72732.]—**Electric Lighting with Gassner Cells.**—Supposing you were using a medium-sized type, having E.M.F. 1·60 and R 0·5 ohm, and a lamp having a hot resistance of 5 ohms, and taking about 1·5 ampère of current, which is about the average for a 10v. five candle-power lamp; then you would need 10 cells to light the lamp, arranging the cells in series, since

$$\frac{10 \times 1{\cdot}6\text{v.}}{5\text{w} + 10 \times 0{\cdot}5\text{w}} = \frac{16\text{v.}}{10\text{w}} = 1{\cdot}6 \text{ ampère.}$$

I expect you would find the light begin to fail after 20 minutes' run. If you arranged the 10 cells in two sets of five in series and two in parallel, you would be able to light the two lamps in parallel; but I think the duration would be rather less than 20 minutes. S. Bottone.

[72734.] — **Reducing Valve.** — Pintsche's reducing valve for lighting of train carriages with gas (oil-gas), is in exterior form something like a circular pan with flat bottom and sloping sides. The top is covered with a gas-tight membrane, which is adapted to the pressure required at the jets (say 1in. water column), and has a rod from its centre dipping into the pan connected to a lever of the second order, the weight of which is balanced by a curved spring within the pan. The lever operates a small plug, which closes or opens the inlet from the gas-holder (the gas being compressed, at starting, to 150lb. per square inch, and contained in a gas-holder or receiver, placed below the carriage, of about 84 gallons capacity, and sufficient for six lights during two nights), according as the pressure within the pan is very slightly more or less than 1in. Thus the play of the membrane is such that a very nearly constant pressure of the gas is maintained within the pan, from which it flows by an outlet to the burners. The whole affair is very simple, but one of nice adjustment. The solution of the problem was not so easy at first; but the arrangement is highly efficient and a perfect success. Marienberg.

[72735.]—**Barometer.**—I suppose "the upper part of the flask contains air," as "F. W. C." says so; but how much? Does he not understand that to make the thing act the flask is filled with water and the thumb placed on the outlet when it is inverted? Nun. Dor.

[72735.]—**Barometer.**—The instrument is more of a thermometer than a barometer, as it is affected most by change of temperature. The air being under a certain pressure, the volume will certainly vary in accordance with the pressure of the atmosphere; but the change is so slight that you could not detect it by the unaided eye. Sm.

[72736.]—**Adjustment of Reflector.**—I suppose "G." has marked a spot exactly in the centre of his mirror, and that he adjusts it by daylight, through adjusting eyepiece, or eyepiece with lens removed, and that, in addition to seeing the reflection of the flat in the centre of the large mirror, he also sees the flat itself outside the mirror and concentric with it. If so, I do not see how he can help seeing the spot on the large mirror in the centre of the reflection of the flat. If not in the centre, it must be brought so by the screws of the large mirror.
Fordingbridge. T. Westlake.

[72736.]—**Adjustment of Reflector.**—It is somewhat difficult to see the "spot" in the centre of the mirror, as it appears black upon the dark shadow of the flat; but if you will mark on the mirror the "three spots" at the edge of the shadow you cannot fail to see them, or at least one or two of them, unless the central spot is central in the shadow, and if so visible, you can easily move them into the shadow by means of the screws of the mirror cell, and the mirror will then be in adjustment. The easiest way to mark the mirror accurately is to make a cardboard or thick paper stencil plate and mark through that. Your "lenticular-shaped image" probably only shows a want of perfect adjustment. Do you adjust the eyepiece tube with the pinhole discs at each end?

T. A. Skelton.

[72739.]—**Thermopile to Light 6-v. Lamp.** —To Mr. Bottone.—You would need about 200 blocks, about 2½in. long by 1in. in square section, cast in an alloy of two parts antimony and one of zinc. These blocks are cast with tinned iron strips, about 5in. long, one at each end, and are then arranged in series, with their inch sections pointing towards the centre, on an iron ring, 1in. wide, ¼in. in section, and 1ft. in diameter. To insulate them from the ring and from each other, either asbestos or mica must be used. These blocks will have to be arranged in four tiers one over the other, taking care to connect the front iron strip of one block to the back strip of the next, and so on till the series is complete. A second iron ring, insulated from the blocks by means of asbestos, is now placed over the set, and the whole clamped together by means of bolts and nuts. A circular brazier, or a Bunsen burner, is now placed in the inside to supply the necessary degree of heat. See also my "Electrical Instrument-Making for Amateurs," pages 139 to 146.

S. Bottone.

[72740.]—**Parkin.**—This is how it is made in West Yorkshire: Mix oatmeal and treacle into a stiff paste, roll out on a board dusted with oatmeal, cut out the "parkins" with the lid of a small can or any other kind of pastry cutter, place them on a tray in the oven and bake.

H. A.

# UNANSWERED QUERIES.

***The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.***

Since our last, "J. H." has replied to 72088.

| | |
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| 72433. | Stringed Instruments, 90. |

**A Large Wimshurst Machine.**—M. Ducretet, of Paris, has constructed a large Wimshurst machine which he has given to the Société d'Encouragement pour l'Industrie Nationale. The glass discs, of which there are 12, are 75 centimètres (29·53in.) in diameter. The machine will give a spark 42 centimètres (16·54in.) long.

**Gum Arabic.**—Prof. Leo Liebermann sends to the *Chemiker Zeitung* a paper on the examination of gum Arabic, in the course of which he states that both Senegal and Cordofan gums should dissolve completely in luke-warm water, whereas cherry gum only partially dissolves, or, at the best, swells up in the water. When the solution is treated with large excess of potash solution and cupric sulphate, warmed slightly (not boiled) and filtered, the filtrate and the precipitate may be reserved for examination. The filtrate will contain dextrine if any has been present in the sample, and, on boiling it, the characteristic brick-red precipitate of cuprous oxide will be formed should that be so. The precipitate formed by Fehling's solution in the first instance, gives the data for conclusions regarding the nature of the gum proper. After washing with distilled water, dissolve in dilute hydrochloric acid, and precipitate with a large excess of alcohol. Allow the precipitate a day to settle, collect it, dissolve in water, and again precipitate with alkali and copper, purifying with hydrochloric acid and water. If the sample is pure gum Arabic, it is noticed that the precipitate thrown down by alcohol gathers into one lump, and a little of it dissolved in water and boiled with solution of potash gives an amber-coloured solution. The gum Senegal precipitates, and it fails to give a colour, or only a straw colour, when boiled with alkali; but if the precipitate does not agglomerate, and gives an amber colour with alkali, the sample is a mixture of gum Arabic and gum Senegal. It is also noticeable that the blue copper precipitate formed on adding alkali and copper to the watery solutions of the gums, is more abundant in the case of true gum Arabic than in the case of gum Senegal—indeed, in the latter case the precipitate is not at all abundant.

# QUERIES.

[72741.]—**Telephones.**—In the *Echo* of Oct. 18 there appeared the following reply to a query:—"Bad insulation is the all-powerful evil in telephone installations, and some day, when shrewd and powerful competitors get an innings, this will be obviated with certainty and economy. The rumour about certain experiments being closed because of 'unwelcome and alarming discoveries' is probably based upon the fact that if the companies undertook to apply the remedies which science dictates, their shareholders would be so scared as to jeopardise the position of the company owing to the drain that would take place from the capital." Will some reader kindly say what these experiments were, and what "alarming discoveries" have been made? How would the shareholders be scared—by the cost of applying remedies, or by the "alarming discoveries"?—A. O. F.

[72742.]—**Electric Lamp.**—To Mr. Bottone.—What kind of battery should I use to run a small incandescent lamp, say, 4 to 5c.p., or would a primary battery suit at all? I only require to run it at intervals, and for say, 15 minutes at a time. Full particulars, regarding connection, &c., will much oblige.—F. M.

[72743.]—**Engine.**—I should be glad if some one would oblige me with a sketch of a vertical steam-engine, 1½ bore, as I should like to see a good pattern of standard to hold cylinder up, and pattern of bearings. Flywheel is 7in. diam.—Joe.

[72744.]—**Phosphor Bronze.**—Does anybody know the method of making phosphor bronze, the proportion of phosphor, and the best method of mixing the phosphor with the bronze in a healthy manner for the neighbourhood? Is it a trade secret?—A Belgian.

[72745.]—**Toning Photos. with Lead.**—Can anyone tell me how to tone photographs with a solution of lead, and also the strength of solution, &c.? I believe either the acetate or nitrate is used, and it is mixed with the fixing solution. Any information will be gratefully received by—A Pickled Porpoise.

[72746.]—**Electro-Plating.**—I am successful in plating on brass, &c., but my coppering bath for iron gives me much trouble. At one time I get a good coating; in a month's time, the bath not having been altered, I can get no deposit at all. Have added cyanide and increased battery power and worked it cold and hot. Will any of "ours" kindly say wherein they suppose the fault would lie? There is about 20 gallons of solution kept in a wooden tank. Solution made of cupric sulphate dissolved, precipitated with ammonia, dissolved with cyanide. Or is there any other solution that is more suitable or less expensive to work?—Horo.

[72747.]—**Incubator.**—Can any reader kindly give information as to the best lamp used for an incubator? I have a part, and don't quite understand. There is cistern at the bottom, 15in. long by 6in. deep, 3in. flue through centre; two egg shelves above, then another cistern at the top, 15in. by 1½in. deep, with small Bell's skoop cistern on outside. Could you tell me what the top one is for?—No Sig.

[72748.]—**Smokeless Firing.**—Will some kind reader tell me how to fire a Lancashire boiler, 30ft. long, 5ft. 3in. diameter, with two furnaces, without making any smoke. The bridges are 6in. high from top of bars. My employer tells me that the man who attended this boiler previous to me made no smoke at all; but I have tried different methods, but I find it impossible. I have often been told that by keeping the fire back to the bridges with the rake and throwing the coal in immediately behind the dead plate smoke will be avoided; but I am firing in this way, but I find it all the same, the black smoke is still made if I put on any more than one shovel full at a time. What is the meaning of these three methods of firing—spreading, alternate, and coking? The coal I have is hard splint.—Stoker.

[72749.]—**Electrotyping.**—Can any of your numerous readers tell me how to take a mould from plaster of Paris, without damaging original? I have a collection of casts taken from gems, and should like to take copies of same in copper.—Copper Sulphate.

[72750.]—**$CO_2$.**—I would feel obliged if a reader of the "E. M." would give me a method of estimating the quantity of $CO_2$ in the air of a room?—H. S. M.

[72751.]—**Dust.**—I am troubled with a great deal of dust in large play-room and gymnasium, which has an ordinary boarded floor. The dust is largely composed of wood-fibre from the wear of the floor. Will someone kindly tell me the best way of treating the floor-boards, either by size, varnish, or the like, which will make the surface less friable and more easy to sweep clean?—F. G. S.

[72752.]—**Photo - Printing Frame Pressure Springs.**—What will prevent back of printing frame slipping when opening to examine print? Is there any method of securing it, while at same time allowing springs to be moved?—Photo-Printer.

[72753.]—**To Mr. Grey or Mr. Allen.**—Can you kindly give me the most modern process for estimating phosphoric acid soluble, insoluble, and reverted in a sample of super-phosphate? A reference to any book that treats on this subject will oblige.—A Scientific Farmer.

[72754.]—**Dipping Needle.**—Will someone kindly give, or refer me to, any detailed account of the magnetic surveys which resulted in the assumption recently published that large tracts off the Hebrides and in Berkshire are underlaid by magnetic rocks. The amount of eccentricity of dip is what I most desire to know.—F. J.

[72755.]—**G.W.R. Locos.**—Have this company not recently built some express broad-gauge 4-coupled engines? If so, should be glad of particulars.—S. H.

[72756.]—**Aid for Propelling Chairs.**—I have a wicker-chair on wheels, easily pushed on the level by man or woman, but the hills are a difficulty. Could any mechanism be found to assist up hill, either by storing power when going down (winding up a spring which should uncoil on going up again), or by some machinery which would act on the wheels after the manner of the French mechanical toys?—Invalid.

[72757.]—**Isothermal Lines.**—I cannot understan how it is these lines can run sinuously through differe latitudes. For instance, in latitude 51½°, the line is Fahr., and it continues up to about latitude 66° N. might also ask why is it their vegetable productions so extremely different to each other, although they ha the same line? Would some reader kindly explain? H. J. Hook.

[72758.]—**Electric Light.**—I have charge of an i stallation, consisting of a dynamo and 14 arc lamps. ( starting the machine, but leaving the switch off and o lowering the brushes on to the commutator on one si fire appears on them, as though the circuit was compl and the lamps burning. I should have said the machi was in short-circuit somewhere, had not the armature j been rewound and the machine tested by an experienc electrician. On lowering the other pair of brushes a switching in the lamps, all went well for one hour, at t end of which time the armature fired; and on stopping, found that the wire, instead of being straight on t armature, was lying across it in curves, as though som thing had pulled it back in the middle as the machine w running. This I put down to the winding not being do right. Will some electrical correspondent please put i right, and oblige?—Novice.

[72759.]—**Microscope.**—I have recently brought o along with which are two glasses; one labelled "Selenit R. and G.," and the other "Selenite, unequal." Wi some fellow-reader kindly explain the respective uses these plates? I know they are used in connection wi the polariscope, but do not understand their peculiar use —W. J.

[72760.]—**Polariscope.**—I should be glad to be in formed whether the polarising and analysing prisms a used for the microscope could be made available in th construction of a spectroscope for examination of, say, sugar solutions, &c. I should like a few hints hereon.—W. J.

[72761.]—**Self-polishing Blacking.**—Will any kind reader of the "E. M." give me full particulars o making self-polishing blacking? I made a mixture u thus:—5oz. of treacle, 1 tablespoonful of yeast, nearly ½lb. of lampblack, 2 hens' eggs, 1 teaspoonful olive oil, 1oz. of spirits of wine. The above ought to have brought out a polish upon both boots and shoes—a polish similar to Nubian. What ingredient added to this mixture will make the same to be like the Nubian? The mixture made is about a pint altogether, but no use as it is.—Muddled.

[72762.]—**Xanthus.**—A man can row five miles with the current in the same time that he can row three miles against it. If the current had an additional velocity of half a mile per hour, the man would be able to row twice as fast with as against the stream. How many miles per hour would the man be able to row in still water? This is a question set in the Bancroft Scholarship Exam. for boys. It is to be solved by arithmetic which is beyond my power. As the two pairs of simul-equations—

$$\left.\begin{aligned} a + b &= 5 \\ a - b &= 3 \end{aligned}\right\}$$
$$\left.\begin{aligned} a + b + ½ &= 5½ \\ a - b - ½ &= 2½ \end{aligned}\right\}$$

give different results, how is any solution possible? The answer, I suppose, is 4½, but that does not satisfy the statement.—F. J. C.

[72763.]—**Bible.**—Can any reader tell me if the word "girl" is in the Bible?—if so, where?—G. A. B.

[72764.]—**Telephone.**—What is the most efficient and, at the same time, a cheap telephone to erect between dwelling-house and a summer-house, distance about 100yds.? There must be no wires to show.—T. K. W.

[72765.]—**Insomnia.**—I suffer greatly from inability to obtain sleep, and any remedial suggestions from fellow-readers will be thankfully received.—J. A.

[72766.]—**Morse Key.**—Having made a Morse key for a sounder, I should feel obliged if anyone will kindly give me a rough sketch showing how the connections are made between the terminals and the stud of the key o the underside of the bed, also the sizes of wires used?—Cestrian.

[72767.]—**Margarine.**—I would feel much obliged to any reader who could inform how margarine is manufactured, or refer me to any work on the subject? I particularly wish to know what proportion of butter or any other material is added to the sweet beef-fat.—W. G.

[72768.]—**Cement for Sealing Dry Battery.**—Can some of your correspondents give me a recipe for a good reliable cement, with which to seal a dry battery, so as to perfectly prevent evaporation, or creeping of salts up carbon pole? Have tried paraffin wax, but salts get through it.—A Canadian Reader.

[72769.]—**Lighting Gas by Electricity.**—Will any of your readers oblige me with the best method of lighting 20 gas-burners, fixed in sets of five at the back of four 6ft. clock-dials? At present, I have to go up a tower 75ft. high, and want to light them, either from the bottom of tower or from my house which is 50yds. distant. There is an arrangement attached to the clock by which the gas can be turned on and off automatically at any given time by altering a pin in a metal disc which revolves once in 24 hours, and another fixed pin to turn the gas off every night at 12.—Horology.

[72770.]—**Electric Spark Gas-Lighter.**—Will someone kindly answer the following:—Would a half-pint 1-cell Daniell battery give a spark sufficient to light one gas jet? What is required besides battery, and how filled up?—Jean Sans Nom.

[72771.]—**Nitrate of Potash.**—Will someone kindly inform me how to assay stones (Caliche) for nitrate of soda ($NaNO_3$), and recommend a book on the subject?—Chile.

[72772.]—**Destruction of Zinc Plate.**—How many hours' work does it take to reduce the zinc plate, 1oz. i a one quart Daniell battery?—Jean Sans Nom.

[72773.]—**Watch-Jobbing.**—Will some friend in th watch trade give instructions how to mark the exact sp for drilling the hole for pivot of verge in the cock or pe forated plate over balance of verge watch. The form ıot be a guide, as it is not in the correct place, ı plugging up. How can I get to see when the ı in the right position for escape-wheel and ; seems entirely hid by brass collet. How is ıy the trade?—ANXIOUS.

**Electrical Conductivity of Copper** ›per wire is sold guaranteed to be, say, 98 per tive power. How is this percentage arrived any special book published giving practical imgarding the apparatus and methods used for the conductivity of copper?—ST. MUNGO.

**Wig.**—Will any readers inform me if I can : of a dark brown wig to a lighter shade or to t damaging the fabric?—W. W.

**Metal Wanted.**—I wish to find a metal of r tensile strength than lead, which will stand action of boiling sulphuric acid of various om 30° to 50° Beaumé, at a steam-pressure square inch. I endeavoured to submit the action of this substance in an iron boiler ead, and found that even if thick the lead splits, and the acid gets to the iron with esults. I then endeavoured to make a lead ngly hooped and bound together outside with nd the thickness requisite is enormous, and linder the weight and cost is out of all reason. der suggest a mixed metal which will fulfil ns of strength, lightness, cheapness, and ırability, and from which an egg-end boiler or , 10ft. long by 3ft. diameter, can be built up ry the above pressure, and to safely contain bove?—FIBRE.

**Flexible Metal Tubing.**—Can anyone ars of Levavasseur's flexible metal tubing, id to be suitable both for suction and for oses, and for fluids or gases?—X.

**Cancer.**—Is there any known cure for this ıse, or can any advice be given based on ience?—M.

**Petroleum Furnace.**—Would the petro-, described by "H. B., Moscow," as being ussia (p. 16, Aug. 29), be suitable for the of sugar in Dominica?—ED. FADELLE, Dom-.

**Compound Dynamo.**—I want to regulate machine which I use on a circuit about length, R = ·36w., and where the lamps up to 250, taking about ½ ampère each. Is ans of regulating by hand—i.e., putting reeries with F.M., or having a resistance in main? Will any brother-reader help an difficulty, and show by a rough sketch of I may say I am able to run well with about lways in circuit, but I want to meet the d maximum demand.—COMPOUND.

**Pneumatic.**—By what simple mechanical enough wind pressure be raised to pass of piping with universal joint in centre and lust at about 9in. from end of pipe? Pipe 1½in. to ⅜in. Have tried small fans, but not BOB.

**Arc Lamps.**—Will any kind electrician following? I have an alternating current ıich has a circuit from it for four Siemens arc run in series. They give a very poor light, ıw and then go out for a minute and then in ve tried each lamp separately, and they burn ny information as to the cause will oblige.—J.

**Weights.**—I have had a small set of ights given me; but instead of the weights : value marked in the ordinary way they have sign on each, each weight having a different the other side each of them has a figure — in a circle. The box contains a small
B

l the lid has the words "Dese Gewichten f de Backer, Op De Beurs Tot Amsterdam." der inform me if weights are sometimes so EMO.

**Problem.**—If

$$r = a\,(1 - e \cos.\ a)$$

$$r_1 = \frac{a\,(1 - e^2)}{1 \mp \cos.\ \theta}$$

e, show that—

$$\text{n. } a = \frac{1}{\sqrt{1 - e^2}} \cdot \frac{\text{Sin. } \theta\,(1 - e^2)}{1 + e \cos.\ \theta}$$

ALITA.

**Chinese Solder.**—How is this soft solder Chinese for their tea-chests made? It can the soldering tool being heated in boiling , I believe, what is used for sealing up tins -EXPERIMENT.

**Model Marine Boiler.**—Will some inform me if a furnace for charcoal (with or ıffin) can be used with boiler 7in. by 4in. in so, what is the best arrangement?—L.

**Magnet.**—I have made a magnet of steel H, but cannot get it to take any magnetism, ontact with a powerful electro-magnet nor by s about. I have tried it hard, brown temper, , and soft, and it is all the same—it won't needle. Size, 2½in. long, legs ½in. section, ece, between legs ½in. Can anyone tell me use the failure? Has the shape anything to -ROB. CAUS.

**Fountain.**—Will "Caldemone" oblige ch, and also state what size tubes would for the size of fountain that I require, the not more than 16in. high?—C. E.

**Diamonds.**—Can any reader inform me amond has ever been artificially formed? If the process, and why was it not a pecuniary have been told that diamond dust has been ı this correct? What is the most widely accepted theory as to the natural formation of the diamond? Is there any reason why a diamond cannot be artificially formed?—NEMO.

[72790.]—**Dialysis of Water, &c.**—I have heard that water, when treated electrically, is sent off into oxygen and hydrogen. What quantity of electricity would it take to send off one gallon?—AN OLD READER.

[72791.]—**Telephonic.**—Can any of our electrical experts tell me if I shall be able to make two Bell receivers (using receiver as transmitter and receiver) to speak over two miles of No. 16 copper, about 26 ohms, or would the "E. M." pattern do better, and what is the Bell transmitter like, if there is one?—B.

[72792.]—**Quinine.**—On taking one-third of a grain of quinine I am subjected to a smart attack of nettle-rash, or something very like it. Will our medical readers inform me of the cause, or if the effect is unique? I am induced to think that my experience may be interesting to my fellow-readers, as several doctors have described the above action of the drug as "novel."—ARVOL.

[72793.]—**To Mr. Bottone.**—I have made many spark coils according to the best instructions, but cannot get any of them to ignite cartridges, or pierce paper. The sparks in them all is accompanied with a crackling noise. I have been told by some that this was quite right, by others that it showed a defect. I want to know which is right.—COIL-MAKER.

[72794.]—**The Invention of the Block System.**—Will any reader oblige by stating who first invented the block system for railways, and also upon which line it was first employed?—Loco. No. 1.

[72795.]—**"Jenny Lind" Locomotives.**—About 40 years ago a type of passenger engine was thought very highly of, built by E. B. Wilson, and called "Jenny Lind" class, and just about the same date "Little Sharps" were in high favour. Will any of "ours" kindly illustrate both of these interesting engines?—Loco. No. 1.

[72796.]—**Ink.**—Required, an efficient chemical ink which must be perfectly invisible on white paper, and which can only be rendered visible by damping with another solution. The cobalt, &c., inks show traces of writing on the paper even before heating.—FIBRE.

[72797.]—**H.P. of High-Pressure Engines.**—Will any reader please give a practical and simple rule to find H.P. of high-pressure steam-engine.—ANXIOUS.

[72798.]—**Geological.**—While visiting some chalk-pits near Croydon in search of fossils, I came across a great amount of whitish matter like wool embedded in the chalk. I should be pleased to know what it was.—J. F.

[72799.]—**Telephone.**—To MR. F. C. ALLSOP.—I have a pair of telephones with all their inner parts, but wires on bobbins are unconnected. There are holes through their sides appearing as if terminals had been outside. There are also connecting screws on magnet end. How should the bobbin wires be connected to make them complete for use, similar as in your illustration of last week's number? What quantity of wire should each bobbin contain?—SOMERSET LAD.

[72800.]—**Trisection of an Angle.**—How is this accomplished by means of the trisactrix $r = a\,(2\cos.\,\theta \pm 1)$? —ESNE CARALITA.

[72801.]—**Water-Motor.**—Would someone who is using a water-motor for driving dynamo direct give experience with same, as I have motor, Thirlmere principle, nearly complete, water 90lb. pressure with water free of cost. Can I come near competing with paraffin at 9d. per gallon, as I want to replace two double-wick lamps? Motor disc is 2ft. diameter. Would Mr. Bottone or Mr. Allsop prefer gas-engine to above, as their reply to No. 72676 dropped my flag?—RURAL.

[72802.]—**M.S. and L.R. Bogie Locos., No. 560 Class.**—Would Mr. Douglas Leitch kindly give full dimensions of No. 561 he kindly gave a drawing of?—NORTH WESTERN.

[72803.]—**G.E.R. Single Locomotives.**—Would some correspondent give me a sketch (with original tender, if possible) and dimensions of the 7ft. singles, 0275 class on this line, and oblige?—NORTH WESTERN.

[72804.]—**Repousse Work.**—What substance is used for backing the metal? How are the tools made? Is there any book published on the art, giving practical information?—ST. MUNGO.

[72805.]—**Water Tube Boilers.**—Would any of your experienced correspondents inform me how the tubes in these boilers—Babcock and Wilcox, &c.—are fixed into their end sockets? Are they expanded in, or are they screwed in with running back nut? I am familiar with the working principle of these boilers.—VOLCANIC.

[72806.]—**Inhalation.**—Can any reader give me information on the cure of lung diseases by inhalation?—INVALID.

[72807.]—**Electrical.**—Will some electrician tell me how to put new fuses to electric-light wires and lamps? I have some lights out, the fuses have gone, and I don't know how to calculate to get the right ones for them. Will you oblige by giving me instructions how to get the right fuses for any voltage lamps, and oblige?—DYNAMO.

[72808.]—**Incandescent Lamp in Magic-Lantern.**—I have a ½-horse gas-engine which runs a Elwell-Parker dynamo to light my house. I have also a good magic-lantern. Could the lantern be lit successfully by a 25c.p. incandescent lamp? I have a good room only about 15ft. from my dynamo where I could exhibit my lanterns. Any information will be gladly received.—ELECTRICITY.

[72809.]—**Magnetism.**—Will Mr. Bottone or any brother reader kindly inform me if watches are influenced by the magnetism from a dynamo? I have just fitted up my house with the electric light, and I have found my watch (a very good one) has stopped more than once when I have been near the dynamo. I should be very glad if someone will instruct me.—DYNAMO.

[72810.]—**Glow Lamps.**—In a recent answer of Mr. Bottone's to a query respecting glow lamps, he states that it requires 1 ampère at 3½ volts to light the smallest lamp made, and the light given is about that of a rushlight. I notice in the *Electrical Engineer*, of July 20th, 1888, page 48, a description of a miner's lamp and battery. Lamp is 1½c.p., average E.M.F. is 3·8, current varying from 0·6 to 0·25 ampère according to the lamp used. Will Mr. Bottone please state what is the difference in the lamps? I also notice in Gent and Co.'s price list that their No. 2 accumulator, 4-volt 2-ampère hours, will light a 2c.p. Edison lamp for 12 hours. Would this lamp be the same as the miner's lamp stated above?—J. R.

[72811.]—**Boiler Query.**—How many gallons of water will be consumed or evaporated in a 40H.P. boiler, driving a 30H.P. (nominal) steam-engine per day of 10 hours, boiler pressure 40lb.? What will be about the cost per 1,000 gallons of lifting water to feed said boiler, from a well 45ft. below feed tanks, using a double-acting donkey pump to do the work?—NORTH YORKSHIRE.

[72812.]—**Nickel Bath.**—Will Mr. Bottone kindly inform me how to put a nickel bath right in good working when it gets out of order and won't work? Also say if cyanide of potassium is used in nickel baths.—SUBSCRIBER.

[72813.]—**Colorimeter**—an instrument used for determining the difference of shades in the colours of liquids. I would be glad if any of our readers could give me a description of the above instrument with exact dimensions, as I wish, if possible, to make one. A sketch would oblige. I believe there are two or three forms in use. The simplest to make I would wish.—COLOUR.

[72814.]—**Cropping Machine.**—Could any reader instruct me how to grind a cutting machine for woollen or worsted cloth, or if a cutting machine requires to be ground different for woollen or worsted than it does for silk plush goods? I can grind a little, but not to any great satisfaction.—GRINDER.

[72815.]—**Refractometer.**—Will any correspondent kindly say where Exner's micro-refractometer can be seen? Any account of it would much oblige. Also information as to a simple method of taking the refraction index of any substance.—DELTA.

[72816.]—**Analysis.**—I have half a glass of beer which has certainly been "doctored." I drank half of the glass, and in about half an hour felt sick; but could vomit very little, and immediately afterwards fell into a deep sleep which lasted about three hours. Next day I had all the appearance of having had a good night's carouse, and had a stiffness across the chest. I am at a loss to know what drug was likely to be used, but strongly suspect snuff or laudanum. Can anyone tell me a way of testing the beer?—MORPHEUS.

[72817.]—**Induction Coil.**—Can any reader give me the proportion of an induction coil about once-and-a-half as strong as the coils used by market electricians? Also number of powers and best method of construction?—J. N. LEE.

[72818.]—**Lantern Screen.**—I want a semi-transparent lantern screen to place between the lantern and the audience. I want it for use in a small school. The lantern has a three-wick oil-lamp, and gives a well illuminated disc at a distance of 15ft. from screen. Would a screen of tracing cloth do? I only require a disc of about 4ft.—H. A.

[72819.]—**Nitrate of Potash.**—Will some of your chemical readers inform me how I can make pure crystallised nitrate of potash that will be free from every trace of salt?—CONSTANT READER.

[72820.]—**Richter's Dream.**—Can anyone enlighten me as to where this may be found?—STELLA.

[72821.]—**Diffraction.**—On looking through my umbrella or handkerchief the other night, at the lamp-lights, I noticed a honeycombed appearance which remains perfectly clear and still, however fast or in what direction I move the fabric. If I turn the fabric round, the honeycomb turns round too. But it is not the threads merely which I see on the lamp, for my eye was focussed on the lamp, not on the handkerchief; also the handkerchief threads were three or four times as close as the appearance I speak of. Would someone kindly try the experiment, and give a scientific reason for it?—JOHN M. PITT.

**Causes of the Change of Flour.**—The cereals contain a ferment, which appears to be situated near the germ. The ferment is insoluble, and has the properties of organised ferments. When dry, it resists a temperature of 100° C., but it is destroyed by boiling water. Water and heat are indispensable for its development; a moist temperature of about 25° C. is the most favourable. It acts on and liquifies the gluten. In a well-arranged mill the greater portion of the ferment remains with the bran; the flour contains less of it the better it is bolted. When the friction of the mill is too great, or the rotation too rapid, more of the ferment passes into the flour; this gives rise to the changes which have been observed in the so-called heated flours. The acid contained in old flour is not, as has been assumed, the cause of the disappearance of the gluten, but, on the contrary, is the result of it. The investigations on the gluten have not yet given a sufficient explanation. It appears to contain variable quantities of water, and certain substances, such as common salt, appear to prevent the balling together of the same, while others, like dilute acetic acid, affect it directly. In flour which had been heated to a steam temperature the gluten still retained its properties. The action of the ferment is diminished by the want of water, but not stopped; its former properties are recovered as soon as heat and moisture are restored. The requirements for a flour which should keep a long time are:—Use of a healthy flour from hard, dry grain; thorough decortication of the grain in a well-constructed mill; thorough bolting of the flour, and preservation of the same in a place which is protected from moisture and heat.—*American Miller.*

## ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

### HINTS TO CORRESPONDENTS.

**1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.**

***** Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

**The following are the initials, &c., of letters to hand up to Wednesday evening, Oct. 29, and unacknowledged elsewhere:—**

CAPT. SAUNDERS.—Carino.—C. D. P. Davies.—Tolo.—Stud.Inst.C.E.—P. K.—G. C. C.—Tyro.—G. E. Bonney.—A. E. B.—Sol.—Bewildered.—A. J. Dew.—Organ.—G. W. B., Lancaster.—Latimer and Clark.—J. S.—F. C. Allsopp.—Tibbie Tubbs.—Gorgon.—Jack of All Trades.—H. Wornack—Tristan.—B.Sc., Edinburgh.—Locomotive.—E. H. B.

A. N. X. (The cost of a patent does not vary with the character or nature of the invention. Four pounds will pay for the cost of the stamps, and a few pence for incidental expenses if the inventor does the work himself. Better procure one of the handbooks advertised in our columns by patent agents.)—ENQUIRER, PATENTS. (We do not know of any society which assists inventors or intending patentees, unless it also intends to make as much as possible out of the business for itself. The cost of obtaining provisional protection is now only £1, and if there is anything in your invention there would not be much difficulty in getting a capitalist to back you up. Why not advertise for a partner, protecting yourself first by applying for a patent at a cost of a little over a pound, or say 50s. if you employ an agent?)—REX. (What is it you mean? To what formula do you refer? All the formulæ are explained in Molesworth's Pocket-book.)—A. E. T. (We really cannot advertise any special soap in these columns; but if you wish to make for yourself, you will find many recipes in back volumes. See, for instance, the indices of Vol. XXVIII. and XXIX.)—ROBERTO. (Surely you are joking. The pedal arrangement to a triangle can be arranged by means of a stirrup-cord to the foot; but the actual details would depend on how you want to arrange or support the triangle.)—BRASS. (See the back numbers and those of the engineering papers. Do you want mere drawings of the steam-engines and locos., or full details?)—EXERCISE. (We think Mr. U. Gill, of 170, Strand, W.C., publishes a book of the kind; but any bookseller can procure one for you.)—F. CURRY JERMAN. (Dissolve in hot water as much soda as possible, and run that through the pipe, having previously cleared it with a wire or piece of string.)—A. W. (In the case of a simple tourist's telescope it will be sufficient to wipe the lenses with a bit of chamois leather, or with a silk handkerchief. 2. Scarcely matters how the lenses are posited in such a telescope.)—ENGINEER. (You would require a powerful compressing-pump, and a means of reducing the temperature very low to liquefy carbonic acid. 2. It would depend on whether there was any outlet. The pressure of the gas would probably find or make one.)—S. G. WATSON. (We do not know of a self-shining blacking that will not crack or peel off boots while keeping them soft.)—C. W. (The Vincent shoulder-straightener was illustrated in the last volume, June 30, p. 346.)—IGNORANT. (Had you not better procure one of the handbooks, or read up the back volumes?)—D. HARBORD. (Yes, many; but naturally the numbers run out of print. Get Watt's "Electro-metallurgy," Crosby Lockwood and Son, if you cannot refer to back volumes.)—PLUMBER, Hull. (Full particulars as to the certificates can be obtained from the Secretary of the Sanitary Institute, 74A, Margaret-street, Wells-street, W. Buchan's and Davies's works will be of use.)—G. S. LAW, Dominica. (Ericsson had a motor driven by the heat of the sun, and we illustrated M. Mouchot's solar engine in Vol. XXII. Jan. 14, 1876. That was actually used at one of the Paris Exhibitions to drive a printing machine. Such an engine ought to answer in your locality, if anywhere.)—W. E. MATTHEWS. (The patentee will send full details of Joy's gear, which have, however, been illustrated several times; but we do not remember the Le Chatelier valve-gear—that was a system of reversing for stopping the train, not if we recollect for controlling the steam. However, see Zeuner's "Treatise on Valve-Gear," published by E. and F. N. Spon, 125, Strand, W.C.)—S. P. (How is it possible to answer such a question, when so much depends on the skill and perseverance of the amateur? If you can see the back volumes you will find in them full instructions for grinding glass specula; but it is not easy work for one who knows nothing about it.)—EDWD. FADELLE, Dominica. (Such a query must appear in the Addresses Wanted Column, though we would give the information to a correspondent so far away, if we had it. Can you get the petroleum in Dominica? However, we will insert a query which may elicit information useful to other readers.)—PARA. (You take a plaster cast of the type, and use that cast as a mould for the rubber, which must be vulcanised, after mixing with sulphur, in a suitable apparatus. Full particulars have been given many times.)—SEVERN. (Yes, we suppose that is so. We get only a portion of the light from the sun. What is the use of "supposing" what is, so far as we know, impossible?)—S. E. (Cannot speak as to its lasting qualities out of doors; but apply to Mr. Horne, 6, Dowgate Hill, E.C. 2. One of the best lubricants for all purposes is made by mixing equal parts of washed fat (lard, say) and finely-powdered blacklead.)—BOURDON. (84, Reade-street, New York. One dollar per annum.)—E.P. (Why not try it, by filling it full of water and heating. 2. Rub it over with coarse emery-cloth. 3. It means simply that there is 40, 60, or whatever it is, pressure on each square inch of the square foot; but the pressure is not additive.)—WINDOWS. (See indices. A smear of glycerine (a thin film) is recommended to prevent moisture on windows.)—LEX. (Several recipes in back numbers; but any mixture of powdered wood charcoal scented with cascarilla, and moulded up with a solution of saltpetre and gum, will do, tipping, of course, with the phosphorus paste. For flamers, use a little shellac or resin of some kind. They are bought much more cheaply than they can be made on the small scale, and are going quite out of fashion.)—WALKER MOSELEY. (You seem to us bent on controversy for controversy's sake. The rubbish about "crass ignorance," &c., &c., &c., in your reply, quite prevents its insertion.)—J. T. BARTLETT. (He lives three hundred miles from London, but we have sent him your letter.)—H. H. (We do not remember your previous replies, but it not infrequently happens that the same information is given by several correspondents, and then we are not able to use all the replies sent, though equally obliged to all senders. Reply now sent shall appear next week.)—ARTHUR GREENE. (We do not know. You should advertise in the "Wanted" column.)—A. J. DEW. (Please send.)—H. MIDDLETON. (We will wait for your detailed description before publishing the illustration. We could wish, by the way, that the photograph was clearer.)—J. EMMET. (We know nothing of him. Communicate with the police at Scotland Yard, if he does not send it.)

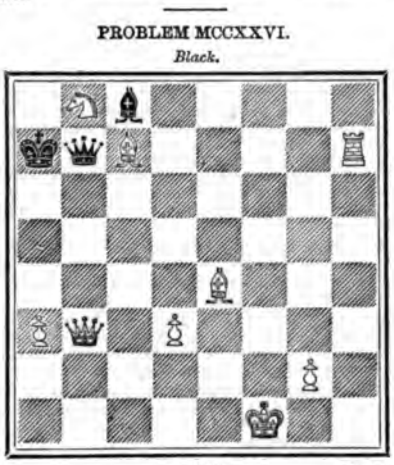
**Colonel Huddleston's Opinion of Harness'** ELECTROPATHIC BELT.—Writing from Newton Abbot, Devon, he says: "The pains in my back have ceased, and I have derived much benefit from wearing your Electropathic Belt." Weak and languid feelings, and every form of nervous, muscular, or organic weakness may be speedily overcome by wearing one of these invigorating health-giving appliances. They are light and comfortable in wear, and are guaranteed to do good in every case. Thousands of unsolicited testimonials have already been received from the grateful multitude who have been restored to health by simply wearing one of these belts. Their original letters may be personally inspected, or copies may be had, post free, on application to the Medical Battery Company, Limited, 52, Oxford-street, London, W. Pamphlet and consultation free, either personally or by letter.

## CHESS.

**ALL communications for this department must be addressed to "J. PIERCE, Knollside, Yawl, Lyme Regis, Dorset."**

### PROBLEM MCCXXVI.

*Black.*



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**White to play and mate in two moves.**

SOLUTION TO 1224.

| *White.* | *Black.* |
|---|---|
| 1. P-K B 3. | 1. Any. |
| 2. Mates accordingly. | |

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CORRECT solutions to 1224 by W. L. Martin, M. Kelly, A. A., D. Mackay, Link, Lieut. Col. Ryan, W. Sangster, Biene, T. H. Billington, J. B., C. P. P., J. H. Eastwood, G. W. Middleton, Fr. Fernando, W. A. Clark (clever and by no means easy); to 1223 by G. W. Middleton (2), W. Jay (2), J. H. Eastwood (second solution), J. B. (2), White Knight (2), J. A. Rogers (2), Link (2), D. Mackay (2), M. Kelly (author's, the other two incorrect).

WHITE KNIGHT.—Entrance fee received with thanks.

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**The address is included as part of the Advertisement, and charged for.**

**Advertisements must reach the Office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.**

## OUR EXCHANGE COLUMN.

*The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.*

Astronomical Telescope, Refractor, good, wanted i exchange for MICROSCOPE and CHRONOMETER, value £25.—BASSETT, 62, High-street, Stoke Newington.

Grand model **Screw Steamer**, cost £12. Accept any reasonable offer in very old foreign Postage Stamps, a collection preferred.—WESTHORP, 1, Spring-road, Ipswich.

**Paddle Wheels and Gear**, manual, suitable fo pleasure-boat, cost £50; good condition, in exchange for strong Safety Bicycle.—CANOEIST, 24, Charles-street, Hull.

**Lathe**, 4in. centres, good order; iron-faced hard-woo bed, heavy wheel and crank, chucks, jaw, solid emery wheel.—RANDLE, Crown street, Kettering.

**Ballard Rifle**, 220, sighted by Rigby, London, i perfect condition. Exchange for good Hand Camera, &c.—LADD, 1 Merrion-street, Dublin.

**Cripper Tricycle**, Baylis and Thomas Excelsior, good condition. Exchange Lathe or offers.—SUTTON, Ingleside, Pontesbury, Salop.

**Angling Rod**, hollow, 14ft. 6in., four joints, tw extra tops. Offers. Want small Bench Vice.—SUTTON, Ingleside, Pontesbury, Salop.

**Parlour Walnut Table**, oval, 4ft. 8in. by 3ft. 6in., inlaid, pillar and claw legs. What offers? Electrical or tools.—SUTTON, Ingleside, Pontesbury, Salop.

**Books**, Scientific, about 15 for exchange; electrical.—For list apply SUTTON, Ingleside, Pontesbury, Salop.

Anything useful or saleable taken in exchange fo MUSIC or MUSICAL INSTRUMENTS.—Address THE MIDLAND MUS AGENCY, Measham, Atherstone.

**Astro. Telescope**, 6½in O.G., Cooke, six eyepiece finder, equatorial mounted, no circles. Exchange. 4in. wanted.—BASSETT, 62, High-street, Stoke Newington.

Pair amateur **Ventriloquial Figures**, on stand Exchange anything useful.—WILSON, 3, Inkerman-street, Stockton-on-Tees.

**Microscopic.**—Polished pine case, with trays containing 48 high-class Microscope Slides, value £1 3s. 6d.; offe invited. Want apparatus for Science Teaching, need not be perfec or models.—MICROSCOPIST, 344, Caledonian-road, London.

**The Chenies-street Exchange** offers greate choice. Entire stocks and single instruments purchased. Best mark Particulars first.—CAPLATZI, Chenies-street.

**Botany.**—Valuable collection of Specimens (4 cases properly mounted, named (Eng. and Lat.) and classified. Offe Lathe wanted.—W. E. T., 144, Grosvenor Park, S.E.

**Magic Lantern Slides.**—24 miscellaneous colour photographs, double slipping, &c.; also grooved Box, good conditi Exchange to value 30s.—ARTHUR, 9, Albion-square, Dalston.

**Model Dynamo**, partly together, armature a field magnets wound, brush holders, mahogany base, pulley, bearing accumulator, &c. Exchange Speed Indicator, or offers.—W. D., Mayall-road, Brixton.

**Leclanche.**—Portable set of 20 new Vulcanite Cells by Mottershead, with selecter, worth £1. Exchange.—LANG, Pe terrace, Old Trafford, Manchester.

**Steam Launch**, 16ft., complete inventory. Injector, pumps, all highest class; vertical multitubular boiler, working pressure 100lb., speed about 8 miles. Must part (for no fault). Will take in exchange 1H.P. Otto Gas-engine, small Milling or Shaping Machine, best make.—HAWLEY, Malton, Yorks.

**Steam Launch Hull** or Vertical Boiler will be exchanged separately. What offers? Dynamo, Steam fittings, Engineering Tools, Safety Bicycles, as above.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
*FRIDAY, NOVEMBER* 7, 1890.

# TELEPHONES: THEIR CONSTRUCTION AND FITTING.—X.

By F. C. Allsop.

Author of "Practical Electric Bell Fitting," "Electric Bell Construction," "Practical Electric Light Fitting," &c.

### Connecting-Up.

TWO Instruments with Microphones, Receivers, and Magneto-Bells for Signalling.—Fig. 54 shows the connections for two telephone instruments, with microphones, Bell receivers, and magneto switch-bells. This is the form of instrument now in most general use, and is the form best suited for long-distance working. It will be noticed that it is a similar instrument to that shown in Fig. 52, the difference being that the form shown in Fig. 52 has a battery switch-bell, while this has a magneto form.

In the figure, *a* is the microphone, *b* the receiver, *c* the automatic switch, *d* the generator, *e* the bell, *g* the two springs by means of which the local circuit is opened and closed, *f* the battery for the microphone, and *n* the induction coil; *a′*, *b′*, *c′*, *d′*, *e′*, &c., being the corresponding parts of instrument No. 2.

When the handle of the generator *d* (instrument No. 1) is turned, and the receivers are on the switch-hooks *c* and *c′*, the "ringing" circuit is starting from the left-hand terminal of the generator *d*: generator *d*, bottom contact of automatic switch *c*, switch-hook pivot, "line" wire between the two instruments, pivot of automatic switch *c′* (instrument No. 2), switch-hook, bottom contact of switch, generator *d′*, bell *e′*, "earth," right-hand terminal of bell *e* (instrument No. 1), left-hand terminal, and from there back to generator *d*. When the handle of the generator *d′* is turned, a similar action takes place, and it will be noticed that both bells ring when the handle of either of the generators *d* or *d′* is turned. When the armature of either of the generators is at rest, it is cut out of the circuit so as to avoid having the extra resistance of the armature of the idle generator to ring through. For an explanation of the action of this armature cut-out, the reader is referred to the description of the magneto-generator that appeared in the articles "Electric-Bell Construction," since published in book-form.

When the two receivers, *b* and *b′*, are off the switch-hooks, the circuits are as follows: The "local" circuit runs from the carbon pole of the battery *f* to induction coil *n*, springs *g*, microphone *a*, and from there to the zinc pole of the battery. The "speaking" circuit is, starting, let us say, from the secondary windings of the coil *n*:—Coil *n*, top contact of automatic switch, switch-hook, pivot, line-wire between the two instruments, pivot of switch *c′* (instrument No. 2), switch-hook, top contact of switch, secondary of coil *n′*, receiver *b′*, "earth" or return wire which is used, from "earth" to receiver *b* and back to secondary of coil *n*.

The diagrams that have so far been given relate chiefly to the internal connections of the instruments; but those that now follow show the various ways of connecting up several instruments to meet certain requirements. The form of instrument shown is of the magneto switch-bell kind, the connections of which have just been given in detail in Fig. 54. The "line" and "earth" terminals only are shown, as all the other connections are internal, and do not in any way affect the connection of one instrument with another. Every telephone has its "line" and "earth" terminals—i.e., a terminal to which the "line-wire" is connected, and another for the "earth" or "return-wire," irrespective of whether it has a battery or magneto switch-bell, microphone or no microphone. The form shown in the following figures contains a magneto generator and bell (the two gongs of which are visible at the top of the case), a microphone transmitter (the mouthpiece of which is shown at the bottom), with induction and local cell inside the case. The receiver is shown hanging on the hook at the left-hand side of the case, and on the right-hand side is the handle of the generator.

If in any of the diagrams it is wished to follow the inside connections of any one of the instruments, it is only necessary to refer to Fig. 54 and follow the circuit through the instrument shown there, from the "line" wire to the "return," or the "return" to "line," as the case may be. If it is wished to follow the connections, presuming the instrument has a battery switch-bell, the same process must be pursued, only with the instrument shown in Fig. 52. The form of instrument shown in the diagrams has been adopted, partly because, being compact, it adds to the clearness of the diagrams, and partly because it is the form which the writer believes will come mostly into use on the expiration of the microphone patents. However that may be, the diagrams apply equally to all forms of instruments, any particular instrument can be substituted, the "line" and "earth" terminals being connected-up as shown.

*Three Telephones in Series.*—Fig. 55 shows how three or more telephone stations are connected in series so that any one station can communicate with any other on that circuit. In order to be able to distinguish which station is wanted, a code of signals must be arranged, such as one ring for No. 1, two for No. 2, and so on. Thus, if No. 2 station wishes to communicate with No. 1, he gives one ring; with No. 3, three rings. When No. 2 receives a reply, he takes off his receiver, which cuts his bell out of circuit and puts the microphone and coil on, enabling him to carry on conversation with No. 1 or No. 3, as the case may be. Thus, when any one station rings, the bells at all the other stations ring also; but only that station replies whose number corresponds to the signal given. If the instruments are of the battery switch-bell type, then a relay should be used for each instrument; otherwise there will be difficulty in getting the bells to ring nicely, unless they are of the form (described in "Practical Electric-Bell Fitting") which govern their vibrations, not by breaking the circuit, but by shunting their coils.

*Three Telephone Stations, One of which is able to Communicate with the other Two, as desired.*—Fig. 56 shows an arrangement suitable for such places where it is desired for one station to be able to communicate with the other two, but not vice versâ. As, for instance, where the head of the firm wishes to be able to communicate with the clerks' office, stores, or other part of a building, without allowing himself to be communicated with unless he desires. In order to accomplish this, a two-way plug, switch B, is required. This switch is fixed within easy reach of the person who uses the instrument. No. 1, and to the top blocks *b* and *c* are respectively attached the two line wires from the instruments No. 2 and No. 3. The bottom block *a* is connected to instrument No. 1, and the return wires from all the instruments are joined together. Each of the brass blocks *a*, *b*, and *c* are fixed to a non-conducting base, and insulated from one another by an air space. When the brass plug is put in either of the two holes, the top plate above that hole is connected to the bottom plate. Thus it will be understood that if the brass plug is inserted in the left-hand hole of the switch, No. 1 instrument will be connected to No. 2, and if placed in the right-hand hole, to No. 3. When withdrawn altogether, communication is cut off from both instruments. A larger number of stations can, of course, be connected into the system by employing a larger switch. Once the application and method of working the plug switch is understood, it will be seen that it is capable of great extensions, and, in fact, forms the simplest and most ready means of connecting-up instruments to meet special requirements.

*Four Telephone Stations, One of which is used as a Central Exchange.*—Fig. 57 shows four telephone stations arranged on the exchange principle, the best method to adopt where there are many stations in the system, any one of which it is desired may be able to communicate with any other. No. 4 station is used as the exchange, and contains besides the instrument No. 4, the annunciator switch-board A, local bell B, and local battery C. The annunciator switch-board A is shown in detail in Figs. 35 and 36, thus allowing the connections to be followed right through. For the purpose of following the circuit right through, let us suppose that station No. 2 wishes to communicate with station No. 3. The person at station No. 2 first turns the handle of his generator, or if the instrument has a battery switch-bell, presses the ringing key, thus sending the current to station No. 4. This causes the shutter of No. 2 drop to fall, closing the local circuit, and causing the bell B to ring, the circuits being as follows. Left-hand terminal of No. 2 instrument, line-wire *d*, No. 2 terminal of annunciator, drop No. 2, spring $s^2$, plate *b*, terminal E and earth, and from there back to instrument No. 2. The shutter of the annunciator falling, closes the local circuit which runs from the carbon pole of the battery C, to bell B, terminal B of annunciator, shutter, terminal $B^1$, and thence to zinc pole of the battery. This causes the bell B to ring, calling the attention of the person at that station, who then pushes the "jack" J underneath the spring $s^2$, thus putting his instrument in connection with that at No. 2 station. He then rings back and inquires of No. 2 which station he requires. Having obtained this information, he connects across the slipper spring $s^2$ of No. 2 annunciator with that, $s^3$ of No. 3 by means of a piece of flexible cord with a "jack" at each end, thus putting No. 2 station in connection with No. 4. The circuit now runs from the left-hand terminal of instrument No. 2 to line-wire *f*, terminal No. 2 of annunciator, annunciator drop No. 2, spring $s^2$, "jack" spring $s^3$, drop No. 3, terminal No. 3, line-wire *d*, instrument No. 3 and earth, and from earth back to instrument No. 2. A similar action takes place when communication is effected between the other stations. The operator at No. 4 station withdraws his jack, and replaces the annunciator drops after he has connected the two stations through. Generally the "jack" J takes the form of a "knife-jack," which can be slipped above the ordinary jack, thus enabling station No. 4 to converse with any of the two stations that are connected up as described in article VI. When No. 2 and No. 4 stations have finished talking, they press the ringing key or turn the handle of the generator, as the case may be, which causes the annunciator shutter to fall, thus informing the operator at No. 4 station that they have finishing talking, who then pulls out the connecting jacks. This is the method upon which the various exchanges in the different towns are worked, though of course modified to suit the requirements of a large number of subscribers. The system described above is known as the "slipper board" system, the more modern form of switch-boards having had many improvements introduced which facilitate the rapid connecting-up of the different subscribers.

*Three Telephone Stations, arranged on the*

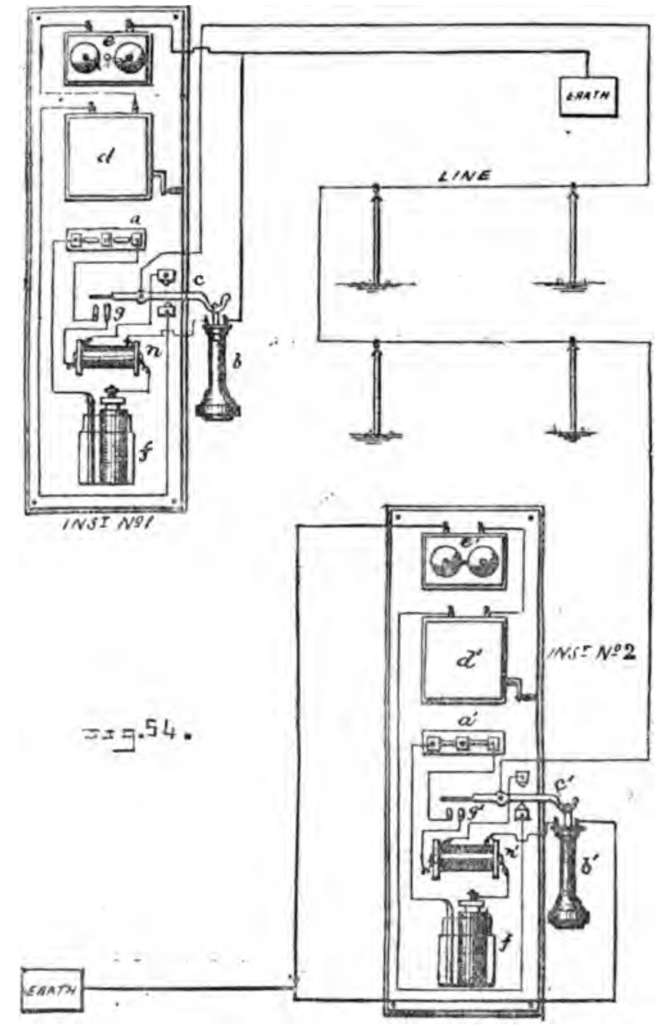


Fig. 54.

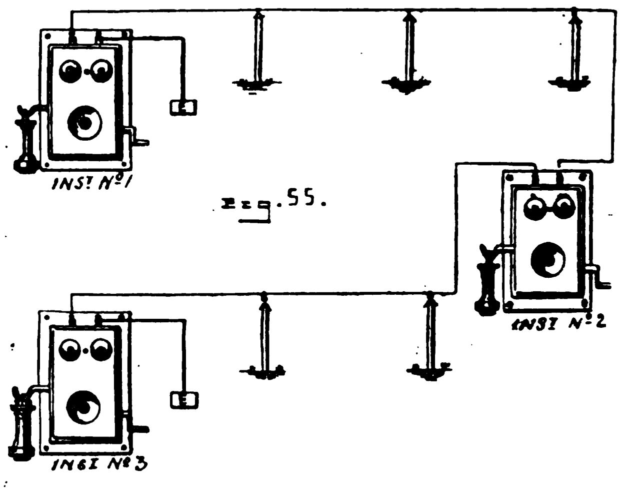


Fig. 55.

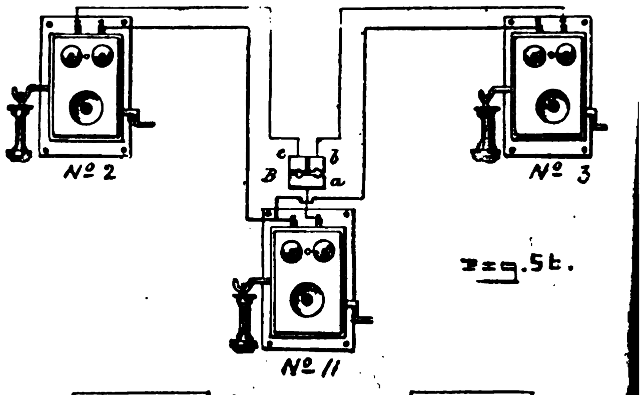


Fig. 56.

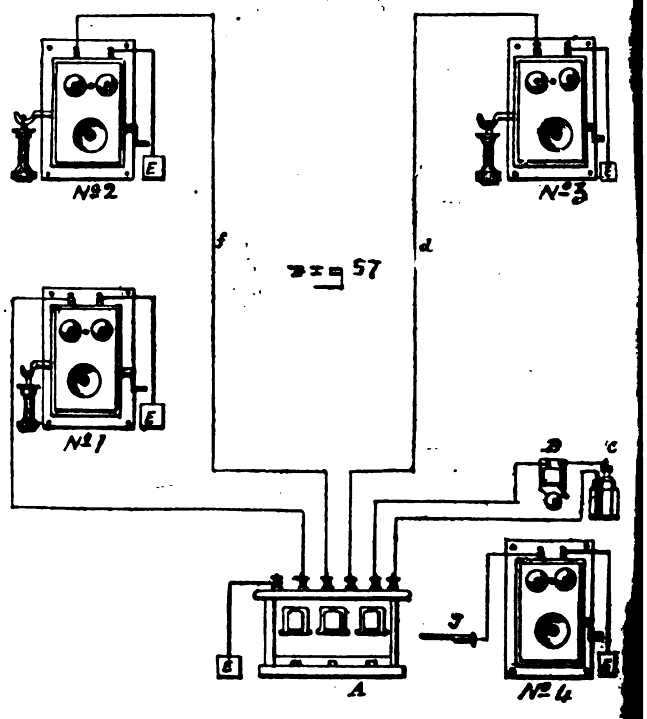


Fig. 57

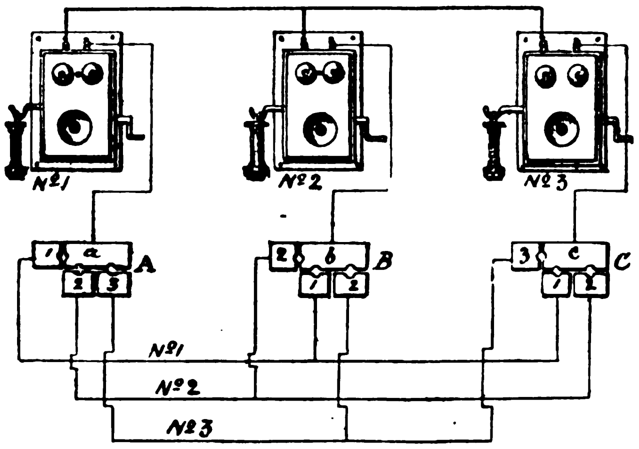


Fig. 58.

*Intercommunication System.* Fig. 68, shows a method of arranging telephones on the "intercommunication" system—a system or method of connecting telephones that allows of any one station being put into communication with any other on that system by the operator himself. On comparing Fig. 57, which is an "exchange" system, with Fig. 58, the difference between the two systems will be seen. In the "exchange" system it is necessary for all the other stations to communicate first with the central station before they can be put into communication with one another; but in the "intercommunication" system, the operator at each station can, by inserting a plug or moving a switch, place his instrument in connection with any other on that system. The method by which this is effected in Fig. 58 is by means of special plug switches. The instruments are marked No. 1, No. 2, No. 3, and the line-wires to each instrument are also likewise numbered. The plug switches to each instrument are marked A, B, and C respectively. In their normal position, the brass plugs of each switch are always in the holes connecting the brass blocks 1 and *a*, 2 and *b*, 3 and *c* together. Now, we will suppose No. 1 wishes to communicate with No. 3; to do this, he takes the brass plug from between the blocks 1 and *a* of the switch A and places it between *a* and 3; he is then in connection with No. 3, and after ringing him up, can carry on conversation with him. When No. 1 has finished talking, he withdraws the brass plug from between the blocks *a* and 3 and inserts it back into its original position between the blocks *a* and 1. A similar action takes place when any of the other stations wish to communicate, the only precaution to be t
being to see that the brass plug is retu
to its original position when conversa
is finished. It will be seen that
number of stations can be connected
on this system, the number of w
between each station being $n + 1$, wh
$n$ equals the number of stations.
system is especially adapted for commu
tion in hotels and other large buil
though, when the distance between
station is very great, the expense b
high owing to the number of wires re
For long distances the exchange sys
the most suitable, and an automatic s
board might be used, one of which we
probably presently describe. This ki
switch-board does away with the nec
for an operator to make the connecti
the central exchange, as this is done

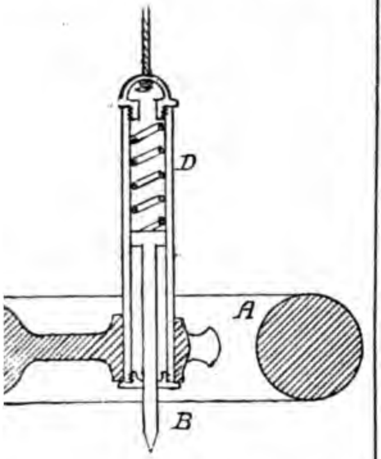
ers themselves by means of contact- arranged as to work synchronously.

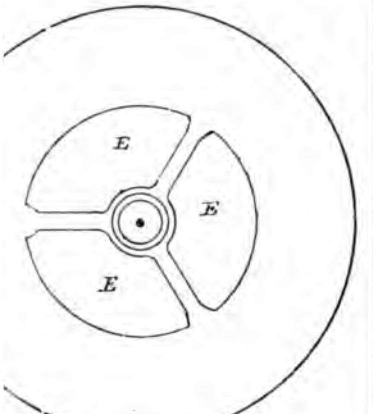
(*To be continued.*)

## NEW PLUMMET.

rdinary form of plummet is, for many poses, found to be hardly of sufficient and we are glad to call attention to the new design of plummet, which has pted by the Standards Department of l of Trade. The accompanying sketch contrivance, which aims at securing a centre of gravity with an accurate point m above.

eavy brass or gun-metal wheel or ring, e light spokes; B is a fine steel point, hen pressed upwards by accident or , retreats within the central tube D, g a spring, which presses down the Mr. A. Hilger contrived this part of the t.) The point is easily visible from looking through the spaces E E E, and ment is intended to be used in connec- a small circular mirror, marked with s and placed on the ground. The point be adjusted exactly opposite its own at the intersection of the lines. Mr. nwards is the designer of the plummet.





## MPROVED INDICATOR.

nproved indicator has been recently ented in this country by Mr. G. C. f Monument Chambers, London, and A. E. Tavernier and E. Cusper, the eing apparently to "indicate" the irectly from the connecting-rod or d. In the drawings, Fig. 1 is a front Fig. 2 is a section on the line $x\,x$ in which $a$ is the base of the indicator, low so as to form a chamber, $b$, the communicating by means of a channel, he passage $b^2$ in a nozzle at the lower e base; $c$ is a nut by means of which ntus is secured to the cock upon the f an engine; $d$ is a disc fitted upon the flange $a^1$ of the base $a$, and having at its centre an enlargement containing a chamber, $d^1$, which communicates by means of a passage, $d^2$, with the chamber $b$ in the base; $e$ is a cylinder which rests upon the disc $d$, and which at its upper end is closed by a cap, $e^1$, secured by screws, $e^2$; $f$ is an indiarubber or other flexible diaphragm arranged between the disc and the flange of the cylinder $e$; $g$ is a piston working within the cylinder $e$ and connected with the rod $g^1$ by a ball-joint, $g^2$; and $h$ is a spring surrounding the rod $g^1$, secured at its upper end to the block $h^1$ screwed on to a correspondingly screw-threaded projection on the cover $e^1$, and at its lower end to a block, $h^2$, bearing upon the piston $g$. The piston $g$ is pressed against the diaphragm $f$ by this spring, so that any pressure acting against the diaphragm upon the underside is transmitted through the diaphragm to the piston. $i$ is a socket projecting from the base-piece $a$, and adapted to receive the shank $i^1$ of a bearing, $i^2$, in which is arranged a shaft, $i^3$, carrying two pinions, $i^4$, $i^5$. Upon the exterior of the cylinder $e$, and adapted to rotate thereon, is mounted a drum, $j$, having at its lower part a pulley, $j^1$, designed to work in connection with the pulley $i^4$ on the shaft $i^3$. Within the drum $j$ is a helical spring, $j^2$, one end of which is fixed to the interior of the drum, while the other end is connected to a movable sleeve, $j^3$, adapted to be adjusted in any required position upon the cylinder $e$ by means of the set screws $j^4$. It is obvious that by means of this sleeve the power which the spring exerts upon the drum $j$ can be regulated. The object of the spring is to return the drum to its normal position after it has been rotated by means of the pulley $j^1$. $k$ is the indicator-paper carrying cylinder which is adapted to fit on to the drum $j$, as shown, and which is provided with the metal strips or fingers $k^1$, $k^1$ of ordinary construction with which the paper is engaged to hold it in position, the carrying cylinder $k$ being adapted to follow the drum $j$ in all its movements. $l$, $l$ are two series of crossed levers arranged in the same manner as lazy tongs, the free ends of which are connected by links, $l^1$, $l^1$, to the cover $e^1$. These two series of levers are connected together by rods, $m$, $m^1$, $m^2$, so that they act simultaneously. The rods $m^1$, $m^2$ project into slots formed in two guides, $n$, secured to the cover $e^1$ at their lower ends, and connected by the cross-bar $n^1$ at their upper ends, and the upper rod $m^2$ projects quite through the slotted guides, and has jointed to its ends two vertical rods, $o$, $o$. These rods $o$, $o$ at their lower ends are secured to a frame, $p$, and to the latter are also secured two guide-rods, $p^1$, sliding in sockets, $p^2$, carried by arms, $p^3$, projecting from the base-piece, $a$. The frame $p$ serves to carry the pencil-holder $q$. This pencil-holder comprises a small cylinder, $r$, through which slides a small tube, $r^1$, for carrying the pencil, and having on its outer end a head or knob, $r^2$. A spring, $r^3$, surrounding the tube $r^1$, tends to hold the pencil in contact with the paper on the cylinder $k$, but in order that the said pencil may be held out of contact with the paper when desired, a small lug or projection is formed upon the tube $r^1$, and a corresponding slot is formed in the cover of the cylinder $r$. By drawing the tube $r^1$ backwards, and slightly rotating the same, it is obvious that the pin thereon can be caused to bear against the solid part of the cover, and so hold back the tube and also the pencil carried thereby against the pressure of the spring $r^3$.

Fig 1

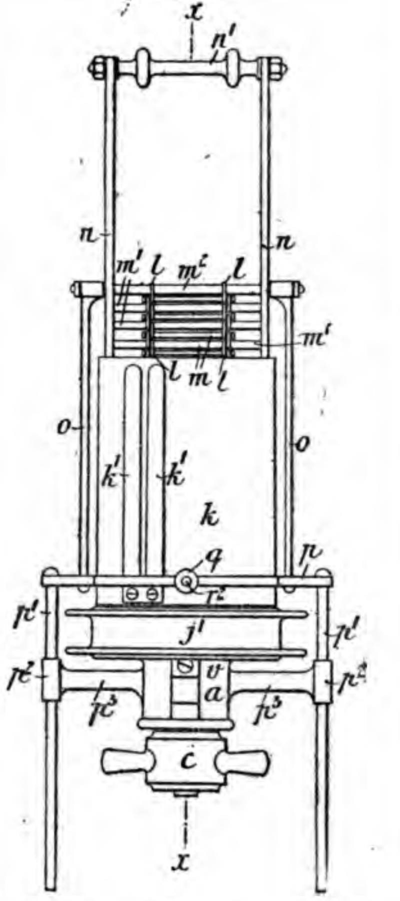
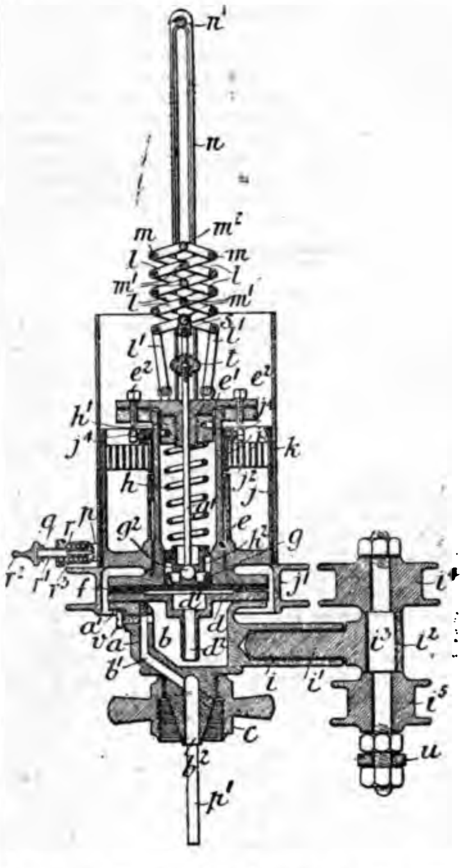


Fig 2



In order that the motion of the piston shall be imparted to the levers $l$ and thence to the pencil-holder, the piston-rod $g^1$ is connected to a block, $s$, on the lowermost rod, $m^1$, so that the motion imparted to the lowermost levers $l$, $l$ will be transmitted through all the other levers, and so considerably increased or multiplied. It will thus be obvious that the very slight movement of the piston can be amplified to such an extent as to give the required amount of vertical movement to the pencil. To permit of the adjustment of the pencil-holder $q$ relatively to the paper cylinder $k$, the patentees provide for increasing or decreasing the length of the rod $g^1$, and for this purpose the rod is formed in two parts which are connected together by a screw nut or socket, $t$, having right and left hand screw-threads. To impart the motion of the engine piston to the paper-carrying cylinder $k$, a cord wound around the pulley $i^5$ is attached to some moving part of the engine, and a second cord is wound partly upon the pulley $i^4$ and partly upon the pulley $j^1$ of the cylinder $k$, in such a manner that during the out-stroke of the engine piston the cord will be unwound from the drum $i^5$ so as to rotate the latter. This rotation being transmitted to the pulley $i^4$ causes the winding of the second cord upon the last-named pulley, and the corresponding unwinding of the same from the pulley $j^1$, whereby the latter with the drum $k$ is rotated against the power of the spring $j^2$. During the in-stroke of the engine piston the reaction of the spring causes the unwinding of the cord from the pulley $i^4$, and the consequent rotation of the latter and of the pulley $i^3$ upon which the cord is rewound. $u$ is a bar upon which is fixed a small guide pulley for the cord upon the pulley $i^5$.

In order to work the apparatus, the chamber $b$ in the base $a$ is filled with glycerine, oil, water, or other desirable fluid, through the opening shown in the drawing as closed by the screw $v$, which fluid serves as a cushion between the steam or other fluid from the engine cylinder and the diaphragm $f$. When the indicator is applied to an engine-cylinder, and communication is opened between the interior of the latter and the chamber $b$, the fluid will be forced into the chamber $d^1$ through the passage $d^2$, and there press upon the diaphragm $f$, which in its turn presses upon the piston $g$, and more or less raises the same against the pressure of the spring $h$, the upward movement being communicated by the piston rod $g^1$ to the crossed levers $l$, $l$, and thence to the pencil-holder. By varying the relative diameters of the pulleys $j^1$, $i^4$, $i^5$, the rotation of the paper-carrying cylinder may be regulated to the stroke of the engine to which the indicator is applied, so that the paper-carrying cylinder shall not make more than a complete rotation during each in-stroke and each out-stroke. It is thus possible to connect the cord on the pulley $i^3$ directly to the piston rod or connecting rod without the intervention of levers.

## PRODUCING MINIUM.

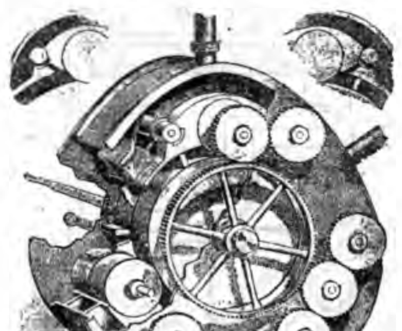
An improved method of making minium has been patented in this country by Mr. Alsberg, of New York, and is described as follows:—Minium, in its commercial forms of red lead or "orange mineral," has been generally manufactured by exposing oxide of lead (litharge) or hydro-carbonate of lead (white lead) for a long time to air at a temperature between 500° and 600° F. The monoxide of lead (i.e., litharge or oxide resulting from the decomposition of the carbonate) absorbs oxygen, forming a triplumbic tetroxide or plumbic plumbate which possesses a more or less red colour. According to the state of fineness of the material employed the oxidation is more or less complete, and it is almost impossible to so control the absorption of oxygen as to have the whole of the material converted into triplumbic tetroxide. The object of this invention is to provide better and more certain means of oxidation, and to reduce the time and labour required for the same. The invention consists in incorporating nitrate of lead into the material employed, which may be either oxide or carbonate of lead, and exposing the mixture to a moderate heat, sufficiently high to decompose the nitrate of lead, and by the oxygen of the nitric acid convert the lead monoxide into the triplumbic tetroxide (or plumbic plumbate), but not high enough to decompose this latter and reconvert it into the monoxide. The nitrate of lead by its decomposition supplies oxygen for the conversion of the plumbic monoxide into triplumbic tetroxide without leaving any foreign substance which might either combine with the lead oxide or have to be removed by lixiviation.

In carrying out the invention, the patentee mixes dilute nitric acid with either litharge or white lead, thereby obtaining a mixture of basic lead nitrate with lead oxide or lead carbonate. This mixture is exposed to a heat of about 700 to 900° Fahrenheit. The reaction (i.e., the decomposition of nitrate of lead and the formation of minium) takes place at about the melting point of zinc, which is 775·5° Fahr., or at an incipient red heat. Care must be taken not to heat up to a red heat, at which minium is decomposed and fusion takes place. The process may be carried on by placing the material upon the hearth of a reverberatory furnace, or of a muffle, or the mass may be packed into iron or clay trays or pots. By the application of heat any water that may be contained in the mass is first evaporated, and when the temperature rises to about the melting point of zinc the lead nitrate is decomposed, and supplies oxygen for the formation of minium. Access of air or stirring the mass is not absolutely necessary when a sufficient quantity of nitric acid has been used, but when the mass is heated in a muffle or on the hearth of a reverberatory furnace it should be stirred from time to time. In place of incorporating nitrate of lead into the material, by forming it within the same as above described, nitrate of lead already formed may be incorporated into the material, either dry, or preferably, as an aqueous solution, which latter insures a more intimate mixture. In practice the patentee uses for 100 parts by weight of litharge about 7·1 parts of hydrogen nitrate (i.e., nitric acid) diluted with sufficient water to make about 12·5 parts. Or he takes for 100 parts of litharge 18·6 parts of lead nitrate and 15 parts of water. In the case of white lead, he takes a quantity containing 100 parts of lead oxide. The invention, however, is not restricted to the above-mentioned proportions, for the patentee has obtained a good colour by heating a mixture of 100 parts of litharge and 5 parts of lead nitrate, giving the air free access to the mass, whereas the same kind of litharge without the addition of lead nitrate, exposed to the same degree of heat for the some length of time, did not change its colour materially. Likewise a larger quantity of lead nitrate may be employed, provided care be taken to decompose the nitrate completely.

For the finest quality of orange mineral the patentee uses by preference litharge produced by burning atomised lead, or lead carbonate precipitated from a basic lead acetate solution by carbonic acid (so-called French process white lead).

## IMPROVEMENTS IN ROTARY ENGINES.

The novel rotary engine illustrated is the invention of Messrs. Samuel J. Holt and Daniel Kinney, of West Plains, Mo. This engine is provided with a rotary piston furnished with a central circumferential groove into which projects a flange from the interior of the cylinder, practically dividing the cylinder into halves, each half containing a rotary piston. Each piston carries wings which are fitted to the interior of the cylinder, and at three points in the circumference of the cylinder are arranged rotary abutments which are adapted to pass the wings as the piston turns. The rotary abutments receive motion from a spur wheel on the main shaft of the engine, and rotary valves on either side of the abutments control the supply and exhaust of the steam. Each division of the cylinder is provided with throttle valves, and all of the throttle valves are operated by a system of levers connected with a single wheel or circle, which, being turned, operates all the valves simultaneously. By means of this construction also, the engine may be reversed. The details of the rotary valves and of the abutments are shown in the small views in the upper part of the figure. This engine is very simple, and as all of its parts are rotary, it must necessarily run in balance.—*Scientific American.*



## A SIMPLE CHUCK AND MICROMETER STOP FOR AMATEURS.*

In a former article (see p. 114, No. 1306) a dividing machine for amateurs was described, and it is now purposed to describe a simple chuck for use with the same, and the micrometer stop that is used to regulate the depth of cut in the graduation of circles, &c.

Everyone knows the difficulty in holding thin plates in a scroll chuck. They can be held by first backing them with something else; but wood is unreliable, metal expensive and hard to use; so a chuck which obviates all trouble, and once made will last always, is a desideratum. Such a chuck is the one described.

A face-plate casting of the size required is obtained and then turned up and accurately fitted to the lathe. Its face is turned smooth and semi-polished, and its edge turned with a shallow groove, as shown in the first section in Fig. 1, which shows a side view of the chuck complete.

A ring is now turned up, the same size as the face plate, and its back face is turned with a projecting lip that fits accurately in the groove in the edge of face plate. This back face can be turned up first, and be fitted to the face plate before the front face and edges are finished to size.

The ring is now put in place and accurately laid off with a number of points to be drilled for screws. Two, four, or better yet, six holes may be laid off. As stated, they should be *accurately* spaced, so that the ring may fit, haphazard, after once being removed, and not necessitate replacing exactly the same each time it is replaced.

The holes through the ring are clear. Those in the plate to match are tapped for a good strong machine screw—say a 10-24 size.

The ring can now be turned up on its edges and finished, and the chuck is complete.

Its use is obvious. Any flat, thin plate of a circular form can be clamped firmly and truly to the plate by the ring and screws, and the plate will be firmly supported against the tool, no matter how thin the plate may be.

Of course, the chuck ring must be large enough to take in the size circle to be cut out, with room for the tool to work while cutting out the circle, after the other work has been done.

This chuck is so simple and easily made that several sizes can well be afforded. The amateur has then a chuck to be depended upon that will not fail him, instead of depending upon a makeshift of wood that may let his work slip, or bend, and so spoil all the job perhaps just as it is about completed.

Fig. 1, side view. Fig. 2, plan or front view. The micrometer stop is shown in Figs. 3 to 9, Fig. 9 being the finished tool.

It is simply a modification of the principle of the micrometer caliper, and all who are familiar with the latter tool need no description of its construction or use. The following is, therefore, for those who are not so familiar.

A bar of steel is bent and forged to shape, as shown in Figs. 3, 4, 5, a slot being cut in the bottom piece, as shown in Fig. 4, and a hole drilled and tapped at the upper end of the upright piece, as shown in Fig. 5.

To this latter hole is fitted a piece of steel that is drilled and tapped with a 20 or 40 thread for part of its length, and then drilled completely through with a somewhat smaller drill, as shown in Fig. 6. The dotted lines show the size and depth of the holes. This forms the "barrel" of the tool.

A screw is now got out that fits this threaded part accurately, and to a good working fit. One end is turned off plain for a certain distance to fit into and project through the smaller and plain hole in the piece just made, Fig. 6. The other end is also turned down plain for a purpose to be presently mentioned. See Fig. 8.

Fig. 7 shows the size and shape of the hub piece—the sleeve—with its milled head. It is drilled so as to slip over the piece, Fig. 6, at a good working fit. It is best to turn it up out of the solid, and the bore should be accurately drilled and polished. Concentric with this bore, and through the head, a smaller hole is drilled that will just take in the short blank end of the screw, Fig. 8, at a tight driving fit. This hole should be slightly countersunk on the *outside*. The head may be milled or knurled with any pattern to permit a good grip to be taken.

The screw, Fig. 8, is now fitted to the sleeve, Fig. 7, by forcing the blank end into the hole and riveting down and finishing off. The piece, Fig. 6, is securely fastened into its place, and the tool is ready to go together.

But before final putting together the parts should be graduated.

The graduation will depend upon the pitch of the screw and the fineness that is desired. If the screw has twenty threads, then, to get thousandths of an inch, fifty divisions will have to be put on the beveled end of the sleeve; as many more or less can be put on as may be desired.

This graduation can easily be done in the by the use of an index plate or the dividing ma An index plate works the faster of the two. with a horizontal cutting edge should be used the marks.

A reference line is now needed to which to these divisions. This line is cut upon the shown in Fig. 6, at any convenient place, as sh in Fig. 9. It can be easily done in the lath locking the work between centres and movi horizontal edged tool along the same by mea the slide-rest.

For use as a micrometer stop this is all the

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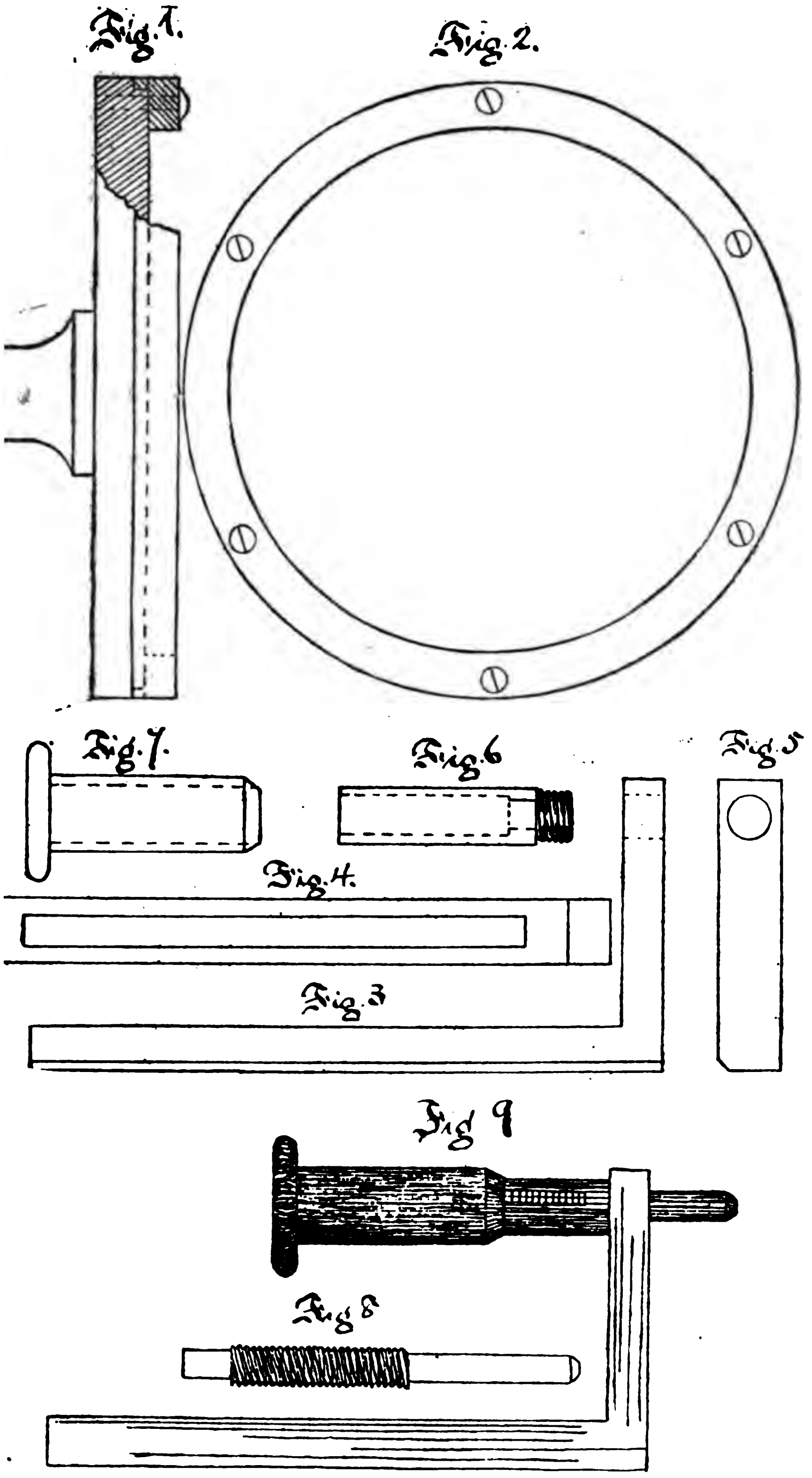
* By Lieut. C. D. Parkhurst, in the *Scientific American Supplement.*



, as the graduation upon the sleeve and the ɜ line are all that are required to adjust the ermit any depth of cut of the tool. But lso be desired to graduate the barrel, Fig. 6, ı in Fig. 9. This can also be done in the follows: Set the screw-cutting gear to cut 40 thread screw, according to which has upon the screw of the micrometer. Place ıl chisel-edged tool in the tool post, and everything as though about to cut a screw ıpon the piece, Fig. 6, the reference line rst been cut. Turn the lathe over slowly, *tool drawn back*, so as not to touch the til the reference line comes in sight, then the tool so as to bear lightly—it is well to stop to regulate the depth of cut—and let bear for a short distance, draw back the ke another turn and another cut, and so t for each revolution. Those cuts will be ents of a screw thread, to be sure, but they ɔo near right lines perpendicular to the mark as not to appear inclined, and will ll the purposes.

ɔt in the base of the tool is to permit of its tened to the lathe bed. Screw holes may d at regular intervals along the bed, and the tool can be screwed down and adjusted, explains itself.

Besides its use with the dividing machine, this micrometer stop has many uses in other work, and will well repay the amateur for the trouble of making it. By its use the length of a cut up to a shoulder upon screws, shafting, and any such work may be regulated to a nicety, and, while duplicates are being made, dependence can be placed upon it to bring them out alike in length.

While upon this point of micrometers, I would like to call attention of amateurs to the ease with which any of these apparatus for lathe work, and their lathes also, can be graduated so as to make all screws to be micrometers.

In making new work, either light or heavy, all one has to do, to get a graduation of hundredths or thousandths, is to cut the screws for the work with 10ths, 20ths, or 40ths of an inch. A heavy screw can be 10 threads to the inch, as well as some odd number. Then a graduation upon the head of the screw, or upon a sleeve fitted under the handle, of 10 parts readily gives hundredths of an inch. The tail screw and cross feed screw of my lathe are so graduated, and I can drill to the hundredth of an inch by the graduation upon the tail screw, or take a chip of one two-hundredth inch on turning by the graduation upon the cross feed screw.

If one prefers to work by eighths, sixteenths, &c., then the screws need only to be cut with eight, sixteen, or thirty-two threads to the inch, and the circular graduation be halves, quarters, eighths, &c., to get down as fine as one wishes to go. I have a slide nut that runs by the thousandths of an inch; the tool-post runs in and out by the thousandths also; a gear-cutter that I can set by thousandths, and anyone can make these tools in a similar manner, and thereby save lots of time and patience, and at the same time turn out better work.

The amateur will find in the end that it pays to time and do only first-class work. He generally has plenty of time to put upon a job, and if he were not in quite so much of a hurry, and would not be so desirous of seeing the result of his work, and "how it is going to work," he would produce more jobs that would bear critical inspection, and be in reality first-class in every respect. Adopt the motto that "nothing but the best will do," instead of "anything will do," and in a short time the work will begin to tell for itself, and its possession, as well as the "fun of making it" will be a pleasure.

## USEFUL AND SCIENTIFIC NOTES.

Of the 4,200 species of flowers now cultivated in Europe, only ten per cent. give forth any odour. Therefore it cannot be said that most flowers are fragrant.

The *Papier Zeitung*, of Berlin, announces that an important discovery has been made in the art of engraving, and especially in photogravure. As usual the design to be engraved is placed on a zinc plate, either by photography or by an artist; this plate, backed by a coating of asphaltum, is then placed in an acid bath. In the new process the plate is put into connection with a dynamo machine, and the current is led away by a wire placed in the bath. As soon as the circuit is established the acid attacks the metal with an astonishing rapidity, and a few minutes are sufficient to bite in several millimètres deep.

**Captive Balloons for Army Purposes.**—Every *corps d'armée* of the French Army is provided with a military captive balloon to serve as an aërial observatory and signalling post. Most European nations have followed this example; but the French have recently gone a step further in providing balloons for the fleet. Thanks to the experiments of Lieutenant Sarpette, the Mediterranean squadron has been supplied with a balloon which can be raised or lowered from a man-of-war. It was constructed at the military balloon works of Chalais-Meudon, under the direction of Commandant Renard, the well-known aëronaut. It is small, having a volume of 320 cubic mètres (11,300 cubic feet), but it can support a single observer at the extremity of its silken cable, a height of 400 mètres. It is inflated with pure hydrogen, prepared in advance, and kept for use in compression tubes.

**Electric Lamps for Divers.**—Some practical improvements in diving apparatus have been effected by M. Albert Marcelhacy, a French engineer. Instead of the heavy electric hand lamp hitherto used by divers he affixes a light but powerful glow lamp on the top of the helmet, so that the diver's hands are both at all times free for work. The lamp is connected by a conductor with a battery either on shore or in a vessel above, as the case may be. The next point is a new method of connecting the helmet with the dress without any loose parts, and this is effected by means of only one watertight joint instead of two, as in the ordinary dress. In the new method the upper part or collar of the indiarubber dress is gripped in between the lower rim of the helmet and the upper rim of the breastplate, and there held fast by gripping pieces attached to the breastplate. These improvements have been adopted in the French navy.

**Disinfection by Burning Sulphur.**—The proposal to discard the fumes of burning sulphur as a disinfecting agent meets with a vigorous remonstrance from Dr. Henry B. Baker, Secretary of the Michigan State Board of Health. It seems that the health officer of Detroit has decided to discard this method of disinfection. In a circular addressed to him, dated August 8, 1890, Dr. Baker insists that the method should not be cast aside on account of a few laboratory experiments of apparently adverse significance, in face of the success that has attended the method in actual practice throughout the rest of the State. By several tables and diagrams he shows how efficient isolation and disinfection have been in controlling outbreaks of diphtheria in Michigan during the past two years. He thinks that failures to disinfect with sulphur are due to using too little sulphur. The burning of 3lb. of sulphur to the thousand feet of air space is sufficient to destroy the germs of contagious disease in a closed room, without extra moisture in the air. In support of his position he quotes the results obtained by recent French experiments in this field. He might have quoted Homer, for certainly the fumes of sulphur were known to be powerfully disinfecting in his time.

# SCIENTIFIC NEWS.

THERE is an interesting paper in the *Comptes Rendus* of the 20th ult., in which M. Deslandres, who has charge of the spectroscopic work at the Paris Observatory, describes the instruments to be used with the great equatoreal. To keep a star on the slit of the spectroscope for a long time is rather difficult, even to an expert, so M. Deslandres places a total reflecting prism near the dark slide, so that the red end of the spectrum can be observed whilst the blue end is being photographed—a method by which he has obtained many comparison spectra of stars. He has also devised an arrangement which, utilising reflection, forms a "finder" for use with the spectroscope; but necessarily few amateurs can, or will, afford the necessary outlay for such work.

M. Bigourdan, observing what is now recognised as D'Arrest's comet, describes it as an indefinite glimmer, excessively feeble. It is not likely to be seen again until the next return, which should occur in 1897.

We understand that a smaller edition of Mr. Arthur Cottam's "Charts of the Constellations" is in preparation, and will shortly make its appearance. This is welcome news to amateurs of small means. We reviewed the original work on p. 234, No. 1286.

The death is announced of Mr. Alexander John Ellis, F.R.S., F.S.A., &c. He was born at Hoxton in 1814, and died at West Kensington last week. The deceased gentleman was a member of several learned and practical societies, and was a voluminous author on his favourite subsubjects: Phonetics, Universal Writing and Printing, Pronunciation "for Singers," and pronunciation of the Latin and Greek languages, and Musical Pitch, for his papers on which he received the Silver Medal of the Society of Arts. We should be inclined to say that the most lasting work from his pen is the translation of Helmholtz's "Sensations of Tone," which he translated and enriched with many valuable notes, so as to make it an excellent textbook on the theory of sound, and a valuable repertory for the use of students of music.

The death is also announced of M. P. de Chihacheff, who will be recollected by members of the British Association as a frequent visitor and contributor. His chief work was a geographical and geological exploration of Asia Minor.

An old Arctic voyager, an intrepid sailor-medico, is dead in the person of Robert M'Cormick, F.R.C.S., R.N., Deputy Inspector-General of Hospitals and Fleets. He accompanied Sir E. Parry in the *Hecla*, and in 1839 joined the *Erebus* on the expedition to the South Polar regions, undertaking the duties of geologist and zoologist in addition to his medical work. His labours in the Arctic regions gained for him the Arctic medal in 1857.

Dr. Heinrich Will, for thirty years professor of chemistry and director of the laboratories at Giessen, where he succeeded Liebig, died recently in his 78th year.

From the report of the Meteorological Observatory at Sydney we find that the rainfall for last May was 3·189in. greater than that of the same month during thirty years—the prevailing direction of the wind being the same as for the last thirty years—viz., W. The minimum temperature was 49·4, and in parts of the colony a second crop of apples appeared and reached diameters of 1in. to 1½in.

The City and South London Railway was "opened" by the Prince of Wales on Tuesday, and the event may mark the commencement of a new era in railway working—at all events in underground working. The line will not be open to the public for some days, but it has been in practical use for several weeks by way of trial and training for the officials. The cost of the electric motive power for the first two years is guaranteed by the contractors not to exceed 3½d. per train mile.

The *Engineer* says:—The electrically-propelled cars on the Bristol-road of the Birmingham Tramways Company sometimes get tired early, and do not always run their proper distance. Our Birmingham correspondent transmits the explanation, which has been given: Swelled wood pavement — disturbed gauge — flange friction. How long would this state of things exist on a horse tramway and no one but the horses know it?

The foundation of the first electric lighting station in the parish of St. Pancras was laid on Wednesday last. The works in Stanhope-street are to supply the S.W. portion of the parish, which is in the unique position that it is the only one in the metropolitan district in which the control of the electric lighting is in the hands of the vestry. The work is being carried out under the direction of Prof. Henry Robinson, electrical engineer to the vestry, who has adopted the continuous-current system, with an E.M.F. of 110 volts, to suit incandescent lamps. The mains are laid on the three-wire system, the current being sent from the central station at 220 volts, and a difference is thus maintained between the side mains and the centre wire of 110 volts. Provision is made for five miles of distributing mains to supply 25,000 lamps of 16 candle-power, and separate mains will be laid for supplying the public street lamps. The other stations will be proceeded with as soon as the experiment has had a fair trial in the S.W. portion of the parish.

Steam pressures are going up on board the steamers having triple-expansion engines, for Messrs. Robert Stephenson and Co., Limited, of Hebburn, have just launched a vessel which is to have three doubled-ended boilers working up to 180lb. on the square inch.

Dr. Koch's treatment of tuberculosis, so far as it has been applied to a human being, is said to have given so much satisfaction that he has been granted a prolonged leave of absence from his professorial duties in order that he may the better pursue his investigations. Dr. Koch is reticent himself as to the success of his remedy, and also as to its nature, but promises to make it freely known when he has proved its efficacy.

The old and well-known business of Mr. J. H. Evans at 159, Wardour-street, and 17, Oxford-street, is being turned into a company, with a capital of £25,000, in 5,000 shares of £5 each. Mr. Evans is retained as managing director, and there is little doubt that the success which has attended the concern during its eighty years' existence will be continued. Lathe-amateurs and others interested might do worse than acquire an interest. The premises comprise an excellent turning-room, smoking-room, reading-room, &c., and lovers of the art will always find something going on to interest them.

**The Earliest Velocipede.**—Dr. C. Purcell Taylor writes to *Engineering*:—A paragraph is going the round of the papers that the first velocipede was invented by a German in 1784. We are getting pretty well used by this time to German "inventions"; so neither you nor your readers will be surprised to hear that I have before me as I write an engraving and description of "A New Machine to go without Horses," by Mr. Ovenden, published in November, 1774. Four wheels support two seats; the front seat for the squire, the after seat for his man, who works the treadles acting on ratchet wheels.

**Vinegar Eels.**—Dr. G. Lindner discusses, in a German paper, the occurrence of the "eels" common in a weak or impure vinegar. The males and the females respectively measure 1—1½mm. and 1½—2½mm. in length. The worms move actively in a fluid medium, creep slowly in thick concoctions, or coil together in complicated knots. They thrive well on a diet of egg, withstand even tolerably strong vinegar, are killed at once by pure acetic acid, are very slightly perturbed by artificial digestive cultures, live well on fruits, bulbs, &c. The females reproduce viviparously or oviparously, according to the nutritive medium and the temperature, but soon die after reproduction, nor are the males long-lived. They flourish best between 60° and 80° Fahr., are killed by a temperature over 107° Fahr., or under the freezing point; on light and air they are very slightly dependent, but to drought very sensitive. After dessication for three or four hours no revivification even of the eggs was observed. The worms have great powers of adaptation to the most diverse conditions. Their natural home seems to be in moist mud and putridity, but they are rare in drinking or running water. That millions of germs float in the air is a fable. How they get into the vinegar is uncertain; but they probably insinuate themselves at certain stages of its manufacture. In vinegar prepared from wine by the quick process they are very rare. The "vinegar eels" are not exactly dangerous; but it is at once safe and more appetising to make sure either that the vinegar is of the better sort, or at least boiled and filtered.—*The Microscope.*

# LETTERS TO THE EDITOR.

*[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]*

*All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

*All Cheques and Post-office Orders to be made payable to* J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

## ROMSEY OBSERVATORIES.

[31755.]—As the formation of the new Astronomical Association will probably give a considerable impetus to the pursuit of astronomy among amateurs, and consequently to the construction of observatories, especially of the Romsey type, the experience of one who has succeeded fairly well in an enterprise of this kind may be of service to others.

It will not be necessary to describe minutely every step. I assume that anyone who thinks of erecting such a structure will consult the full and valuable directions contained in the second volume (pp. 229—234) of Chambers's "Handbook of Descriptive and Practical Astronomy": fourth edition, Oxford, 1890. What I have to say will consist in part of notes and comments on the instructions there given.

Let me at the outset observe that there is some confusion in the plan (admirable in most respects) which accompanies the directions. There is a cross to indicate the points of tha compass. If the figured point of the shaft of this is intended to indicate the North, the letters E and W should clearly change places, the E cannot be on the left hand. Moreover, the ground plan of the observatory does not correspond to either the actual or the corrected indication of the points of the compass, for the description (p. 231) makes the doorway face to the north, while in the ground plan it is, on the other hand, looking in the direction indicated by the letter W. The doorway being on the north side, the transit room, as indicated, must, of course, be on the east. This is in accordauce with what is shown as the south elevation, but then what is given as the east elevation is all wrong; the transit pier and the sloping shutter are at the wrong end. Diagrams A and B show them (as they must be to be of any use) on the south side. To get this result out of elevation G, you must suppose yourself looking at the eastern wall of the transit room from the inside. In practice it is obviously indifferent whether the transit room be on the east or on the west side of the circular observatory, as on either side you can have a wide opening over the transit instrument running north and south, and giving scope for observations in either direction. For obvious reasons it must not be either on the north or the south side. Posts well tarred at the bottom, and then simply set in the ground (which with me happens to be dry and firm) being able to last more years than I shall be likely to use the observatory, I dispensed with the dwarf brick wall described in Chambers. The ground having been levelled, a circular hole was dug, 2ft. deep and 4ft. in diam. This was filled with concrete, which was raised to six or seven inches higher than the ground. When the ground was well solidified, it was covered with an inch thick layer of Portland Cement, carefully smoothed and levelled so as to form a steady support for the telescope. With the help of a radius twelve pegs were set equi-distant from each other, and 5ft. 9in. from the centre, and round them holes of a foot and a half in depth were dug for the posts, which were 8ft. long and 4in. square, with a double bevel on the outer face to take the weather boards, which I had decided to use, and to nail up on the outside. The posts when set upright in the holes, so as to have their inner face 5ft. 7½in. from the centre of the telescope base, were held in position by temporary struts from post to post, and by stays nailed to pegs driven at so distance in the ground. The elaborate precauti which I have seen insisted on for setting posts in the holes so that their tops shall be on t level, are quite needless, and would give a gr deal of trouble. I found it quite enough to them in the holes as above described, ram in a lit earth to keep them from slipping out of place, them perfectly upright by the help of a plumb-li and keep them in position by means of tempor struts or stays; then by means of a straight-edg line was marked on each post in the plane of t levelled top of the telescope, a length of six feet u arked off on each post, and the excess in each case awn off. The tops were then exactly level.

In the directions given on p. 211 for the con-ruction of the wall-plate there is a good deal of bscurity.

In the first place, there is no reason why the egments should be 14 in number. They may be ore or fewer. Nor need care be taken to get hem *exactly* of the same length. All that is equisite is that they shall admit of being accurately tted together, so as to correspond with precision o a gauge-circle marked on a floor. Whatever the umber of segments fixed upon (I adopted twelve s the number), they should be cut in the first nstance so as to be ½in. longer than their theoretical ength. This allows for the free use of the plane n the ends, so as to get accurate joints; and if the ast segment to be fitted in requires to be shortened y a few inches, this is of no consequence.

In the next place, do not attempt to cut your egment yourself. Mark out on a piece of board or ardboard the shape and size of a single segment, ith specifications of the radius to which the inner nd outer edges respectively are to be worked, and end this to a saw-mill where a band-saw is orked. You will be supplied with all the seg-ents you want, cut with extreme accuracy, at a st very little exceeding that of the timber.

The directions in Chambers for fitting the seg-ents together are not very clear. A 12ft. circle is be marked out on a level floor, and the segments tted together in two layers, so that the outer edges ay correspond accurately with the circle, and then e two layers are to be securely screwed together. ut if the level floor is that of a barn or a large oom, how is the ring so formed to be got out? nd if not fastened together on the spot, where nd how are the segments to be screwed together? he observatory builder should make a temporary oor close to the scene of his operations. The oards and joists intended for the floor of the bservatory and transit room will answer the pur-ose. If there are not enough of them, trouble nd expense will be saved by purchasing or hiring few more. On this floor should be marked out ith the utmost care, with a wooden radius (not a ord, which is apt to stretch) a circle of 11ft. 3in. iameter. The segments for the wall plate (which hould be three layers thick) should then be not nly fitted, but firmly screwed together, layer after ayer, so that the *inner edges* may correspond accurately with this circular gauge. The outer edge is of small importance. Indeed, the only absolutely essential points are that the *inner edge* of the *dome-ring* shall be perfectly circular, and that the guide-rollers by which the rotation of the roof is controlled, shall be screwed on to the posts so as to avoid touching that inner edge by exactly the same interval. The perfect rotation of the roof will then be secured in spite of any irregularity in the wall-plate, or in the outer edge of the dome-ring itself. When the wall-plate has been thus made and trimmed with a compass plane, it may be lifted off, and at once fixed on the top of the post (5in. screws are quite long enough, as the only strain upon the wall-plate is the downward pressure of the roof). The struts and stays may then be knocked away from the posts, the earth well rammed in round the foot of each, and the weather boards (or part of them) nailed on. A cylindrical drum of great rigidity will then have been formed.

The dome-ring should be made on the temporary floor in the same manner as the wall-plate, care being taken in each case to use plenty of screws; six or seven to each segment will not be too many. If the inner edge be accurately adjusted to the gauge-circle, a few touches of the compass plane at the last will insure perfect circularity. This plan is much better than putting the segments of the dome-ring together on the top of the wall-plate, as specified in the instructions published some years ago in the ENGLISH MECHANIC. It involves far less trouble, and insures accuracy much more certainly.

Before the dome-ring is removed from the temporary floor, the rafters should be set up. The directions for this in Chambers are very good and clear, but may be departed from in one or two instances with advantage. There is no need of a heavy piece of timber, 4ft. long and 2¾in. by 2¾in. thick for the ridge-piece. A piece of plank 1in. thick and 4in. wide is all that is wanted; but it should be fixed in its place not by the rafters marked *g g* in the plan, which run in the same direction as the ridge, but by the rafters *i, i, i, j, j* at right angles to the ridge, or rather by four of them—two at each end. A small piece of board should first be nailed across to keep the rafters in place at the proper inclination to each other, and with their ends an inch apart so as to allow of the easy insertion and fixing of the ridge-piece.

The plan in Chambers allows a width of only 2ft. for the shutter opening, which occupies half the breadth covered by the ridge piece, and appears to me to be on the wrong side (unless the plan shows the roof as seen from the inside); for as the observer will usually want to follow the stars in their apparent movement from east to west, it is clearly undesirable that the shutter should stick up on the right-hand side of the opening, that being the side towards which the stars appear to move, so that his view of them will soon be interrupted by the shutter, unless, indeed, the shutter falls back out of sight; but in that case the closing of it must be rather a difficult operation. I had the shutter opening made 2ft. 3in. wide, and placed it in the middle of the 4ft. space spanned by the ridge-piece, though this, by the way, was quite unnecessary, except for symmetry. The shutter was made in two lengths, the upper one (always to be opened first and closed last) overlapping the lower one by means of a strip of zinc, as the opening of a single shutter 7ft. or 8ft. long and more than 2ft. wide is a ticklish business if there is even a moderate wind. Each half is opened to a vertical position by means of an iron rod, in which a hole is drilled at such a distance from the end, that when it is slipped on to a straight iron stud fixed to the rafter it holds the shutter upright. Iron supports fixed outside keep the shutters from falling back, and guy-cords are attached, as advised in Chambers (p. 234).

For the covering of the roof I was induced to try the "patent wire-wove roofing"; but I do not recommend its adoption for this purpose. It is excellently suited for fastening on rafters that are parallel or that converge in the same plane, but it is very difficult to bend it round any but the most obtuse angles, and it is ill adapted for a roof in which the adjacent rafters are not in the same plane. There is a great deal of waste in cutting it to fit, and it is considerably heavier and more expensive than canvas. If canvas is used, care should be taken to carry it round to the under side of the dome ring to prevent water from trickling down the edge and getting between the layers of the ring. For carrying the roof I have found rollers not more than 1¼in. in diameter quite large enough when screwed on upside down.

My transit room, 6ft. square, was constructed on the west side of the observatory, with a flat zinc-covered roof and a horizontal opening for the shutter, not a sloping one as delineated in the plan in Chambers, which seems so arranged as to restrict observations to one half of the hemisphere. Instead of catches for fastening the roof down like that shown at F in the plan, the management of which would be troublesome, especially if one had to turn the roof single-handed, I had three movable clamps made with a flat-headed screw at the bottom large enough to clip both rings. These can be fixed on in any position of the dome without any trouble. The shutters are held down when closed by a simple cord.

I will only add that if any amateur who purposes building a similar observatory cares to see what I have done, I shall be happy to make an appointment with him to examine my work, when I can point out various oversights which he would save trouble by avoiding. With proper care the cost may be kept considerably under £30.

**C. P. Mason.**

Parkside, Caterham, Surrey, Oct. 28.

## OBSERVATORY—REFRACTORS v. REFLECTORS—FLATS.

[31756.]—I AM sure many amateur observers, in common with myself, feel very grateful to Mr. Bell for the capital illustrations and description of his observatory appearing in your issue of October 10. One very important item is, however, omitted—the cost; and this, it seems, must have been something considerable, even if the greater portion of the work is done at home. I should be glad of a rough idea as to cost. The total cost of the small one I described was certainly under £2, and this was quite large enough for a 6½in. equatoreal, and has served for my 8½in., although more room would be very desirable. One other matter is the observing shutter. I have always understood that such an arrangement does not answer with a reflector, as it increased the already sufficiently troublesome air-currents. Perhaps Mr. Bell will give us his experience. Mine is always practically in the open air, as one or both halves of the span roof is always thrown back when in use. Is it not always a difficult matter with a movable shutter to get an observation near the zenith? The framework must interfere considerably. A somewhat smaller structure than 16ft. diameter would, I presume, be sufficiently large for an observatory for an 8½in.

*Re* the discussion "Reflectors v. Refractors." Is it not an optical fact that with a perfectly-figured mirror and achromatic refractor of similar aperture and equal focal length, the size of star discs in good air would be identical with similar magnifying power? How is it, then, that so many observers say that a reflector is inferior to a refractor for double-star work and accurate measurements? In fine air my 8½ With mirror gives beautifully-defined star discs with power of about 500, using full aperture. I have never had an opportunity of looking through a refractor of equal size; but am sure they could not be better. Stopped down to 4½ (eccentrically), I get equally good discs with a lower power, and with bright stars stopping down certainly improves the discs. For planetary definitions I never find any advantage from stopping down except the air is very bad, and then definition is, of course, not good, even with small aperture. A great deal of the sharpness of the image, I find, depends upon the perfection of the polish of the silver film, and even a well-figured speculum will not define if the film is milky or covered with fine scratches with the polisher. A bright star in the field serves as a test of this; if well polished, the field is comparatively dark, and faint objects in the same field are easily picked up; but with an imperfectly-polished film, or one which has become cloudy or dull for want of repolishing, the field is filled with a nebulous light obliterating faint objects. Dust on the mirror has the same effect. For this reason I cannot agree with the usual injunction not to repolish the silver surface oftener than can be helped.

Some little time since I tried the solid silver surface-flats which were advertised in your paper, the maker kindly sending me two or three for the purpose. I most carefully compared them with my silver-on-glass one, on which I deposited a new film. There was little, if any, appreciable difference, even with the highest powers, and one of the three seemed to be, if anything, a little superior to the glass one on close double-stars, giving a trifle harder star disc. With bright stars I considered the silver-on-glass a little superior, as it was freer from diffused light in the field. On examining carefully the surface of the flat, the cause of this was soon discovered in the fine circular scratches left by the polisher. This defect could, no doubt, be remedied by more careful polishing. These silver-surface flats have certainly two or three very important advantages — they are more easily mounted—a single screw into the middle of the back sufficing to hold them to the mount; the surface does not dew very quickly, and when it does can be wiped without injury. The maker also states that the surface, if damaged, can be renewed with far less trouble than the silver film on glass.

Wellington, Nov. 1. **W. S. P.**

## OCCULTATION OF STARS BY THE MOON.

[31757.]—As I have given some attention to that curious and inexplicable phenomenon—(viz., the non-extinction of a star when occulted by the moon), I wish to advance a theory as to its explanation.

Now, the nature of the phenomenon is, when the moon comes between our line of vision and any moderately bright star, the star does not instantly disappear, but glides on to the moon's disc, and remains so for a few seconds, and then vanishes from view. Now, we are enabled to see a star by the rays of light which come in a continuous stream from the star, and these rays entering the pupil of our eyes excite the retina, and we behold the distant object. The foregoing explanation will be more readily understood by referring to Fig. 1.

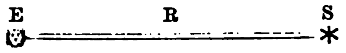


FIG. 1.

S is the star, R the rays of light coming from S, and entering the eye E. Now, the mean distance of the moon from the earth is 240,000 miles, and a ray of light coming from the moon takes about 1½ second to reach the earth, as light moves at the rate of about 170,000 miles a second.

Now, when the moon comes between the earth and a bright star, it is natural to suppose that the star will vanish; but such is not the case, and for an explanation we must refer to Fig. 2. S is any

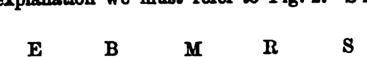


FIG. 2.

star being occulted by the moon M, E is the earth, and the line R B is a stream of light coming from S. The stream proceeding from S to E is broken by M, and S is hidden from a spectator situated at E. The image of E, which will appear gliding on to M, is caused by the part of the stream of light B (the part between M and E), which has been cut off from the original stream R; the stream between M and E will reach E 1½sec. after S is hidden by M, and will produce an image of S on M, and M moving in the mean time, the image of S will appear to glide over M. **Luna.**

## BURNHAM 641—FLATS.

[31758.] — BEING away from my ENGLISH MECHANICS, I am unable to refer "H. E." to the page on which my reply to "Bramley," *re* Burnham 648 occurred; but I certainly did insert an answer. We looked up the star M. Gaudibert so kindly pointed out to us, and easily saw its companion—a trifle north of one preceding; but whether it was 648 or not seems to be doubtful, from what "Bramley" said. "H. E.'s" remark about my "Flat" is answered by my assertion that my telescope defined perfectly at times.

**Tenebris.**

## THE TAIL OF A COMET.

[31759.] — SOME years ago, the theory of "J. S. L. L." (letter 31730) was anticipated by a writer to the *Times*. Nobody replied; so, about a fortnight later, another writer (or perhaps it was the same one) wondered why?

It is, or was then, a grand idea that the comet is encircled by an immense nebulosity, luminous; only we cannot see it because the sun shines on it. We generally do see things the sun shines on, but not this; and we see the tail because the sun does not shine on it. Bravo! "J. S. L. L."

**Hammer.**

## AUSTRALIAN AMATEUR ASTRONOMERS.

[31760.]—FOR some weeks I had been intending to write for the "E. M." some account of the valuable work done by the late Capt. Baker, of Ballarat, in making first-class Newtonian reflectors, and giving a great local stimulus to amateur astronomy; and yesterday I was very much pleased to see, in the "E. M." for 25th July, 1890, a short note on the subject. We all regret his loss very much. But he has done a work that no other in this city, perhaps in the colony, could do; and as he has instructed several in his methods, it is not likely that his art will die with him. Nine or ten instruments, six to 12in. aperture, were made at one time under his personal instruction and supervision, by as many gentlemen, eager to explore the glories of the heavens, with results beyond their most sanguine expectations. Having been for some months the happy owner of one of these, an 8in., though not fortunate enough to have been one of the favoured few who were thus initiated into the mysteries of making highly-finished silvered specula, I can testify to the immense increase of interest, comprehensiveness of view, and knowledge of details, that is gained by a *practical* acquaintance with the orbs of heaven, as compared with a knowledge gained merely by reading. And here, after devouring many volumes on astronomy, allow me to express the intense pleasure with which I always sit down to the new numbers of the "E. M." in our Mechanics' Institute. The freshness of the news, the benefit of having various views on the same phenomena, and the great variety of useful information, cause it to be eagerly read by several of the most intelligent in the city.

Just here, I want to put in a plea for the amateur astronomers of the Antipodes, and there are more of them than many in England suppose. Your "Astronomical Notes," giving, a month in advance, a most useful conspectus of the chief interesting phenomena to be expected, are absolutely useless to us, as the latest of said phenomena have become things of the past before the Notes arrive. You would confer a very great favour on us, and no doubt increase your circulation, if you could arrange to bring out said notes *two* months in advance instead of one. This would involve no loss to your English readers, as they would only have to refer to a number a little older. It would make no real difference to the writer of the Notes after the change was once established, which would involve, of course, a double set of Notes to start with. There is no similar ephemeris published in Australia known to me, and I need not say that such a one would be as much prized by us as by our fellow workers in England, and I cannot think they would be willing to deprive us of the privilege, when the only difference to them would be consulting a somewhat older number. Not to mention the superb 27in. Newtonian, made by the late Capt. Baker for the Oddie Observatory of this city, I know of quite a number of fine instruments, up to 8in. achromatics and 12½in. reflectors, in the hands of amateurs, and none will doubt that many things would be observed and recorded if we knew just beforehand, as your English readers know, when and where to look for them, which are never seen through that knowledge coming "a day after the fair." The number of observers would, no doubt, be considerably increased out here if it were known that such an excellent guide were available month by month in advance, as it is at home. Please consider our plea, as I feel sure it represents the wishes of a goodly number, and that the small change asked for would give a very welcome and notable impulse to astronomy in the south.

Having had some difficulty in trying to resilver my flat, I hunted over all the back numbers of the "E. M.," and other likely works that I could get at, for further information, and found, in a lecture by Mr. Common on Astro. Telescopes (*Nature*, June 19, 1890), that "to restore the surface of silver to the glass speculum is only a small matter now"; and he mentions two liquids—one a solution of the oxide of silver, and the other a reducing agent; but, unfortunately, no formula is given as to quantities and manner of preparation, nor could I find a recipe for silvering with the oxide of silver, which appears to be such a simple affair, in a host of volumes consulted. Could you, or some of your learned correspondents, oblige by giving a reliable formula? Many shrink from the nitrate method; and if the oxide plan is simpler and more certain, you would confer a boon on many who possess reflectors by publishing it, and many would-be observers, who cannot afford costly achromatics, would the more readily invest in 6in. or 12in. Newtonians, if only they could feel sure of resilvering the mirrors without much trouble. Possibly, the recipe may have been given in some late volume of the "E. M."; but it may be well to state that the back numbers are not bound up in our Mechanics' Library, and are not available after a few weeks. But I searched in vain through nine old volumes of the "E. M." at our School of Mines Library.

It is pleasing to note that an amateur astronomical society is to be started in London. I hope it will be so constituted and managed as to be available and beneficial to us in Australia. If so, there is no doubt that Victoria, and Ballarat in particular, will be represented in its membership.

I hope at some future date to send you some notes of observations.

**W. H. Wooster**, Mem.Roy.Soc., Victoria.
Sept. 15, Ballarat, Victoria, Australia.

## THE REFLECTING TELESCOPE.

[31761.]—As the possessor of a reflector (speculum by With, 9¼in. diameter, 74½in. focus, plane by Browning), I have been much interested in the discussion on the above subjects. If you have not closed your columns to this correspondence, I should be grateful to be allowed to mention a point which has not yet been brought forward. On Sept. 12 last "Amateur" mentioned the difficulty he had experienced in the dewing of his speculum. A mode of avoiding this was indicated by "Heliostat" a week or two later. My difficulty has been the dewing of the *planes*. This with me happens in the evening. The speculum at the bottom of the tube is all snug and secure; but not so the plane, which, being near the mouth, is more or less enveloped by the moist atmosphere, and shares, though in a less degree, the same fate as the exterior of the tube, which, of course, is simply dripping. On putting away for the night, then comes the difficulty! I am on the horns of a dilemma. (1) Cover the speculum with the dew on it. (2) Put it away uncovered, knowing that on taking the telescope from the box next morning, it will, before I can cover it, be thickly dewed? The last alternative is the lesser evil, and I accordingly choose it. I should be glad to know if there is any means of avoiding this really serious evil. My plane is about 5 or 6in. within the two.

Mr. Tarrant (August 22) speaks of wooden tubes, comparing them with iron. The late Mr. De la Rue's telescope, now at Oxford, has no tube at all, and I am strongly inclined to think this is the best. For night work it would be easy to have a light waterproof wrapping for the frame to ward off dew.

With Miss Brown (August 29) I find my reflector fail in projection of sunspots, &c., on a cardboard disc; they are faint, hazy, flitting shadows, and nothing more—faculæ and mottled surface quite invisible.

Mr. Williams (Sept. 5) defines Jupiter well on 6½in., with power 225. I wish he would tell me how to do so on my 9¼in. with 250.

"Tenebris'" friend (Sept. 9) never has seen diffraction rings with stars, nor have I with stars or any other object with any power whatever, mine ranging from 65—250 negative, and one positive, 350.

"May" (Oct. 10) sees δ Cygni with mirror of 6½in. I have never seen it yet, though Mr. With told me that mine was one of his best and finest specula. I am very anxious to try my eye with some other instrument of known capacity, for I should like to settle the question once for all, whether the fault lies in the telescope or its master. With Mr. Tarrant, I have quite discarded stops.

As to adjustment, I adopt the following plan, which, I fancy, is not uncommon. Immediately in front of the speculum I place a circular disc of white carboard, cut to fit the tube. In the centre of this is cut a circular hole, larger by about ¼in. than the minor axis of the flat. I then adjust, as usual—viz.: (1) Set flat so that speculum or disc of cardboard is centrally reflected in flat; (2) set speculum so that image of flat appears as an annular eclipse. I confess to having not tried the pinhole method; but is it in any way better than this? My eyepiece tube is fixed.

Mr. Tarrant (Aug. 22) implies that present methods of fixing specula in their cells are inadequate. From the first I have felt this most strongly, and have devised one or two little modifications, which, I think, might possibly be an improvement in some particulars. If you would care to insert a description of them, I should be most happy to do my best with it at any time. I am anxious to make them known, as though they might turn out to be of little or no value in themselves, they might suggest a good idea to a better head than mine.

Ringmer, Lewes. **Charles D. P. Davies.**

[31762.]—WITH Mr. E. Nelson's letter (31742) summing up the discussion on "Reflectors v. Refractors," most readers will agree on his suggestion to attempt the making of *apochromatic* dialytes; some will probably act. Will the conclusion arrived at be final? I think not. This discussion was again carried on, mainly by the makers of the two types of telescopes and their patrons, just as it had been some years ago; it has not exhausted the points on which the final judgment will rest.

The reflector came into vogue on account of its supposed cheapness. When it was found out that silvered mirrors acted better than speculum metal ones, and were far easier to construct, amateurs received them kindly, for they were anxious to possess larger instruments. Whether it will continue in favour when its weak points become better known is doubtful. If its prime cost is lower than that of the refractor capable of the same kind of work, the cost of preserving it in an efficient condition will more than make up the difference. How long will its mirror stand the effects of a damp climate by the sea shore? What inconvenience, trouble, and expense will the frequent renewal of its films be in out-of-the-way places, or in the colonies? Some clever and patient observers can do that themselves on the spot.

By far the majority of them, however, shirk the trouble and risk of dismounting, remounting, and adjusting, and even more so the silvering, because these operations are new to them, and success uncertain; still, it has to be faced. Those who will not undertake it themselves, must get others to do it for them; send the mirrors hundreds, ay, perhaps thousands of miles away, intrust them to unknown hands, pay a good price, and perhaps put off half-finished observations for a long time. These facts militate seriously against the reflector. None of these interruptions of work occur with the refractor. It can be used at all times, and in all climes, and by everybody. It is portable, can follow the observer to the seaside or into the country. You can use it in an upper room, and require no observatory, unless the instrument is a large one. But these are not all its prerogatives. Owing to its portability and handiness, it keeps up its commercial value much better than the reflector. Where, in a sale, you find one bidder for a reflector, you will find a dozen for the refractor. It has always a ready cash value, whilst the reflector becomes a drug in the market. Persons with fickle minds, who take up astronomy only for a short time, as any other fad, do well to take this into consideration. No matter of what size the refractor is, it is always useful; a small reflector is not. The dialyte will probably be the telescope of the future. I can see difficulties in the way, but no valid reason why it should not succeed.

**A. Caplatzi.**

## THE COMPASS NEEDLE: THE CAUSE OF ITS SECULAR VARIATION, BOTH IN DECLINATION AND DIP.

### 1. Of the Declination Needle.

[31763.]—IT has been known for centuries, that the declination needle does not always lie in the same direct line even in the same locality; but, in the Northern hemisphere, its north pole has a secular movement about a certain point or pole not far from the pole of the world, called the north magnetic pole; and there is a similar pole to the south of the Equator. The line joining the two magnetic poles is called the earth's magnetic axis, which I will call the prime magnetic meridian.

According to Sir John Herschel, the inclination of the Ecliptic to the sun's equator is 7° 20′, which, taken from its inclination to the earth's Equator 23° 27′ = 16° 7′, the inclination of the earth's Equator to that of the sun, which is about exactly equal to the observed inclination of the earth's magnetic equator to the terrestrial 16° (see Dr. A. M. Mayer's lecture, "The Earth a Great Magnet"); so the magnetic axis of the earth must very nearly coincide with the axis of the sun extended. This angle of 16° between the two equators must be a constant quantity, for as the inclination of the Ecliptic to the Equator diminishes, that to the sun's equator must augment at the same rate.

I am aware that the two magnetic poles of the earth are not in opposition on its surface, but are in latitude of about 70°, so a line drawn from one pole to the other would not pass through the earth's centre; but our scientific authors, Fleeming Jenkin, Dr. Noad, &c., consider that the earth has a magnetic equator and axis; they find the poles of a bar-magnet not to be at the extremities of the bar, but at a distance from them. See Jenkin "Electricity and Magnetism," page 119, and since those of the earth appear to be so, the magnetic axis might pass through its centre after all.

Now since the magnetic axis of the earth is in the

the axis of the sun, the cause why the her daily variation, has been observed to e sun in his apparent diurnal circuit about becomes more evident, as it always the earth's magnetic pole. For in the hemisphere, or during the hours of the needle vibrates from east to west and the way during the hours of the night, which rection of the vibration in the southern re, as it is day there when it is night here. e daily variation in both the hemispheres o the mean daily movement of the sun in c—60 minutes—half of which is the mean ation in each hemisphere. At the magnetic the mean daily variation is nil. At the gnetic pole Sir James Ross found it to be so the mean is still 30 minutes.

ne thing is lacking to show that there is arly variation of the needle, and that the riation is of the same amount and in the ction as the mean daily vibration of the re.

nmon year consists of 365·25 days; during the earth performs one revolution in its it the sun. This, in the apparent motion eavens, is equal to one earth's rotation, it is done in the same direction as the tary motion, it is plain that before we get 365 days, the earth must rotate 366 times; rth, in its axial motion, gains one day on every solar year. Or, which is the same sun recedes from the earth towards the he same amount in that time, and so on to year. And since the pole of the needle that of the sun, to what distance soever rogrades in his westerly movements, so far will in her vibrations. At the magnetic said that the mean daily variation is zero; Northern hemisphere the vibrations are in the Southern, as the sun stays longer an in the opposite hemisphere; so even sun is on the Equator, Dr. Bache, of Phil- found about 4 to be added in the Northern e, and subtracted in the Southern. Thus l secular vibration with us amounts to he whole revolution is 360°, or 21,600′; d by the 34′ = 636 years.

bat have I done? What is the meaning ilt—636 years? Is this the secular period ination needle? No, you say. All of fic books say it is about 318 years, and lity it is a swing like that of a pendulum meridians, and termed "the secular the declination needle." Hear what Mayer says of it in his celebrated lecture d to. "Here we see in the needle a most e motion, governed by some cause acting through a long period of time, which, after ren it a swing from the meridian to e westerly position in 158 years, is now ar after year, throwing it to the meridian erly swing. Thus, in about 316 years, it oscillation, and what is more remarkable follows the same kind of motion as a ; for, from the figures, you see that it er and faster until it gains the meridian; cks its velocity, and gradually comes to extreme easterly or westerly position. s is a most noteworthy fact, and well being studied and remembered."

y result is, the pole of the declination ot merely swinging to and fro, pendulum se scientists suppose: this oscillation is an motion; only in fact, the pole of the lves uniformly in a circle whose radius rforming a revolution about the terres- in 636 years, half of which (or time in escribes one hemisphere of its orbit) is which is the mean of the values given for of a swing form tropic to tropic, and as e as long for it to swing back again, it ne round trip in 636 years, so that the exactly corresponds with the observa-

e original cause of the pendulum-swing have seen how close the equator of the nsequently the magnetic equator of the o being coincident with the plane of the nerein the observer stands; and since the er vast orbit sails so near to the Ecliptic to us has all the appearances of a swing- um, for while in those parts of her orbit that are about the easterly and ations, her motion must be nearly in the the line of our vision, and so for a while pear as stationary; as she advances in e course of her swing makes a greater that line, so she appears to move swifter until she arrives at the meridian on, where her sweep is at right angles of vision, and her motion appears the all.

s a station where observations on these have been carried on for some centuries. ng is a table showing the amount of the and the apparent rate year of the at station, at different periods during an entire vibration from tropic to tropic.—From Sir Wm. Snow Harris's "Magnetism."

WEST DECLINATION.

| Years ......... | 1660 | 1692 | 1723 | 1730 | 1765 | 1818 |
|---|---|---|---|---|---|---|
| Declinacion ..... | 0° | 6° | 8° 36′ | 13° | 20° | 24° 36′ |
| Rate per year .... | 10′ | 11′ | 11·7′ | 11·5′ | 9′ | 0 |

The needle ranged on the curve of the opposite hemisphere from London, going westward.

Here we see that the rate per year was the greatest about 1723, so the needle came to the meridian of London at that time. The declination was 8° 36′, which is the distance of London in declination from the prime meridian. The western tropic was reached in 1818. At that time the declination was $8^\circ 36' + 16^\circ = 24^\circ 36'$, and the rate per year zero again. In 1977 the needle will return to the prime meridian on its easterly swing. In 2042 it will reach the meridian of London again, and in 2136 it will arrive at its easterly tropic—measuring from the prime meridian, when its distance from London in declination will be about 8°, so London is not far from being midway from the prime meridian to the easterly tropic, the whole swing being about 32°.

Now the way of finding the declination of the needle at any time and place is evident. If the station and needle are on the same side of the prime meridian, the difference of their distances from that meridian is the declination of the needle there, east or west, at the time. If they are on opposite sides of the prime meridian at the time, then the sum of their distances from that line is the declination of the needle then at that place. And her declination, when at the farthest tropic, is the distance of the place in declination from the prime meridian, added to 16°, and the same distance subtracted from 16° will be her declination there when at the nearest tropic.

Example.—Give the declination of the needle at London, 1890.

Half of the swing of the needle is 16°, which is performed in 159 years, and $1890 - 1818$, when the needle was in its westerly tropic = 72 years. Then, as $159 \text{ years} : 16^\circ :: 72 \text{ years} : 7^\circ 17'$ the distance in declination from the western tropic in 1890, and $16^\circ - 7^\circ 17' = 8^\circ 43'$, the distance from the prime meridian, which add to 8° 36′, the distance in decl. of London from the prime meridian = 17° 19′, the decl. of the needle at London required.

The cause of variation of the compass needle has always been a mystery to philosophers. Prof. A. M. Mayer, Ph.D., in the lecture before alluded to, says: "Various hypotheses have been formed to account for this wonderful phenomenon. As far as observations extend, they seem to show that the very magnetic pole of the Northern hemisphere is revolving, in a direction opposite to the hands of a watch, around a fixed geographical point."

### 2.—Of the Secular Variation of the Inclination Needle.

The secular variation of the inclination or dipping needle is made on the same principle as that of the declination needle; but the poles concerned here are those of the magnetic equator and the Ecliptic. If the earth were revolving in the plane of the sun's equator—since that is also the plane of magnetic equator—there would be no secular variation in the dip: it would always be the same in the same place. But since the earth's orbit inclines to the sun's equator at the same angle of 7° 20′, the pole of the needle will revolve about that of the Ecliptic at that distance, so the needle ranges in its secular swing to that amount, sometimes above and sometimes below that plane, while performing the longer journey of the variation of its declination in the same time. So one station of the dipping needle is on one side of the Ecliptic, and the other on the other; their distance asunder is the diameter of her orbit, 14° 40′.

The secular period of the inclination needle is the same as that of the declination needle, 636 years; but as their orbits incline to each other at an acute angle, the two do not come to their tropics at the same time—the difference is 95 years.

Major-General Sabine says: "It has been expected by many that the secular period of the vibration of the dip which was then decreasing, would synchronise with that of the declination needle, and that the dipping needle would come to its tropic in 1818, and that the dip would augment from that period." So the philosophers were disappointed; the dipping still decreases at London, and will for scores of years.

The dipping needle, according to Sir Wm. Snow Harris, was in her upper station in 1723, to which add one half-swing, 159 years = 1882, when she crossed the Ecliptic, or came to half-way of her descent. To this add 159 again = 2041, when the needle will arrive at its lower tropic. The dip at London will then be 60°, when its augment will commence, and it will continue for 318 years.

General Sabine says: "The present rate of the diminution, as observed at Kew, is 2·8′ annually, and that it had not materially changed for the last 150 years." As its swing is vertical to the Ecliptic where we stand, the rate of motion in the dipping needle is not so variable as that of the declination needle appears to be, whose orbit runs nearly along the Ecliptic, as shown before.

But to give the proof. The radius of the dipping needle's orbit is 7° 20′, or $4{,}400' \div 2{\cdot}8' = 158$ years, the very period Prof. Mayer gives for a swing of the declination needle from meridian to tropic, as found from observation, so the rate per year of variation in the dip is nearly uniform throughout a revolution. But the change of rate is only an apparent one in each of the needles. In reality, both needles revolve in circular orbits, one at 16° 7′ from the Pole of the Equator, the other at 7° 20′ from that of the Ecliptic. But the range of the dipping needle is not constant like that of the declination needle: it increases with the diminution in the obliquity of the Ecliptic, 46″ in a century.

Prof. Elroy M. Avery says, in his "Natural Philosophy," page 193: "At the magnetic pole the inclination is 90°. At the magnetic equator there is no inclination. The inclination at any place is not greatly different from the latitude of that place." But this is a great mistake. Truly the needle has no inclination at the magnetic equator, and stands at 90° to a tangent to the surface of the Pole, but not to the magnetic axis there; it is in line with the magnetic axis, so the axis of the needle stands in the same direction at the Pole as it did at the Equator, that by carrying the needle freely suspended from the Equator to the Pole, and letting the flower-de-luce move along the surface, its tail will sweep through 180°.

Goshen, Utah, U.S.A. **Thomas Job.**

## WHO INVENTED THE TELEPHONE?

[31764.]—WE are all familiar with the earlier telephonic experiments of Reis, which are given in the *Jahres Bericht des Physikalischen Vereins*, of Frankfort, for 1860-1861, and which are regarded as the precursor of the telephone of Graham Bell. Prof. Bell read a paper on the subject before the Society of Telegraph Engineers on 31st October, 1877, and at this lecture I called attention to a still earlier description of a telephone by Charles Bourseul, which is to be found in the second edition of the Comte Theodore du Moncel's "Exposé des Applications de l'Eléctricité," published in Paris in 1857, Vol. III. page 110. Du Moncel does not give any reference to the original paper; but in the *Didaskalia*, a weekly paper published at Frankfort-on-Maine, No. 232, dated 28th September, 1854, there is an interesting account of his invention, which I do not remember to have seen printed in English. I am indebted to Messrs. Siemens Brothers and Co. for making the translation, which I inclose, and if not hitherto published it will, I am sure, interest your readers, as his description of the principle of the telephone is almost as clear as if it were written at the present date. If he had only put his idea to the test of experiment, we should have had the telephone in 1854.

It would be interesting to find the original source from which Count du Moncel derived his account of Bourseul's telephone. **Latimer Clark**

(*Didaskalia*, No. 232, Thursday, Sept. 28, 1854.)
"ELECTRICAL TELEPHONY.

"The number of miracles with which electricity has astonished us lately is said to have been increased by one which would not only cause a revotion in electrical telegraphy, but would add considerably to its utility. The invention in question is nothing less than the electrical transmission of the *spoken word*. The idea was conceived by an educated and modest young man, named Charles Bourseul (now living in Paris), who was a private in the African army in 1848, where he brought himself under the notice of the Governor-General by a course of mathematical lectures which he gave to his comrades in the garrison of Algiers. Possibly Bourseul's scheme, of the practicability of which he is perfectly convinced, may be one of those which learned men will afterwards declare as very simple, and which, if troubled about, would have been brought out much sooner. The principle of electro-telegraphy, as is well known, is the following:—An electric current passing through a metal wire surrounding a piece of soft iron, transforms the latter into a magnet. The magnetic properties of the iron vanish when the electric current is discontinued. This magnet, called the electro-magnet, can therefore alternately attract or repel a movable plate, which by its forward and backward movements, produced the conventional signals used in telegraphy. It is further known that all sounds are transmitted to the ear through the air vibrating, and that, therefore, sounds are virtually vibrations of the air, and that the infinite variety of sounds is solely dependent on the rapidity and strength of these vibrations. If it were possible to construct a metal plate sufficiently sensitive and flexible to admit of the reproduction of the vibrations of sounds (like the air), and if this plate could be connected with an electric current in such a manner as to alternately interrupt and

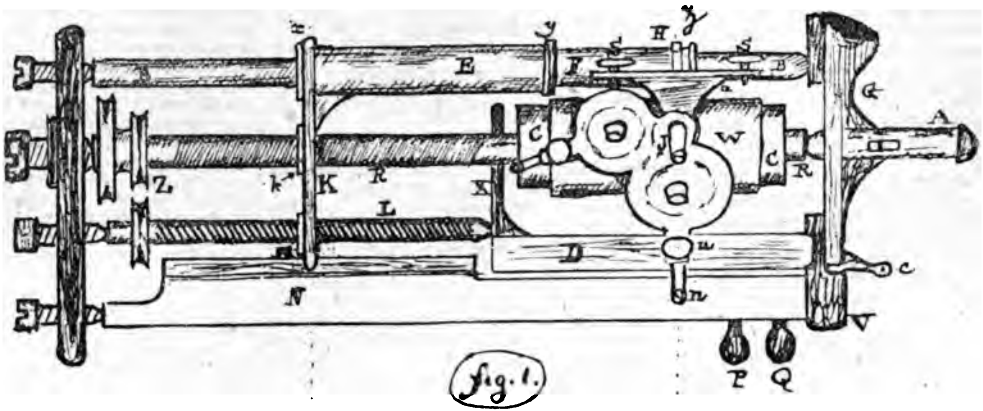


fig. 1.

continue it according to the vibrations of the air to which it would be exposed, it would be equally possible to electrically affect a similar metal plate so as to repeat exactly and simultaneously the vibrations of the first plate. This would create the impression as if the speaker had spoken in immediate vicinity of the second plate; or, if put differently, the ear would be affected in a similar way, as if it had received the sounds through the first metal plate. Electrical telegraphy, which was once academically declared to be almost an absurdity, is now almost universally established, and if we investigate this new idea of the young scientist on the principle of physics, we find that, not only no objection could be raised against the soundness of his theory, but that its practicability is more probable than that of electrical telegraphy was only a short time ago. If the theory should prove a success, electrical telegraphy will attain a position of general usefulness. No special knowledge or apparatus will be required, except a galvanic battery, two suspended plates, and a metal wire. Without any other preparation, one person will have to speak into one of the plates, while the other person places the second plate close to his ear, thus enabling them to converse as if in private.

"The youthful inventor is confident of the success of his invention, and challenges scientists to prove the impracticability of his theory on scientific grounds. In the mean time the invention fully deserves the attention which will, no doubt, be bestowed on it." L.

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## EDISON'S DOUBLE-DIAPHRAGMED PHONOGRAPH.

[31765.]—The same parts in all the drawings have the same letter attached. Fig. 1 is a plan of the machine (quarter-size), Fig. 2 is a sectional view through line $z$, Fig. 3 sectional view through line $x$, Fig. 4 is a plan of the underneath side of the spectacle frame (all these are half-size).

The shaft R and cylinder C are in one piece; on R a fine spiral is cut, 100 threads to the inch—upon the end of this shaft two wheels are secured; the larger about 2in. diam. receives the motive power (electro-motor, treadle foot motion, or gravity clock-work mechanism), the smaller is banded to shaft L by wheel thereon.

The cylinder C should be about 6in. long by 1¾in. diam.; it is preferably made slightly tapered—about $\frac{1}{16}$in. in its length will be sufficient. This assists in slipping off and on the phonograms W, and secures them also.

Upon the thread R rests a knife-edge, K; but an improved modification of this is a female screw-covering, about one-third of the shaft's circumference, as shown at $k$. By means of this the parts E and F, and with them the spectacle frame, &c., are moved along the shaft B.

Sliding upon the shaft B is a stiff, strong tube F, and, to avoid friction as much as possible, touching B only at points $x$ and $z$; over this is another tube, E, also for the same reason preferably touching F at two points only, $x$ and $y$. Upon the tube E is fixed the knife-edge K, and upon the tube F is fixed the support H of the spectacle frame: it will be seen that, presuming these parts are well fitted so as to be almost frictionless, either F or E may be turned independently of the other; that is, the weight of K will be sufficient to keep it in its place if F is turned.

The support H has a flattened top with a central projection, J, serving to form a rigid bearing for the spectacle frame. At the side of the support the "knife" is pivoted, which is used for taking off a thin shaving from phonograms, thereby preparing the surface for a record. This is adjusted by the screw $t$. The spectacle frame is lifted or lowered by the screw $u$; the point of this screw slides along the level surface D; the spectacle frame moving slightly on the pivot J, is also adjustable by the screws S. The diaphragm cases can be lifted from the frame for repairs or examination; the diaphragms of thin glass, mica, or ferrotype plate are secured as shown by being screwed in with rubber rings above and below. Attached to the centre of the diaphragms are the recording and the reproducing stylus.

Upon the shaft L a left-handed coarser screw is cut, this shaft being put in motion by the two small wheels, and upon its underneath side the knif
M will work when lifted into position.
machine is desired to be temporarily stopp

pressed down—it tilts the lifter N upwar
point $n$ is so adjusted as compared with th
K, that the lifter first moves the spectacl
upwards, thereby freeing point of stylus fr

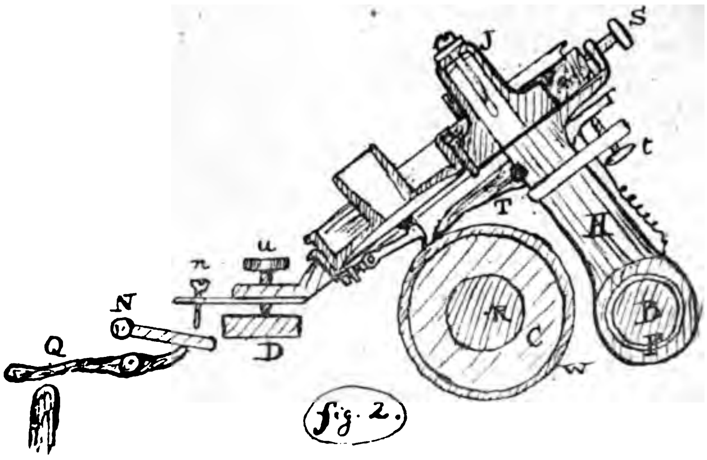


fig. 2.

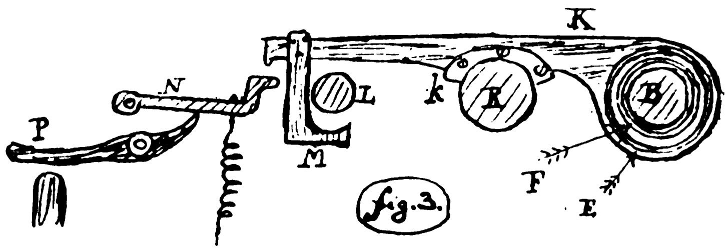


fig. 3.

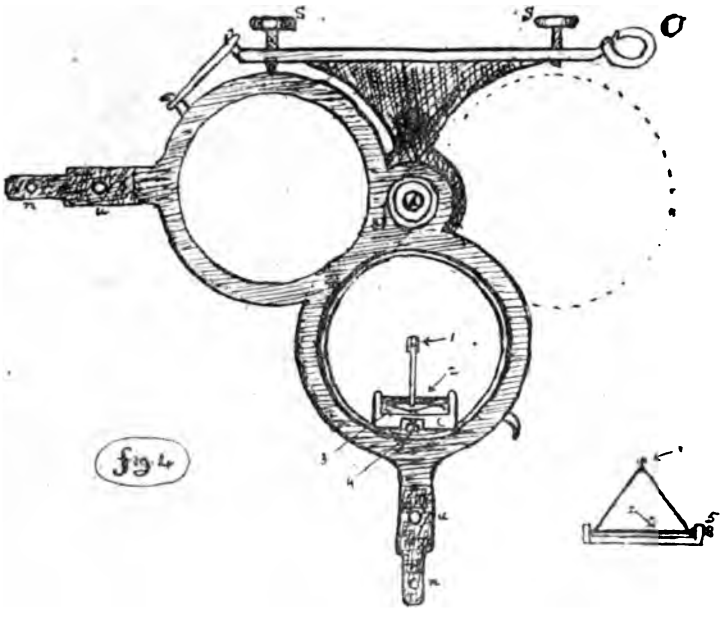


fig. 4.

nd afterwards lifts the knife-edge high enough to eave spiral on R; it cannot lift it higher as the stop elow Q hinders further motion.

Supposing the phonograph is required to repeat a ew words, then the repeater P is pressed down, and cting as Q does, the frame first, and then the knife-dge is raised; but the stop below P is lower than he Q stop, therefore the knife-edge M is lifted high nough to come in contact with the spiral L, thus he frame, &c., are moved in the reverse direction.

The gate G turns on a hinge, as shown; the rojecting tube A contains a strong spring, and ointed bearing for end of cylinder, this bearing s hindered from leaving its socket by the stop orking in the slot; a catch of some sort is fixed to ecure end of gate to take the phonogram W. he spectacle frame and knife-edge are thrown ack, the catch *c* is pulled; the gate, due to pressure f spring in A, will fly open. The phonogram is ow slipped off and a "blank" placed on; the ylinder being held approximately true by the oose bearing X, the gate is now closed and the pparatus is ready to receive a new record.

Underneath the cylinder is a box to receive arings; shields, not shown in the drawings, may ith advantage be placed over bearings at each end f the cylinder to prevent wax shavings from logging them; also shields may be placed below pectacle frame and D, to guide the wax dust into ox below.

As regards materials, I would suggest C R be of ast iron, the screw *k* be of steel, the support H and rame of brass, the diaphragms of thin micro-glass, e stylus of steel, and make C R and G all strong, eavy, rigid. L, R, B, D must be truly parallel.

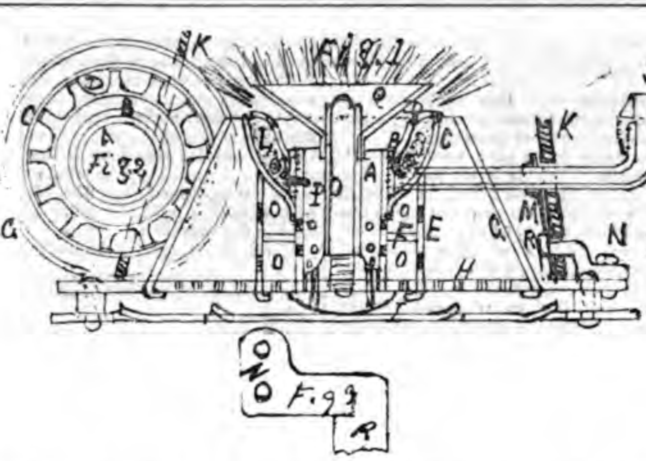
The foregoing description and designs are for the ost part Edisonian (from memory—it is some time ince I examined the machine); but some of the arts I have had to imagine, not having a detailed lea of the correct method of construction, hence hey may be improved on. However, they are ostly of a simple character—e.g., the gate, the art A—I do not remember how Edison constructs his. The catch can easily be designed, preferably ixed to V; again, the parts, P, Q, N, &c., are the est methods I can think of just now to act as equired. The rubber ring O, Fig 4, is rather a eak idea—perhaps some of the brain-pans in "Ours" will suggest an improvement. As to the to est of the machine, I believe it is fairly accurate as izes, positions, and angles of different parts. I hope n the course of a few days to be able to find time to o more fully into reasons and details.

Meanwhile, I may add that I thought it unnecesary to begin with an elementary prelude as to how he phonograph receives, records, and reproduces he sounds, as, I am presumably writing for those ho know, and this has all been explained in former umbers.

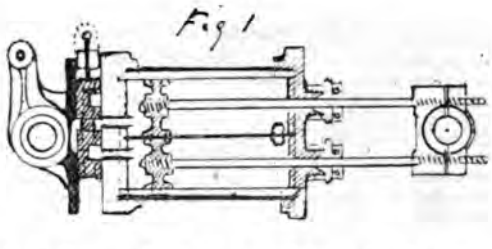
**Cave Diamond.**

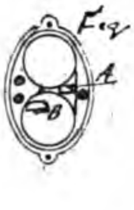
## AUXILIARY POWERS FOR TRICYCLES.

[31766.]—The sketch submitted to you now is he arrangement for heating the steam generator. s it has been stated that petroleum is the thing hat is best, and as it can be got cheap and almost nywhere upon the road, I have taken these things to consideration. Now as paraffin-oil is to be the ing—that is the name it is generally known by—e have to consider what we want. From what I ave experienced from a small Rippingille stove I ave, an ordinary burner with an adjustable wick not to be depended upon, and it will be seen that is is worse when subjected to vibration, as upon tricycle; and that we cannot regulate the flow of l or heat in an ordinary lamp, as the lamp, hough situated some 2in. below in my stove, gets hot that I cannot bear my hand upon it. The ext thing is that cross-winds affect it very much. ow in our case we want to hug, i.e., condense atters as much as possible. With this view this ffair comes up close to the steam-generator, and ocks on the projecting plain tube with latches and bayonet-joint, and the openings are covered with shield to prevent the wind from blowing the light ut. It has a double bottom, one perforated with in. round holes in a series of rings, and the out-de with a series of half dents that perforate the late, and set up a series of lips something like the ace of a rasp. These are in rings, one lot coming termediate with the others, and these lips come p to the other face nearly. The burner is two ups. The inner one can be taken out, and is made lock on the inner tube with a bayonet-joint. he cup upon this has two collars turned up, and e top is cogged. Between these two a coil of pun asbestos-wool is wound, and then it is put to its place. Of course, lamp-cotton or darning-otton will do, but I have a fancy for asbestos per-anent indestructible wick. I think this will do ay with the hard edge—i.e., coke and mushroom uts, and in this case, the cotton being a ture, it cannot go down with the vibra- n of the machine. The oil is fed into bottom cup directly under it, and by eedle valve in the shape of a wire tapered h a long taper set with a screw on the top end, l a lock-nut. Now for the sketch, Fig. 1. From the inner base plate a centre tube, A, is driven in tight, and to this a cup, C, is brazed; upon this tube another short tube is locked on it by a bayonet. joint and pin, with another cup brazed on B. This is the burner proper, and L is showing where the asbestos yarn or cotton is placed for ignition. At the bottom of tube A is a stop end, which carries a pin, G, upon which the baffler or spreader cone is slipped; on this cone is put upon a tube to fit tight upon G. Outside of tube A is another tube, E, with a diaphragm, F. These tubes, E A, and diaphragm are perforated with rings of small holes, but not to come opposite one another. G is the outer cone, not perforated, but has got an opening around about $\frac{1}{16}$in. full (see Fig. 2), with the cone removed. This is looking down upon the burner, H is showing the series of small holes, and I the openings in the outer plate; J is the pipe-feed connections to oil cistern, K K showing position of the steam generator tube, M the shield to cover slot up where the tube passes up, and N the latch, with shield to stop up the bayonet slot shown again at Fig. 3, and Fig. 2 showing the tubes and cones, A, B, C, D, and G. This drawing is full size, so can be worked from the cone; G has tenons upon 5 or 6 put through mortises and clenched, the same by tube E. These may be sweated together with soft solder. The stop end that carries the pin for the baffler cone, Q, if driven in tight, will hold the other all right. The head of this should be perforated as shown, and you may drop a piece of solder and sweat that together. This will not take up much room, and can be easily disconnected and put away until wanted, or, for trimming, a little door can be made in the tube to light it, and I think it will lie very snug. The area of holes and openings should be about 1½sq.in. to 2in., not less, and I do not think more will be required, as the opening of the top of tube of generator should be from 1⅛in. to 1¼in. I have put my considering cap on to see whether I could make anything out of the Hurricane lamp to suit, but I connot see my way.



*Dual Cylinders.*—The other sketch is one that we may turn to advantage, I think. Dual cylinders at 70lb. per square inch: these ought to be as much as we shall want, and, if so, they will lie very snug, and be a saving of between 20 and 30 per cent., and that is a consideration. They are built cylinders, steel tubes, same as the others. This makes the outside elliptic, as shown at Fig. 2. As the others have been explained, I think this will want no further explanation. Now, there was a tubular gudgeon shown upon the carriage of frame, and the use I intended this for was to put a bolt through the lot with two diagonal stays. Cross-section or ×, $\frac{3}{16}$ in section, with bosses on, and bearings to grip the main axle. This is to keep the engines from causing the machine to roll, the which, I think, it will have a tendency to do. There is not the least doubt but what a couple or three pounds weight in that shape will do a great deal towards keeping all things snug and quiet.





**Jack of All Trades.**

## ETHER.

[31767.]—I am with Mr. Brown in his contention that those who object to an explanation are not bound thereby to give another; but, in the case considered, I tacitly assumed that only two hypotheses were conceivable. If another is so, then I have been too hasty.

I would venture also to hint most respectfully, that Mr. Brown's position is the "bumptious" one, and not mine.

I have again read the sentence, re-stated by "Sigma" (letter 31752), referring to gravity and momentum, and I persist in my interpretation. The sentence really states that "the laws of motion and facts of momentum do not apply" in the case of a body acted on by no force. Whereas, one of the "facts of momentum" is, that a body under the action of no forces will preserve its momentum unchanged—in truth, the first law of motion; but this question is irrelevant, as it is no necessary part of the hypothesis that the medium should be devoid of gravity or of an extremely *small* viscosity.

In a substance such as glass, "Sigma," I presume, would be with me in saying that the presence of ether is required to explain the passage of the luminous undulations. There is, then, an economy of hypothesis in assuming that the same medium conveys the electro-magnetic undulations. (I take it that, when anything moves, it is either a substance or an undulation of the state of a substance.) Moreover, we have the remarkable coincidence between the velocity of light and that of electro-magnetic disturbances in a non-conducting medium, as well as the circumstance that the electro-magnetic medium (which, according to "Sigma," is ordinary matter) must be one of at least extremely small viscosity, and, therefore, cannot be air, much less a solid, which may be considered to have almost infinite viscosity.

I presume ordinary matter may be subject to three classes of vibrations—molar, molecular, and etherial. The ether I consider to be as distinctly material as a mass of iron, but with, of course, very different properties. The ether, whether for light or electro-magnetic disturbances, is but a working hypothesis, but the same may be said of our conceptions of ordinary matter. It is only now that I have become aware in what particular respects the facts accepted by "Sigma" were supposed by him to differ from those adopted by the "mathematicians."

I am unable to say whether the sun be a magnet or not; but I should think it probable on *a priori* grounds that all kinds of electric action would be prevalent, and considering the close analogy between currents of certain form and magnets, it would not at all surprise me if the sun were to act magnetically.

An hypothesis which daily appears to gain ground is that the phenomena of comets' tails are due to the mutual electric action of the sun and the material of the comet. This would be an *a posteriori* verification of the electric condition of the sun. I am not aware, however, that those dreadful people the "mathematicians" ("Sigma's" *bêtes noires*) profess to know more about the magnetic state of the sun than other people.

"Sigma" asserts that electric and magnetic lines of force cannot exist in space concomitantly with unchanging gravitation! For the life of me I cannot see what gravitation, changing or unchanging, has to do with the equipotential surfaces or the lines of force normal thereto. In that portion of space in which we make our experiments we have lines of force along with gravitation, and why should we not?

I can only suppose that this proposition of "Sigma" contains some recondite meaning which my stupidity prevents me from grasping.

"Sigma" complains that I have been trying to make him ridiculous. He is remarkably thin-skinned for the writer of letter 31729, in which he was throughout trying to make some one ridiculous. As to the success of the attempt I say nothing.

"Sigma" therein gibbets an extract of Prof. Heavyside's paper, containing a few technical terms as something supremely ridiculous. Isotropic and Eolotropic in the classification of media; scalar, linear, and vector operator in quaternion geometry; magnetic rotation in the theory of light.

All these subjects, along with the ether, are, I suppose, nonsense, together with almost the entire body of the mathematical methods. But surely "Sigma" must have heard of the electro-magnetic rotation of the plane of polarisation of light, for the first experiments in that matter were made by his favourite, Faraday.

The question that "Sigma" asks about momentum, &c., is based upon the strange idea that a body not subject to the action of gravity cannot have any momentum, and is besides absurd. One might as well ask how is it that the laws of motion are what they are and not something else.

These are my last words upon this subject.

**W. C. E.**

## DRY BATTERIES.

[31768.]—In reply to Mr. Henry G. Leitner (letter 31734), it is evident that he did not carefully read my letter, nor does he seem to have read the former letters on the subject, for had he done so he would not have so misrepresented the results of my experiments. I will, however, set him right as well as I can. In the first place, he tells us it should always be borne in mind that the circulation of the liquid is of fundamental importance. Very true in theory, but in practice it does not seem to affect the dry cell, seeing that we get 122 and 125 hours' bell-ringing out of it. Moreover, I am of opinion that the necessary moisture in the dry cell *does* circulate, for I do not believe that the mere film in contact with the electrodes is going to give us such long spells of bell-ringing. Convenience of handling is not the *only* advantage of the dry cell. We have no evaporation, no creeping, and cleanliness—are these not advantages? I smiled to read that dry cells are comparatively useless for plating and gilding, when I successfully plated a couple of metal plates about 6in. in diameter only three days ago with dry cells. The proof of the pudding is in the eating. I do not say that they are the best cells for the purpose, but I do say that they are very handy for occasional work. As regards the platinum wire heating, two cells, 4½in. by 2½in., will make a short helix of ·004in. platinum wire sufficiently hot to light a spirit-lamp or to fire gunpowder.

Now here comes the misrepresentation—the 3½ volts. If Mr. Leitner had read what followed, he would have seen that the true voltage of the cell was two volts, or nearly—not 3½ volts, as he wrote—and that it gave *when regenerated*, 3½ volts; and if he had read the previous letters he would have seen that dry cells, when *regenerated*, have a higher voltage—thus, the Gassner cell gives about 1½ volt; but when regenerated by dynamo or battery, gives 2 volts, but only for a short time, for in a few days the extra voltage will pass off, no matter if the cell is used or not, leaving the cell at its original voltage. My cells do the same thing; but this "remarkable" cell that should have "elated and not disappointed" me gave, *after being regenerated*, 3½ volts. I am still of the opinion that the extra E.M.F. is caused by the accumulation of gas at the electrodes, and if, as Mr. Leitner says, H against O gives about 1 volt, then the 1 volt extra to my 1½ volt would account for the 2 volts or more. If I am wrong in this explanation, I shall be very pleased if someone will kindly set me right. After all, the extra voltage is of but little importance, as it is available only for a short time.

**A. E. Ball.**

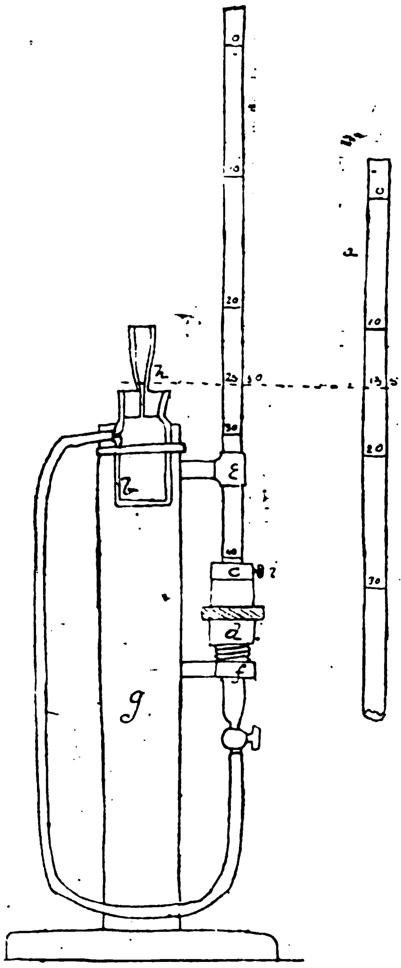
## RAPID DETERMINATIONS OF THE SPECIFIC GRAVITIES OF BODIES.

[31769.]—The following apparatus was invented by the writer for the rapid determination of the specific gravity of bodies. It consists of an accurately graduated burette, *a*, and a specific gravity flask of special construction, *b*, which are connected by indiarubber tubing of great thickness and small bore, *k*. The flask is fixed by an elastic band in a recess on the top of the stand *g*, and the burette *a*, when the set-screw *i* is slackened, slides in the vertical guides *e* and *f*, fitted on the side of the stand.

The instrument being partially filled with water, the burette is raised until the flask is filled with water nearly to the mark *h* upon the side of the tube of the ground-glass stopper, the set-screw *i* is tightened, and the water is accurately set to the mark *h* by means of the screwed collar *d*. The height of the water in the burette is then read.

The body is next carefully weighed (the stopper withdrawn, and the burette lowered so as to partially empty the flask and prevent overflow of water when the body is placed therein. The stopper is replaced, and the burette raised until the water approaches the mark *h* upon the tube of the stopper. The set-screw *i* is tightened, and the water-level adjusted by the screw *a*, and the level of the water again read in the burette *a*.

Where the weight of the body is taken in grains, the burette tube must be graduated into divisions, each of which represents the 256th part of a cubic inch.



With the mètre system the weight would be taken in grammes, and the burette tube would be divided into cubic centimètres and decimal division.

| Experiments. | I. | II. |
|---|---|---|
| Weight of the body in grammes (W) | 38·69 | 52·51 |
| Readings of the burette in cubic centimètres:— | | |
| First | 30·60 | 25·30 |
| Second | 25·30 | 13·55 |
| Volume of the body in cubic centimètres (V) | 5·30 | 11·75 |
| The specific gravities are $\left(\frac{M}{V}\right)$ | 7·301 | 4·468 |
| By the ordinary method the specific gravities were found to be | 7·330 | 4·486 |
| Consequently the error is less than | ·0031 | ·0040 |

It will be seen that the body need not be removed from the flask unless there is not space for the insertion of the second or following samples. Thus in the experiments recorded the second body was introduced while the first sample remained in the tube.

If a sufficient volume of the mineral be taken, say 16 cubic centimètres, the error should not exceed ·005, or ½ per cent. The accuracy of the results is enhanced when the burette is of small diameter.

The apparatus can be used for the determination of the specific gravities of all bodies irrespective of whether they are heavier or lighter than water and for powdered bodies.

When the body is soluble in water the d tion may be made in some fluid, such as oil, or mercury, in which it is insoluble product of the number by the specific the fluid used in the experiments will be t gravity of the body.

**M. Walton**

## TO INSCRIBE A PENTAG

[31770.]—The method of inscribing a teral pentagon in a circle, given by ("E.M.," page 209), is extremely simple of application; but some readers may be i demand a proof of the result being pentagon. I, therefore, offer the followin

It is shown, by Euclid IV. 11, that if i circle we inscribe an isosceles triangle, ha of the angles at the base double of the th the base will form one side of an inscribed Now, from the construction of this triang the base, we know that each of the two e $= \frac{\sqrt{5}+1}{2} . a$, and from the geometry of it is easy to prove that—

$$a = 2r . \frac{\sqrt{5+2\sqrt{5}}}{3+\sqrt{5}}.$$

Multiply numerator and denominator fraction by $3-\sqrt{5} = \sqrt{14-6\sqrt{5}}$. Tl in the denominator disappears, and we fin

$$a = \frac{r}{2} \cdot \sqrt{10-2\sqrt{5}}.$$

This is the expression for the lengt "W.S.'s" figure. Hence the given rule correct result.

Charing. J

## SAP IN TREES.

[31771.]—J. A. Reeves, I suppose, is th in earnest? That being the case, I s would not hesitate to risk a little hard c pet theory. I would therefore propose pieces of land be purchased—one low-l joining a river, and liable to floods; th high-and-dry piece on the top of a hill- both be properly planted with osiers.

I think that after an interval of from five years, the purchaser might be able t fellow men some valuable information relative pecuniary advantages of the two also to form some sound practical, as theoretical, ideas on the functions of roots.

As an amateur gardener I had hithert hot, dry weather, allowed some of my stand in pans of water. As this seems mistake, I suppose in future they wil more if water is totally withheld from the

St. Ives, Hunts, Oct. 27.

## SUBSTAGES FOR STUDEN MICROSCOPES.

[31772.]—Under this heading (31741 Watson and Sons reproduce, if I mista figure of the underpart of the stage of on microscopes, which was published in the " year or two ago. They appear to claim f originality of design, and bring it forward if it wholly superseded the necessity for Son's rival production, notwithstanding that such rival production is recommend secretary of the Quekett Microscopical Report of Proceedings Q.M.C., "E.M.,"

Examining Messrs. Watson's figure wit what experienced eye, I note that the s not mounted on a substantial tail-pie merely connected with the stage pro screw, on which it pivots out of the axis, position being roughly secured by a stop- centring is then effected by the two screws on the circumference of the subst upon a movable inner ring or tube in condenser or other apparatus is applied.

This system of pivoting the substage been in use on the Continent for all microscopes, from the most elaborate do commonest types of so-called student's ins It is a bad system—bad in the Johnsonian mutton" sense—bad from every point of

A focussing and centring substage can too substantially connected with the m for it has to suffer more rough handling other part of the instrument. The few ments it has beyond those actually neede the better; for every additional joint bearing brings in its quota of unsteadiness additional demands on the observer's wat and patience in securing exactness of adju

The only satisfactory arrangements of yet devised act by rack-and-pinion on a piece.

Many attempts have been made, both i and America, to devise means for focussin denser of a less expensive character than and-pinion; but they have all been found bad in practice by those who were familia

ınces of the rack-and-pinion, and who have
led upon to test the various systems devised
tution.

older models of drum microscopes (*micro-*
*tambour*) of Georges Oberhäuser—who was
the first to apply mechanism to focus the
condenser of the achromatic microscope—
tage socket was a fixture beneath the stage,
condenser tube sliding in it was provided
ıd-pins on either side, on which a forked
gaged, the free end of the lever projecting
through a vertical slot in the drum base, so
its movement up or down the condenser
justed beneath the object. This arrange-
ıs generally combined with some primitive
f centring the condenser with a screw-
ıuch centring being on the "once for all"
e, not to be altered during the process of
ion, the very moment when it was most
that it should be possible to alter it! In
nstructions Oberhäuser applied a sort of
o the forked lever to secure an easier sliding
to the condenser for focussing; but the
of direct push or pull of the condenser tube
he substage socket, with or without gimbal,
ays bad, and frequently ended in injury to
hanism.

t and others improved upon Oberhäuser's
nent by applying under the stage a tail-
aving a dove-tail groove in which a slide
the substage was actuated by a stud-pin
r projecting laterally.

recently, and particularly in America, the
s been omitted by many opticians, and the
pist has had to *slide* the fitting up or down
piece by small knobs on either side. Even
recent students' microscope—that of Swift
, to which I have above referred—has this
onvenient arrangement.

uld be too tedious to describe the various
stems that have been applied to avoid the
of the rack-and-pinion. They consist
y of some form of screw-action, and prob-
best of them is now made by a leading
tician.

bly one of the worst focussing arrange-
ecently designed for the substage condenser
roposed—if not invented—by Mr. E. M.

It consists of a substage socket fixed to the
ce of the stage; a spiral slot is cut in the
n which a stud-pin on the side of the con-
ube moves up or down as this tube is
by hand. The focal adjustment of the con-
btained by this motion in a spiral direction
nsatisfactory. I suppose Mr. Nelson him-
recognises its inferiority.

our opticians face the matter by applying
-and-pinion motion to a fixed tail-piece for
' microscopes I fear we cannot credit them
e serious intention of meeting the present
nents of students. It would appear that
makers are constantly handicapped by
n desire to supply a superabundance of
" in non-essentials, to the neglect of much-
focal and centring substage adjustments
very student would soon learn to appre-

eginner now asks the advice of an expert as
icroscopical outfit he should obtain, on ex-
his requirements to the optician, he will
y be met at once with some such statement
s:—"You can have a substage with rack-
ion and centring adjustments; but these
re only fitted to the better class of micro-
commencing at the price of £*x*"—the *real*
which is to force the student into a larger
-to make what is commonly known in busi-
a "substantial transaction."

act seems to be that in England the manu-
of fairly good microscopes is in the hands
w opticians that they believe they can
control the trade. It is for responsible
in medical schools to combine and autho-
y formulate the *desiderata* of a student's
ope—the laws of *demand* and *supply* will do
though they should lead us to engage foreign
s to drive English microscopes of the
' class out of the field. Such a course does
n patriotic; but I fear our opticians are
ainst friendly council on the matter. They
be made to move in a popular direction
ey find such firms as Zeiss's establishing
ves—as they are now doing—in London.

scopists naturally want the highest class of
ppliances they can acquire with the outlay
disposal. They feel that inferior means
to inferior results only. The demand for
roved instruments—apochromatic object-
npensating eyepieces, projection eyepieces,
ists. The supply of these novelties by
opticians has been so extremely limited,
hal so tardy, that it has amounted to
of any importance, so we have to rely
on Zeiss, of Jena. That great firm, em-
some four hundred people, has now estab-
o representative houses in London, and it
our opticians to look to their laurels, for
petition promises to be the most serious
occurred during this generation. Moreover, the competition will not be limited to the production of microscopical apparatus: the firm of Zeiss has now brought out a series of new photographic lenses which will, no doubt, demand and obtain the keenest attention of those who are interested in the progress of photography.

**Microscopist.**

[31773.]—In submitting the student's microscope, made by Messrs. Swift, at the last meeting of the Quekett Microscopical Club, I expressly disclaimed any idea of novelty in the parts of the instrument. My sole intent was to show how easily some better form of centring fitting could be applied in place of the make-shift understage tube, which is, *pace* Messrs. Watson, after all, the only thing provided in the vast majority of students' instruments. These gentlemen state that the form adopted by them in their Edinburgh model was designed by Dr. Edington about 2½ years ago; but Messrs. Crouch have, for a much longer period, made a very similar form, and so has Reichert of Vienna. The great drawback, in my opinion, to this arrangement is that it is in the way when turned aside; and, moreover, I do not think it can be contended that a substage supported by, and swinging on a single screw, is as steady and free from tremor as one with long bearings moving in a dove-tailed guide. Mr. Nelson, whose criticism in these matters is always deserving of great respect, drew attention to the absence of a rack-and-pinion focussing adjustment in Messrs. Swift's instrument, but one is very easily fitted if required, and for the class of work this instrument is intended for it is by no means necessary.

I shall be very pleased if a discussion on this subject leads to the abolition of the non-centring substage tube, and the substitution of a more scientific arrangement, by whomsoever it may be designed.

**George C. Karop.**

## SEAMLESS TUBES FROM SOLID BLOCKS OF METAL.

[31774.]—The sketch which appeared on p. 163 is not in any way "misleading," as suggested by "E. T. B." in letter 31747. The diagram he gives simply makes another shape or size of tube—that is all. The principle is exactly the same, and there are many different arrangements for carrying it out, several of which are, I think, illustrated in the specification of the patent.

**S. R.**

## A RAILWAY-ENGINE PROBLEM.

[31775.]—"A Railway Man" (letter 31745), calls the attention of your various readers to the extraordinary address given by Mr. Tomlinson before the Institution of Mechanical Engineers, and I suppose wishes them to explain it.

Well, Sir, the address is so very—very wrong, that how to correct it I don't know. I feel now, as I did when I heard it delivered—namely, that it would be useless to try to point out the errors, as there are so many.

I will take first of all the main point, the valve-gear and four eccentrics. Mr. Tomlinson says: "All engines up to 1840 had only two eccentrics, which necessitated hand-working at starting."

Let us see. Why, in 1834 all the new engines put on the Liverpool and Manchester by Stephenson, Hawthorn, Haigh-Foundry, Tayleur, and Forrester had *four* eccentrics and gab-ended rods.

The Sunbeam of the Stockton and Darlington, 1837, which illustrated the address, had Hawthorn's gabs and four-eccentric motion; and no engine was ever built after 1836 with single eccentrics.

In the address it was said that the "Swift" engine was made by Kitching. Well, sir, it was not; it was one of Hawthorn's. Passing over a number of errors, one comes next to the words, "Jenny Sharp."

Well, there were no such engines. There were the Sharp, Roberts, and Co.'s engines, and there was the engine of E. B. Wilson and Co., called "Jenny Lind." Wilson and Sharp were two distinct firms, and built two distinct forms of engine.

Mr. Tomlinson told the Institution that the grand 8ft. 6in. wheels of the fine old Cornwall on the North-Western are only 8ft. It is too bad to understate the largest pair of wheels in this kingdom.

Passing over many other errors, I will come now to the questions.

Take the Lord of the Isles first. That engine was *not* made in 1846, but was turned, brand new, out of Swindon shops for the Great 1851 Exhibition, and she never worked a mile till after that was over.

The Midland engine 648 was turned out by Dubbs and Co., of Glasgow, new in 1868, not 1857. That same firm turned out 784 tank-engine in 1870, not 1863.

It is perhaps hardly necessary to say Mr. Tomlinson is very wrong about the 8ft. 2in. Caledonian engine. If it was not built till 1863, how did it happen to be in the Exhibition of 1862? The engine was built 1861. Great Northern No. 776 was made at Doncaster Works 1887, not in 1870 (a difference of *only* 17 years). The Midland 1738 class was designed and brought out at Derby, 1885.

I won't tire your readers by going any further; I have given plenty to show what the recent address by the President of the Institution is made of.

**Mem.Inst.M.E.**

## RULE FOR ELECTRIC-BELL WIRING.

[31776.]—I am afraid Mr. Maycock can hardly call the rule he mentions new, seeing that it is the general practice with electric-bell fitters. It was about one of the first things I learnt in regard to wiring, and I advise its adoption on page 2 of "Practical Electric-Bell Fitting."

The colours I employ are red for main push wire and white for the remainder. It is very rarely another colour is required for the other pole of the battery, as the wire from terminal of the bell to this pole is never very long. If I wish to be able to identify any special indicator wire, I use another colour and make a note of it. Were this not the case it would be well-nigh impossible to repair faults in large buildings, where there are often as many as 100 wires in one casing. In electric-light wiring, also, some contractors use two coloured wires—a black and a brown.

**F. C. Allsop.**

165, Queen Victoria-street, E.C.

## VIOL D'AMOUR.

[31777.]—To "E. P." (letter 31754) I reply:—

1. We hear little of this instrument because it is obsolete; as are also other viols—the viola bastarda oralto, the viola da braccia or tenor, and the viola da gamba or bass. The double bass alone retains viol, as distinguished from violin, form.

2. Violins are preferred to viols, as being an improvement both in form and generally in resource. Apparently shifts were little, if at all, used with viols. The extension of compass attained on the violin by the use of shifts could only be approached on the viol by multiplying the strings. Hence a thick and cumbrous neck, increased trouble in tuning, and inconvenience from breakage. The viol d'amour, of course, produces special effects of its own, impossible on the violin.

3. In making a viol d'amour—that is, a copy of the original instrument—the proportions and thickness of wood can only be satisfactorily determined by a close study of a good model. Not only size, but increased pressure, due to the greater number of strings, have to be considered. If the instrument came again into general use, I imagine it would be modernised, and made upon the lines of the violin, subject to the necessary allowance for size and pressure. The flat back is simply a remnant of antiquity.

4. I cannot give the gauge of either the principal strings or the resonators. The former would range from about tenor C to violin A; the latter are very fine wire. I think perhaps Mr. Schneider, whose address I have given, would furnish "E. P." with information as to this, and generally upon the instrument. I do not know him; but I am told he is very obliging and courteous.

5. Tuning: 7th string, D (third line bass clef); 6th string, one third higher (F sharp); 5th, one third higher (A); 4th, one fourth higher (D); 3rd, 2nd, and 1st, F sharp, A, and D respectively. I believe there is also a minor mode, in which the F is made natural.

As to measurements, I must remind "E. P." that mine were only approximate. The instruments seem to vary, though not, I think, very widely.

**C. J. Tahourdin.**

**Zinc.**—Three different processes, each believed to possess its peculiar advantages, are in vogue among the manufacturers of zinc in Europe. In Belgium, to get pure zinc from the oxide, the latter is mixed with coal and heated in a retort, the zinc volatilising, and coming out of the mouth of the retort as a vapour; cadmium is always mixed with the zinc, and cadmium vapour comes out first, and, when lighted, burns with a brown flame, the latter changing to green as soon as the zinc vapour begins to come off; an iron cap is now placed over the mouth of the retort, through which the vapour passes, and is condensed into a fine dust, and gradually the cap becomes hot and melts the dust into liquid zinc, which runs into moulds, and is cast into blocks. The Silesian process differs from the foregoing only in the retort, the mixture of ore and coal being put in and heated, and the vapour passing out through a tube bent at right angles to the retort; the tube is kept cool, but not cool enough to condense the vapour into solid zinc, as, if this should happen, the pipe would become clogged and the retort burst. In the English process, the retort consists of a tightly-covered crucible, through the bottom of which passes a pipe; the pipe is stopped with a wooden plug, and the mixture of ore and coal put into the crucible and heated, and, as the mixture grows hotter the plug is converted into charcoal, allowing only the zinc vapour to pass through it.

# REPLIES TO QUERIES.

*⁂ In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[72168.]—**Electric Bell and Battery.**—I share the obtuseness of Mr. F. C. Allsop, in being unable to see any reason in the rule promulgated by Mr. Walker Moseley for connecting the carbon of an electric-bell battery to the wire leading to the push in an electric-bell system. I do not deny that there may be good reasons, for I am always open to learn, and Mr. Moseley may have discovered something that has been missed by others; but I contend that Mr. Moseley has not yet given good reasons for his rule. In his letter on p. 106 he says, "The wire attached to the 'copper' (carbon or other negative pole) is constantly exposed to electrolytic corrosion through any dampness with which it is partially or wholly surrounded." I cannot understand how an insulated wire can be exposed to electrolytic action in the situations occupied by electric-bell wires. If it were possible for a leakage to occur from the positive wire across to the negative wire running parallel to it, then there would be a possible electrolytic action going on (if surrounded by a moist envelope) between them as long as the leakage continued. But in electric-bell installations the wires are insulated from each other, and are placed, or should be, at some distance apart. How, then, can there be electrolytic action between them? If the wires are badly insulated, or carelessly laid, then in damp situations there will be a leakage across, and this, rather than the relative positions of the battery elements to the pushes, will account for extra wear and tear of all the installations. This is from my point of view; but, as my experience in such matters is considerably less than that of Mr. Moseley and Mr. Edwards, I shall be glad if they can can show more clearly than they have done yet a good reason for Mr. Moseley's rule. Mr. Moseley has assumed the existence of electrolytic action on the wire leading from the positive pole of the battery. How does he prove this? The corrosion observed (if there is any) may be due to bad workmanship, either in laying or in insulating the wires. If there is sufficient leakage to cause electrolytic action, evidence of it should be shown when testing the line for insulation with a good detector galvanometer.

G. E. Bonney.

[72284.]—**Cement Kiln.**—"Jack of All Trades" is in error when he says that fire-bars are out of the question for cement kilns. I have been in a factory for years, and have seen many other factories, and have always seen fire-bars used. In our factory we frequently use up our old and useless rails for this purpose; but the best fire-bars are rough castings of inferior metal with a hole right through the centre. The heat required for Portland cement burning is most intense, and the old rails soon dwindle away. Good clinker should be of a dark greenish-black colour, honeycombed, and to produce, when ground fine enough to leave not more than 10 per cent. residue on a sieve of 2,500 meshes per square inch, a cement to weigh on an average 118lb. per striked bushel (116-120lb.)

Cement Maker.

[72341.]—**Driving Mechanism for Tricycles.**—I cannot see that there is any advantage in "Cycloid's" scheme, so far as it has been described. As he says there is "nothing for dust to lie on or stick to," we must take his word for that; but when you think of it, a chain is exactly the same (mechanically speaking) as his "double rack" with the advantage that the chain is flexible, and applies the "power" quite as direct.

Nun. Dor.

[72369.]—**Resin Oil.**—This querist evidently means rosin oil, or balsam of turpentine. It may be rendered nearly scentless (or at least have strong odours removed) by agitating it with a diluted solution of sulphuric acid and afterwards rectifying it from a strong or saturated solution of lime-water; but I do not think it possible to remove the odour entirely, especially what is left after the turpentine has been taken. A. C.

[72457.]—**Petroleum Burners.**—"Perfect Combustion" means, I suppose, what is known as a paraffin-oil lamp, or a kerosene lamp. When he gets one to give 41 candles with only an inch wick I hope he will let us know, because I should like to have such a lamp. There is so much competition in the lamp trade that the best that can be done is easily found. I have a little stove with a 3in. wick, and I doubt whether that gives much more than 40 candles.

Nun. Dor.

[72470.]—**Ornamental Ironwork.**—Sorry I overlooked this query; but it is immaterial, for it is impossible to instruct any one in doing ornamental ironwork except with the hammer and anvil in front. It is the sheet-iron repoussé work that I mean, and it is the work that requires the art and skill of the practised blacksmith. "G. R." does not give any indication of where he lives; but if it is near Birmingham he ought to have little difficulty in getting lessons; but, of course, he knows that other tools besides the hammer are required.

T. M.

[72473.]—**Toy.**—Will "Simple" give a little more explanation? Does the ball hold the lower position, or does he mean that it rests in the cup? So far as can be gathered, it is simply a modification of the well-known device of keeping a ball spinning by means of a jet of air, or that other which puzzles many—in which it is found impossible to blow a card off a pipe having a small orifice by means of the breath. Simon.

[72505.]—**Balancing and Truing Emery Wheels.**—If the emery wheel is truly placed on the shaft or axle, it can be balanced by the aid of the diamond cutter, provided the wheel is itself homogeneous and equally thick throughout, or at least at the circumference. The diamond should be used only for finishing—a cutter of hard cast iron being employed first of all. I suppose by "diamond" carbonado is meant. Set it in plaster of Paris, and hold that in some elastic bearing, such as cork or rubber tightly pinched up. L. T. P.

[72549.]—**Analysis of KOH.**—Cannot you find what you require in Sutton's "Titration of Alkaline Salts"? Sm.

[72569.]—**Assaying White Metal.**—Up to the present I have only had one short reply to my question on assaying white metal. I thank "Sm." for his reply. Will he kindly give me details of the humid method he recommends? I am limited to small samples of the material—say about 1dwt. each—and there is a very thin coat of silver on the metal. By the cupellation process I get a bead weighing only ·25 grain, and this gets enveloped in the scaly residue resembling iron scale. Will "Sm.," or some practical assayer, tell me how to determine the identity of this scale? Tyro.

[72570.]—**$CO_2$.**—Aspirate the air through potash bulbs, or U-tubes containing KOH. The increase of weight gives $CO_2$. Of course, the air must be dried by $H_2SO_4$ and $CaCl_2$ before entering the tubes to be weighed. Sm.

[72573.]—**Electric Light for Dark Room.**—*Re* reply by F. G. Willatt, p. 191. I think most photographers who keep themselves well read up to the times will agree that the idea that semi-darkness is required for working dry plates is now exploded. We are now told that we may have plenty of light if of the right kind—nor need it be red or ruby. A perfectly safe light can be had with "canary medium" or "golden fabric," and light orange paper. With a strong paraffin-lamp and the above light I work Ilford Special Rapidity plates without fog. There is nothing simpler than to cover an incandescent lamp. Take two circles (size according to lamp) of "golden fabric," and place between them a sheet of photographic orange paper, and gather this round the lamp in the form of a bag and secure the whole to lamp-holder or higher with tape. Celt.

[72580.]—**Draughts.**—It is quite true that when the game of draughts is played accurately to rule it is impossible to beat the player having first move. It is only because one of the players makes a mistake that the other gains the advantage. Similar remarks apply to chess; but that is a long way in front of draughts, chequers, or whatever it is called; but even chess is a time-absorbing game of little value as an educational device.

D. Gambit.

[72584.]—**Fountain.**—"Caldemone's" reply to the query of "E. P. J." is very misleading, and I am not surprised at the latter requesting an explanation of the use of the lower reservoir, &c. "Caldemone" infers that water running through tube 1 into the lower reservoir, and thence through the lower tube to the upper, would cause it to play. Nothing of the sort. In that case the water would only find its level with that in the bowl. His principle of construction is correct; but the theory is misstated. The upper chamber is charged with water, which, after filling, is rendered air-tight by means of a screw-stopper. The water in the bowl flows down tube 1 into the lower reservoir, which contains air only. The lower chamber, being air-tight, with one exception, cannot, possibly, hold both air and water. The only exit for the air is by means of tube 2, which leads into the upper reservoir. This being full of water, the same principle applies here as to the lower, and the air, in trying to find an exit, makes room for itself by forcing the water in the upper reservoir through the jet pipe. If "E. P. J." will furnish me his address, I will send him plans together with details of material required.

Enfield. B. Brooks.

[72649.]—**L. and S.W. Tank Engines.**—We have got a little mixed up with these engines; but, thanks to "North Western," I think I can put it right. I find, by referring to the builder's numbers, 2602 and 2603, that Nos. 77 and 78 are now numbered 59 and 60. The builders' numbers run consecutively, 2,601 to 2,609, on the following engines—58 to 60, 82, 104, 106, 107, 125, and 126; and, according to "North Western," No. 129 is 2610, making 10 engines of this batch. Is it not possible that there are two more, as 10 is rather an unusual number, the companies generally making them by the half, three-quarter, or whole dozens? I should be glad of information respecting this; perhaps C. F. D. Marshall could oblige.

Brixton. Locomotive.

[72661.]—**Crookes's Tubes.**—I have found, in my private studies, that a coil giving a 6in. spark is about the smallest instrument which can be used for ordinary vacua work with any degree of satisfaction, and some of Crookes's effects really require a longer spark than this. A good modern disc-wound coil, yielding freely 8in. or 10in. of continuous discharge in air, will meet all an average experimenter's requirements; but it is doubtful whether the delicate details of an effect like Crookes's "luminous cross" could be made visible to 150 persons at once by means of such apparatus. A great deal will, of course, depend upon the shape of the lecture-room and the disposition of the audience. The "paddle-wheel" (molecular impact) experiment can be shown in the electric lantern. "R. M." might obtain photographic diagrams of the principal experiments, and project one of them upon the scene side by side with the actual demonstration of the effect illustrated. The lantern diagram would naturally help (and pacify) the more distant spectators. Both electrokinetics and electro-optics are copiously expounded in Vol. II. of Gordon's "Physical Treatise on Electricity." As regards the practical management of public demonstrations on a large scale, I cannot much assist the querist; but why should not "R. M." address a few courteous words of inquiry to one of our leading popular science lecturers? Such an application, properly made, is never without results; and if a distinct question is put it is certain to be well answered.

Ernest Baugh, A.M.I.E.E.

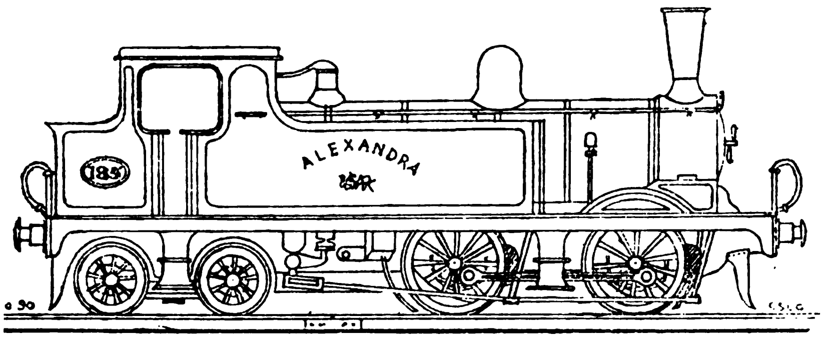
[72687.]—**Screw-Cutting.**—I have overcome the difficulty in my case as follows:—First of all, I procured a set of small change-wheels. At the back of the mandrel is mounted a counter-shaft, a gear-wheel on which engages with another fastened to the back of cone pulley. This shaft slides in and out of gear the same as usual back-gear shaft (my lathe is not back-geared), and overhangs beyond the tail pin. The two screws which bolt the standard to the bed have been replaced by longer ones, so as to permanently attach a casting which projects in front of the lathe and carries an ordinary quadrant plate and a length of patent rolled shafting, which is taken along the front of the bed just the same as a leading-screw, only not so close to the bed. The necessary change-wheels are mounted on this shaft—the small counter-shaft—and the two pinions on the quadrant-plate. All this is easy enough. The next step is to connect this long shaft with the slide-rest screw. This is done with three wheels on a toggle-joint. One end of the toggle embraces the shaft and takes a long bearing, the shaft turning in it freely. The other end of the toggle slides over the projecting end of the slide-rest screw. One gear-wheel is now placed on the slide-rest screw in place of the usual handle, another wheel on the pin which joins the two arms of toggle, and the last wheel on the long shaft, all three meshing. By this arrangement the shaft will always be in gear with the screw, no matter how much the transverse slide is moved. It is obvious that two pinions must be used on the quadrant, otherwise left-handed screws would be produced. There is an arrangement, which will no doubt suggest itself, by which the slide-rest screw can be thrown in and out of gear instantly, and which also overcomes the difficulty which would otherwise be experienced in moving the tool independently—so easy in screw-cutting lathes, but not so in this case, as we have only one traversing movement. As I have not been able to make this description very clear, I shall be happy to show the lathe any night after six o'clock. F. Search.

144, High-street, Putney, S.W.

[72687.]—**Screw-Cutting.**—I have just finished some gear for my own lathe (3½in. centre), which answers well for outside and inside threads. If the querist cares to advertise his address, I will write to him, or I will send sketches and description for publication. A. J. Dew.

[72699.]—**Indicating.**—Since writing on above I regret to find I have made a misstatement as to the performance of the engine cited by "Young Engineman." The statement would have been correct had the cylinders been independent of each other; but obviously the steam in this case does double duty in passing through the pair of cylinders. Therefore, the total I.H.P. must be taken out of the quantity of steam originally supplied the h.p. cylinder, or $\frac{4346{\cdot}4\text{lb.}}{155 + 118} = 15{\cdot}92\text{lb.}$ per I.H.P. Much nearer the mark, and a good performance: but, of course, when the clearance comes to be added, the amount of steam required per I.H.P. will be correspondingly increased.

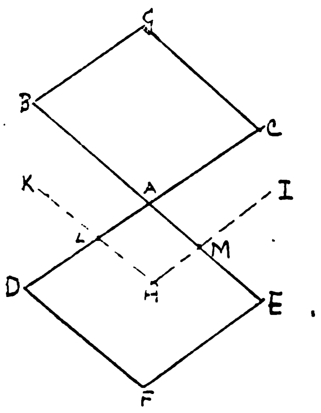
Liverpool. W. S.



7.]—**S.W.R. Tank Engines.**—I send of 185 Alexandra:—Cylinders, 17in. by riving-wheels, 4ft. 9in.; bogie-wheels, 3ft.; 35ft. There are about 10 of them out—' to 186. No. 188 was only out for trial a wo ago, and 187 about a fortnight ago. I now how many more there will be; but I hink at least another half a dozen, as they it a 0 before the numbers of all the old up to 194, from 177. I cannot give further ons. Why have they named only one? I e glad if anyone can give the reason.
on. LOCOMOTIVE.

7.] — **Electric Search Lamp.** — Your brushes simply want shoving forward when d load goes on, to stop the sparking. I supur dynamo is large enough for the work?
A. J. DEW.

l.] — **Pantagraph.**—Take two pieces of od about ½in. wide and 18in. long, and joint the centre. Then take other four pieces n. long and joint the ends of each pair, and frame with easy joints like Fig., B E and ng the long pieces, and B G, G C, D F, and g the short pieces. A is fixed to the drawrd by means of a long pin, about which the free to turn. The pencil is fastened at G, tracing point at F. This copies exactly same it, if enlarging is required, bore a row of int holes along A D, A E, F D, and F E. nt the frame in corresponding holes L and is the tracing point, and the drawing is in the proportion of B A to A M. To , put the pencil at H and tracer at G.
B.Sc., Edin.



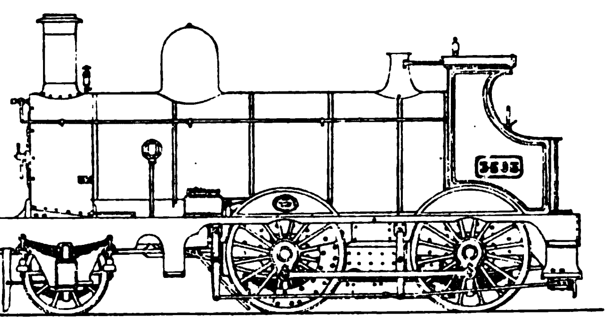
.]—**Indian Ringworm or Washer-Itch.**—If "R." will call, I will give him a ointment which cured me in April last. he require more, he can easily obtain it e same chemist by writing, and quoting d date. I do not know what the drugs three or four applications were sufficient
J. T. B.
werscroft-road, Lower Clapton.

.]—**Photo-Micrography—Section Cut-Microscopy.**—I was fairly astonished on reply 72716, by "B.Sc." The machine has never seen or heard of in England was by Mr. R. Packenham Williams as long 876, and has been made and sold by all the opticians ever since, under the name of ns's freezing microtome." I do not wish r acrimonious, but "B.Sc.'s" remarks show ay the least, he has hardly kept pace with histological methods. His conception of ng in paraffin seems to be that the tissue is ut in the well of the microtome, and melted poured round it and left to set. If this is nt he will not get good sections for photophy or any other purpose; but the real as pursued now, is a totally different proich, if it possesses any interest for your I shall be happy to describe. In letter 22704, "B.Sc." sneers—and not for the first time, I think—at the predilection of English microscopists for diatoms. May I remind him that it is to the diatom we owe nearly all the modern improvements in the optical part of the microscope; that the diatom valve is the standard by which the perfection of figure and correction of an objective are judged, and that this perfection, which indirectly benefits every microscope observer, would probably never have been striven after for the sake of the physiologist and pathologist. Again, some of the best Continental microscopists, as distinct from those like physiologists who use the microscope as a mere accessory instrument, however indispensable it may be, are diatomists, such as Dr. Van Heurck, Prof. De Toni, Herr Adolf Schmidt, and many others. Surely physiology and pathology, which require a special training, are less likely to be interesting to the majority of English observers, who are either naturalists or who pursue microscopy as a recreation or a hobby. I would strongly advise all beginners to join, if possible, one of the very numerous microscopical societies in London or the provinces. By seeing the methods of others more experienced, and by freely questioning, they will gain vastly more than can be acquired by reading alone.
A DEMONSTRATOR OF PHYSIOLOGY.

[72724.]—**To Photograph Polished Silver.**—Coat the bright parts with a white varnish easily dissolved in spirits of wine, and wash the varnish off in warm spirits of wine when the operation is complete. This will not injure the silver.
G. E. BONNEY.

[72725.]—**Mechanical Motion Wanted.**—Let a governor raise the lever or cord.
A. E. B.

[72726.] — **"Cornishman" Locomotive.** — Accompanying sketch is one of the three engines —3502, 3505, 3508—which run this train over the severe gradients of the South Devon Railway between Exeter and Plymouth (north road). Cylinders 18 x 26, diam. of coupled wheels 5ft., leaders 3ft. 6in. Wheel-base: leading to driving 9ft. 3in., driving to trailing 7ft. 9in. Built (tank engines) at Swindon, 1885; 3501—3510 are broad gauge, 3511—3520 narrow gauge. These three engines were converted into tender engines in 1890; the tenders formerly belonged to the 2080 class of goods engines. Will any correspondent kindly oblige me with dimensions, especially wheel-base of the 7ft. 6in. single express engines formerly belonging to the Bristol and Exeter Railway. They were very similar to the G.W.R. Iron Duke type in appearance. GORGON.



[72730.]—**Bicycle.**—By putting a larger wheel on your crank-axle, you will have to exert a greater pressure on the pedal; but, if you put a smaller wheel on—that is to say, gear it down, you will not require to exert so great a pressure on the pedal, but the machine will run slower.
B.Sc., Edin.

[72730.]—**Bicycle.**—You can get just as much power out of a bicycle as you put into it, minus that wasted in friction. No matter how you arrange the gearing or wheels, the only way to get more power out of the machine is to put more in by your own muscular exertion. The only effect of the arrangement you suggest would be to enable you to obtain a greater speed on the level without a very rapid foot action. But, on the other hand, hills that you now ride with comparative ease would have to be walked. F. J. GARRARD.

[72731.]—**Warts.**—Try strong nitric acid; it destroyed mine. Don't let it touch the skin.
A. E. B.

[72731.]—**Warts.**—The milk of the weed Spurge, growing in most gardens, cured mine. Let it dry on them. J. T. M.

[72731.]—**Warts.**—I have lately removed warts from the hands of young people both with acetic acid and spirits of salts. In one case over a hundred warts disappeared from one hand. It should be applied several times with a tiny brush or a wooden match. The warts will depart in the course of a few weeks. H. H.

[72731.]—**Warts.**—Rub the crown of each wart with caustic soda each alternate day, and gently scrape off the dead skin before applying the caustic. Be careful not to touch the skin at the base of the wart with the caustic soda, or it will cause a painful sore. I have cured many warts in this manner. If warts are coming on his face, consult a physician, as it is evidently a skin disease requiring medical treatment. G. E. BONNEY.

[72732.]—**Electric Lighting.**—A 10-volt 5c.p. lamp should be fully lighted with current from a battery of six cells, each having an E.M.F. of 1·60 volt. But, as the internal resistance of the Gassner dry battery rises rapidly when the current is closed, it will take at least seven cells connected in series to fully light up such a lamp. For this reason the Gassner is unsuitable to the work of electric-lighting where a large volume of current is required in a circuit of low resistance, as when two lamps are connected in parallel. The Gassner is only suitable for intermittent work, as when a small night-light is wanted for a few minutes at a time occasionally during the night.
G. E. BONNEY.

[72735.] — **Barometer.** — By Boyle's law, the volume of the air is diminished by the increase of pressure, and therefore the water rises to fill the space left by the compressed air.
B.Sc., Edin.

[72735.]—**Barometer.**—The instrument to which my question referred is not set in action by the help of the thumb. A wide-mouthed jar is half-filled with water, a Florence flask is placed mouth downwards, so that the edge of its mouth is just below the surface of the water. Why does the water rise and fall in the neck of the flask?
F. W. C.

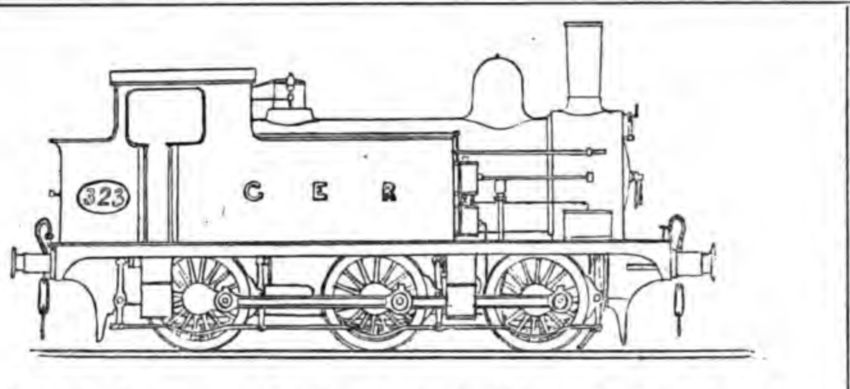
[72741.]—**Telephones.**—It is difficult to tell what is referred to in the paragraph in question, which is very vague. Apparently the last few lines refer to placing wires underground, but at any rate the whole paragraph appears to have been written by one who is more of a business man than an electrician. F. C. ALLSOP.

[72742.]—**Electric Lamp.**—To MR. BOTTONE. —If you do not require the light for more than 15 minutes at a time, you will find six cells of Gassner's battery will give complete satisfaction if used in conjunction with a battery lamp taking 5·5 volts. But if you want the light for longer intervals, you must use a four-celled single-fluid chromic-acid battery with lifting arrangement.
S. BOTTONE.

[72745.]—**Toning Photos. by Lead.**—Dissolve ½oz. acetate of lead in half-pint of water. Dissolve 4oz. of hyposulphite of soda in another half-pint of water. Now pour the acetate of lead solution into the hypo. solution. This receipt is Mr. Ivor Poole's. I tried it. It certainly tones the prints; but, to me, the resulting tone is anything but agreeable, being of a rosy pale purple, very flat, and wanting in sparkle. S. BOTTONE.

[72746.]—**Electro-Plating.**—Have you added ammonium carbonate to your bath? SM.

[72748.]—**Smokeless Firing.**—You had better get Reynolds's book on firing. I think it has been advertised in the "E.M." I don't know who is the publisher. JACK OF ALL TRADES.



[72737.]—**G.E.R. Locomotives.**—I inclose a rough sketch of G.E. engine No. 323. Diameter of wheels 4ft., cylinders 16 × 22. H. WOMACK.

[72749.]—**Electrotyping.**—You had better oil them and take a mould in gelatine and treacle and cast plaster from that. JACK OF ALL TRADES.

[72749.]—**Electrotyping.**—Procure some of the best white wax (best bleached beeswax), not paraffin, and melt it in a clean pipkin over a slow fire. Add to it one-eighth of its weight of flake white, previously well dried; mix well. While this is going on, lay your plaster casts, face upwards, on a flat dish. Pour in water cautiously, so as not to reach up to the faces of the casts. When you see that the moulds have sucked up water so as to look moist on the face, take them out, and wrap a band of damp brown paper round their edges, so as to project up about ¼in. all round. Tie these rims round the moulds with a bit of cotton or fine twine. Now place your cast on a flat board or slate, give a stir up to your melted wax, and pour sufficient over each cast to fill up to the top of the paper rim. Let them stand twelve hours in a cool place to set well. Remove the paper rims, and pull steadily the wax from the plaster. Blacklead the faces of the wax, and electrotype in the usual way.

S. BOTTONE.

[72750.]—**$CO_2$.**—There are several methods so diverse that it would waste space to describe any one in detail until one knew the extent of the querist's experience and the apparatus at his disposal. Judging by several other questions which have appeared from time to time on this and other branches of chemical analysis, it is not altogether superfluous to remark that a chemical balance is required. DIRECTOR R.R.L.

[72750.]—**Carbonic Acid.**—There is no rough-and-ready method of estimating the actual amount of carbonic acid in the air of a room; but a near calculation can be made by means of baryta-water. For accuracy, the work must be done by a skilled chemist. For mere sanitary purposes, it is sufficient to shake a bottle containing clear lime-water in the air of a room. The bottle is empty at first, and the lime-water is added in the room (say ½oz. to a 10½oz. bottle), and if on shaking no precipitate is formed, the air is practically free from carbonic acid. But see Angus Smith's "Air and Rain" (Longmans). S. R.

[72751.]—**Dust.**—Stockholm tar, thinned with camphor or turps, would be best, but dangerous. The next best thing I can recommend is raw linseed oil, a quart, and dissolve a piece of camphor in it about the size of a walnut. Paint the floor when thoroughly dry with that. A small piece of rosin about the same size would improve perhaps.

JACK OF ALL TRADES.

[72752.]—**Photo-Printing Frame Pressure Springs.**—Surely you don't open both sides at once when you examine prints, as your query implies? The cure for slipping is to get a stronger spring; or, in the case of the cheap frames, bend the spring yourself, and increase the pressure.

Plymouth. B.Sc.

[72752.]—**Photo-Printing Frame Pressure Springs.** — What will prevent printing-frame slipping when opening to examine print? Holding fast the right hand by pressing fingers (not thumb) against lower half of back with front of frame resting against the body (chest), and using left hand to open upper half of back. A strong spring is an advantage, but not a remedy. F. G. WILLATT.

[72752.]—**Photo-Printing Frame Pressure Springs.**—If "Photo-Printer" releases only one spring at a time, and examines the half of the print beneath the flap below it, there will be no slipping of the back. Surely he does not loosen both springs at once; if he does, he must lose all control over the print, assuming that he is using the ordinary printing frame. G. G. B.

[72754.]—**Dipping Needle.**—In the January, February, and March numbers of *Good Words* you will find a very interesting paper by Prof. Rücker, entitled "Underground Mountains," which contains an account of the recent magnetic survey undertaken by him, in conjunction with Dr. Thorpe. Full particulars are given of the variations in the declination and inclination of the needle in various parts of the country, including the districts mentioned in your query. At the last meeting of the British Association the Professor read a paper upon the same subject, a report of which appeared in the "E. M." a few weeks ago.

H. BROCKLEHURST.

[72757.]—**Isothermal Lines.**—Vide pp. 137—140 Thornton's "Physiography" (Longmans), p. 879 Ganot's "Physics" (Longmans), p. 494 Deschanel's "Heat" (Longmans). If the temperature of a place merely varied with the latitude, the isotherms would be parallel to the equator; but local causes, height in particular, intervene. Inquirers may consult Huxley's "Physiography," or any decent textbook on physical geography or heat.

W. J. GREENSTREET.

[72757.] —**Isothermal Lines.**—Temperature does not depend altogether upon latitude, but is modified by various causes, such as the direction of the atmospheric and marine currents, the elevation above sea-level, the arrangement of mountain chains, the outline of the coasts, their relation to the neighbouring seas, the nature of the soil and vegetation. The thermal equator—i.e., the curve of the greatest average heat on each side of which the temperature gradually diminishes towards the poles, lies almost entirely in the N. hemisphere, which is warmer than the southern. It traverses America near Panama, then runs along the coasts of Columbia, Venezuela and Guiana, to the embouchure of the Amazons, and there bends slightly to the S. of the Equator. Over the Atlantic it ascends obliquely towards the African continent and the Sahara, the hottest region of the whole world. The precise direction of the thermal equator is not known either here or in the Arabian desert, or over the coast of the Indian peninsula. In the sea of Sunda it bends again to the S. Over various points of this line, the temperature is far from being the same everywhere. Above the ocean it is from 77° to 79°. On the coasts of Columbia and Guinea it is 81° on an average; at Calcutta it attains 82·5°, at the mouths of the Niger it is much greater (85·3°), and probably more in the interior of Africa and Arabia. Thus the tracts where this exceptional heat prevails form on the course of the thermal equator a sort of island, the outlines of which wander according to the differences of relief on the surface, and the atmospheric phenomena. The researches of Mahlmann have proved that islands of less heat exist in the Tropical zone, and that the thermal equator sometimes bifurcates and incloses colder regions. The sinuosities of the isothermals properly so-called are caused over all the terrestrial circumference by these isothermal islands of a higher or lower temperature. In the south hemisphere, where the continents are diminished gradually towards the south, and where the moderating influence of the ocean tends to eliminate all climatic differences, the lines of equal annual temperature seem to be pretty regular, and in the Antarctic Ocean they may be considered parallel to the degrees of latitude. The most marked curves of these isothermals of the south are those which are developed immediately to the West of Africa and South America under the influence of the currents of cold water which flow towards the Equator along the coasts of these two continents. In the north the sinuosities of the isothermal lines are much more marked than those in the south hemisphere, and cut the degrees of latitude at all angles. Considered in a general manner, the isothermal lines of the N. hemisphere have the form of a double wave, the crests of which rise above the W. shores of Europe, and towards those of California, while the depressions coincide with the E. coasts of the the Old and New World. The highest isothermal wave is that which rises off the coast of New England, Newfoundland, and Ireland, the culminating point of which is found to the N. of the British Isles. One would say that it was traced over the Gulf Stream, and, in fact, it is this current of warm water which drives the whole system of isotherms towards the N. The line of 59° F. which passes over the coast of North Carolina near Cape Hatteras, cuts the South of France from Bayonne to Montpelier at 9° lat. further to the N. Between New York and Dublin, where the mean temp. is the same (50°), the difference in lat. is 13°. It is 16°, or nearly 1,100 miles, between Quebec and Trondhjem, where the isotherm of 39·2° passes; and the difference is still greater for the line of 32°. Whatever may be the sinuosities of the lines of equal temperature, they all indicate a more or less rapid decrease of heat between the equator and the two polar zones. In the North Hemisphere it has been possible to trace approximately the various isotherms as far as that which gives an average temp. of 5°; but, beyond this, observations have been too rare for it to be possible to mark lines, the course of which is not entirely hypothetical. The general direction, however, of the curves renders it very probable that in the Polar circle there exist at least two isothermal islands of cold, corresponding to the two isothermal islands of heat which are found in the neighbourhood of the Equator. The researches of Mühry have rendered it very probable that in the Antarctic hemisphere there also exist two poles of cold. The total difference observed on various points of the earth between the highest and lowest extremes of temperature much exceeds 300°. Even on one point of the earth the highest and lowest temperatures in the course of the year often present the enormous difference of more than 144°. In the vast frozen plains of North America, where Bach had to endure the severe cold of 70° below zero, Franklin experienced during the summer a torrid heat of 87°. Not far from the Equator the so-called "burning" regions of the Sahara present, according to Duveyrier, a thermometrical difference almost as considerable as that of the polar countries of New England. This is because in spite of the difference of latitude, the deserts of Africa and the granitic plains of North America resemble each other by their continental position, and the relative uniformity of their relief. Remote from the ocean, that great equaliser of climate, and destitute of high mountain chains, which could arrest the cold or warmer winds blowing from different points of the horizon, these countries must be subject to very abrupt changes of temperature. Through this greater or less change in the height of the thermometer in various countries of the world, it results that the lines of equal temperature for each season, and more still for each month, are much more sinuous than the isothermals of the year. The name of *isochimenal* is given to those which unite all the localities where the winter temperature oscillates to about the same extent, the *isotheral* lines being ditto for the summer. We can also cover the map with *isocral* lines for spring, *isometoporal* for autumn, and *isomenal* lines for each month in the year, but life is too short for such a vast labour. The direction followed by the isotheral and isochimenal lines in Europe and North America is a singularly striking example of the influence which the unequal distribution of land and sea exercises on climate. In summer, when the N. hemisphere is inclined towards the sun, and receives the greatest quantity of heat, the countries situated in the interior of the continent of the N. are much more heated than those bordering on the sea. During the cold season the contrary takes place, the winds and the currents coming from the Equatorial zone temper the severity of the cold in the neighbourhood of the coasts, while far into the continents the tempering influence of the ocean and the aërial currents of the S. make themselves much less felt. Consequently the isotheral lines curve towards the N. in the two Northern masses of the old and new world, and bend to the S. in traversing the Atlantic and Pacific. On the other hand, the isochimenal lines bend to the S. in their passage across the continents of America, Europe, and Asia, and curve in certain places by more than 600 miles to the N. in crossing the sea. You are probably now in a position to understand why plants are not uniform along the isothermals, which show only the *mean* annual temperature. SM.

[72758.]—**Electric Light.**—You are evidently short-circuited. Your armature should have been bolted, to keep the wire in its place. When getting warm it will expand—therefore sag; this sag is thrown out by the velocity of the armature, and if the wire is good and soft, will stretch and come in contact with the fields, and kibe; the consequence is it fires: there is no remedy for it but rewinding.

JACK OF ALL TRADES.

[72758.]—**Electric Light.**—If the machine sparks at the commutator when only one brush is on, and the switch is off, there must be a short-circuit somewhere. As you say the armature was freshly wound, it is not probable, though perfectly possible, that the leakage was there; but there may have been a body contact, or even a "ground." If, as you say, the armature wires appear to be distorted, it points to the fact that they were not properly bound round, and the field-magnets have actually pulled them out of their places.

S. BOTTONE.

[72758.]—**Electric Light.**—Apparently one or more coils of the armature have fused. If the ve shifted as you say, the armature cannot n properly rewound. F. C. ALLSOP.

.]—**Microscope.**—The selenite plate R. vhen used on the stage in conjunction with and analyser, will give a red or green field g to position of prisms. Depolarising now show most brilliant colours. The is very useful in examining films. What equal" plate is, I do not know. Examine lf by polarised light. SM.

.] — **Microscope : Selenites.** — The marked R. and G. gives red and green ions when the analyser is turned through quadrants of a circle. The colourations on the thickness of the film of selenite, her red at one quadrant and green at the blue at one quadrant and orange at the f the films, instead of being of equal thick- ughout, are unequally split, then you will rent colours (with their complementaries) ent parts of the films. Hence your slide "selenite, unequal," is one of them.

S. BOTTONE.

.]—**Polariscope.**—The polarising and g prisms in a polariscope, are no doubt risms. They are no use whatever for a spectroscope, and the querist must ery little of optics or he would not have e question.

WM. JOHN GREY, F.C.S.,
stle-on-Tyne. Analytical Chemist.

.]—**Polariscope.**—No; the polarising lysing prisms of the above are Nicoll's of Iceland spar, and utterly useless for a spectroscope. But spectroscopes are not : examining sugar solutions, while polari- re. In Biot's polariscope one prism is t the lower extremity and the other at the nd of a long tube, having a gap in the n which the bodies to be examined by l light can be inserted. S. BOTTONE.

.] — **Self - Polishing Blacking.** — 1? Yes; rather, I guess; and the why it o do it I cannot see. Buy a bottle of uncork, take the sponge and paint a piece with it, and put your nose to that and the nd try your finger-nail upon it, and some ith water, and see what it is like, and then ht to do it. JACK OF ALL TRADES.

.]—**Self-Polishing Blacking.**—Mix to- wo pints of the best vinegar and one pint water; stir into it ¼lb. of glue (broken up), wood chips, ¼oz. of the best soft soap, ¼oz. ass. Put this mixture into a saucepan over ; let it boil gently for 10 or 20 minutes; e liquid does not get thick; then strain the nd bottle and cork tight—this is very im- or it will be useless. When cold it will be r use. Apply with a sponge attached to a wire. Always keep the wire fixed to the h sponge inside, and after use well cork up.

D. M. LODGE.

.]—**Xanthus.**—"F. J. C." has made a in his equations. Let $a$ be the rate the man the velocity of the stream; then $\frac{a+b}{a-b}$ d $a + b + \frac{1}{2} = 2\,(a - b - \frac{1}{2})$. From these s $a = b$; $b = 1\frac{1}{2}$. ASSOC.N.S.S.

.]—**Xanthus.**—I am under the impression . J. C." has fallen into an error which is quent among beginners. His mistake is in the man rows five miles per hour with the and three miles per hour against stream, we are only told he traverses these distances times.

t $a$ (miles per hour) = rate on still water,
d $b$ (miles per hour) = rate of stream.

$\frac{5}{+ b}$ = time taken to row 5ml. with stream

$\frac{3}{- b}$ = time taken to row 3ml. against stream;

$$\therefore \frac{5}{a+b} = \frac{3}{a-b}, \text{ hence } a = 4b.$$

increased rate of stream per hour $= b + \frac{1}{2}$
te of rowing with stream $= a + b + \frac{1}{2}$
te of rowing against stream $= a - b - \frac{1}{2}$
$+ b + \frac{1}{2} = 2\,[a - b - \frac{1}{2}]\ 2a - 6b = 3$
sub. $a = 4b$, then $2b = 3$, $b = \frac{3}{2}$,

= 6—i.e., rate of rowing per hour on still If "F. J. C." cares to try the problem he these answers will meet its demands. How ins 4½ miles per hour as the rate on still am at a loss to conceive. J. J. C.

.] — **Xanthus.** — This question is an cal one, and ought not to have been in- n an examination paper on arithmetic. The vhy "F. J. C." has failed to obtain a solu- because he has not properly stated the equations. He has put them down as if tion said that the man can row five miles with the current, and three miles an hour it; whereas the velocities are not given, but merely their ratios. $(a + b)$ is to $(a - b)$ as 5 to 3. The other equation should be $(a + b + \frac{1}{2} = 2\,(a - b - \frac{1}{2})$; and from these data it is easy to find that the man can row six miles an hour in still water, that the velocity of the current is 1½ mile an hour, that the man can row 7½ miles an hour with the stream, and 4½ miles an hour against it; whereas if the current had a velocity of two miles an hour, he could row eight miles an hour with the stream and four miles an hour against it.

S. S. S.

[72762.]—**Xanthus.**—(1) The ratio of the rate rowed with the current to that rowed against the current becomes changed by the increased rate from $\frac{5}{3}$ to 2, or a difference of $\frac{1}{3}$. Thus $\frac{1}{3}$ mile represents the distance the water would run with an increased rate of ½ mile per hour in the time taken by the man to row five miles before the current was increased. The rate of rowing, therefore, in the first case $= \frac{\frac{1}{2}}{\frac{1}{3}} \times 5 = 7\frac{1}{2}$ miles per hour with the current. The rate against the current $= \frac{7\frac{1}{2} \times 3}{5} = 4\frac{1}{2}$ miles, and $\frac{7\frac{1}{2} + 4\frac{1}{2}}{2} = 6$ miles per hour the man rows in still water. (2) Let

$$\frac{x}{3} = \text{rate with current.}$$

$$\text{Then} \quad \frac{x}{5} = \text{,, against ,,}$$

$$\frac{x}{3} + \tfrac{1}{2} = 2\left(\frac{x}{5} + \tfrac{1}{2}\right)$$

$$\frac{2x+3}{6} = \frac{2x-5}{5}.$$

$$10x + 15 = 12x - 30, \text{ or } 2x = 45. \quad x = 22\tfrac{1}{2}.$$

$$\text{Rate with current} = \frac{22\frac{1}{2}}{3} = 7\tfrac{1}{2} \text{ miles per hour.}$$

$$\text{,, against ,,} \quad = \frac{22\frac{1}{2}}{5} = 4\tfrac{1}{2} \text{ ,, ,, ,,}$$

$$\text{Rate rowed in still water.} \quad 2\overline{)12} \atop 6 \text{ ,, ,, ,,}$$

W. C. JOCELYN.

[72762.]—**Xanthus.**—"F. J. C.'s" error is in assuming that the man rows with the current five miles an hour, and against it three miles. The question merely states that two speeds bear that ratio one to the other.

Algebraically: Let $a$ = number of miles per hour the man can row.
$b$ = do. do. speed of current.

(With the current): $a + b + \frac{1}{2} = 2\,(a - b - \frac{1}{2})$ (against the current.)
$\therefore a = 3b + \frac{3}{2}$

By ex-hypoth.: $a + b : a - b :: 5 : 3$
$\therefore 3\,(a + b) = 5\,(a - b)$
$a = 4b$

Whence— $3b + \frac{3}{2} = 4b$
$\therefore b = \frac{3}{2}$; i.e., the current is 1½ miles per hour, and $a = 4b$ ∴ speed of rowing is six miles per hour. Arithmetically: Speed with current : Speed against current :: 5 : 3, or, rowing + current : rowing − current :: 5 : 3; in other words, it is required to find two quantities—the sum and the difference, of which are in the ratio 5 : 3. The two quantities are obviously 4 and 1; i.e., speed of rowing : speed of current :: 4 : 1. Again: With the original current, speed of rowing with current : rowing against current :: 5 : 3. But with current accelerated half a mile per hour, speed of rowing with current : rowing against current :: 2 : 1. Required, therefore, to find what must be added to 5 and subtracted from 3, to change ratio 5 : 3 into 2 : 1. 5 + required number : 3 − required number :: 2 : 1. ∴ 5 + required number = 2 (3 − required number). 5 + required number = 6 − 2 required number. ∴ 3 times required number = 1. Required number = ⅓. With accelerated current the ratio, therefore, is 5⅓ : 2⅔, as compared with 5 : 3, the difference (⅓) representing an increase of speed of half a mile an hour. Hence $\frac{16}{3} : \frac{8}{3}$ (i.e., 2 : 1), ⅓ being = half-mile.

∴ whole speed $= 16 \times \frac{1}{2} = 8$ miles per hour.
∴ whole speed before acceleration of current $= 7\frac{1}{2}$ miles.

But it has been proved that—
Speed of rowing : speed of current :: 4 : 1.

Hence: speed of rowing + current : current :: 5 : 1.
i.e., 7½ miles per hour : current :: 5 : 1.
∴ Current $= 7\frac{1}{2} \div 5 = 1\frac{1}{2}$ miles per hour.

And speed of rowing $= 1\frac{1}{2} \times 4 = 6$ miles per hour.

Too bad to set this for boys! W. MODLEN.

[72763.] — **Bible.** — According to "Cruden's Complete Concordance," the word "girl" occurs in Joel iii. 3, and in Zechariah viii. 5. G. G. B.

[72763.]—**Bible.**—The word "girl" occurs but twice in the Bible—once in the singular and once in the plural. It does not occur at all, I believe, in the New Testament. "G. A. B." will find it mentioned in the singular in Joel iii. 3, and in the plural in Zechariah viii. 5. AUTOLYCUS.

[72764.]—**Telephone.**—The best and cheapest telephone you can at present use is one of the "E.M." type. Use guttapercha-covered wire, No. 18 B.W.G., taped and tarred between the two places. This can be buried in the ground, and will not show at all. F. C. ALLSOP.

[72765.]—**Insomnia.**—Get "Sleep and Sleeplessness," by J. Mortimer Granville (David Bogue), price 1s. SM.

[72765.]—**Insomnia.**—I have heard that it is a good plan, in order to readily fall asleep, to endeavour to recall a recent dream; this done, consider it attentively; the "dreamy" condition thus produced is preparatory to sleep, which soon follows. I have frequently tried the experiment myself, and with seeming good results; but not being a sufferer from insomnia at all, I cannot say how much real benefit I have derived from the practice. Anyhow, I have no doubt "Insomnia" will not object to try such a simple and possibly natural remedial suggestion. DUBITO.

[72765.]—**Insomnia.**—This is probably caused from excitement of the nerves or brain, and everything should be done to quiet them. On no account use narcotics of any sort; avoid alcoholic drinks of all sorts and tea; one third milk and two-thirds boiling water with sugar makes a very nice and exhilarating substitute, and is soothing taken hot; more milk would not hurt, but all cannot take it. Do not take any meat after dinner in the middle of the day. All these tend to heat the system. If "J. A." likes to write to me, I shall be glad to reply. Be as much in the open air with exercise as possible.

Fordingbridge. T. WESTLAKE.

[72765.]—**Insomnia.**—Do not quack yourself. Insomnia proceeds from so many causes, that what might do good in one case may do great harm in others. Sometimes insomnia depends on indigestion, owing to late or heavy suppers; other times it owes its origin to want of proper exercise in the open air; in other cases, excessive bodily or mental strain may be the cause. In many cases it points to the presence of serious nervous or brain trouble, and it requires intelligent and discriminating attention on the part of a medical man to decide which cause is at work. I knew a very clever man who overwrought his brain and took to quacking himself with some highly-vaunted phosphorus brain-medicine, with the result that he became a drivelling idiot. Beware of self-quacking; go to a respectable medical man, and you will probably soon get relief.

S. BOTTONE.

[72765.]—**Insomnia.**—The treatment is entirely dependent on your age and constitution. When I was a young student of Oriental languages, in spite of much outdoor exercise, I suffered miserably from this complaint. A homœopathic friend advised strong black coffee or green tea at bedtime. This proved effectual in my case. In later life I have found all the following modes of treatment adapted to most persons:—(1) Sponging the body, from head to foot, at night with very hot water; (2) taking a glass of the best Scotch whisky, diluted with cold water—one wineglassful to the half-pint; (3) green bitter lettuces for supper, highly commended by the celebrated Greek physician Galen, and under the form *Lactucarium* long used in the British Pharmacopœia—I can vouch for its efficiency in producing sleep; (4) celery (if you have a good digestion)—old drunkards, on the verge of *delirium tremens*, declared it infallible—I always become drowsy after eating it; (5) leaving your bed, walk about briskly, and drink a half-pint of very cold water; (6) avoid all dangerous sleep-producing drugs; (7) the dry application of ice to the head. EOS.

[72765.]—**Insomnia.**—"J. A." should take 10 to 20 drops of spirit of sal-volatile (he can buy a pennyworth at chemist's) in half a wineglassful of water before he undresses himself on going to bed, and he will find this quiet him. I have now used it on an average three times a week for about a year, and find it perfect. First used it to prevent "starting" as I fell asleep, which I believed to be result of heart-disease; found it effectual, and secured a good night's rest. Am an amateur mechanic; but found result of working three or four hours every evening to be three or four hours' subsequent sleeplessness, terminating in violent fits of suicidal rage, so resorted to sal-volatile with admirable effect. Can now work with impunity, for a twenty-drop dose will always quiet me. I am compelled to forego the severe mental strain of a good game of chess; but find above sufficient for flying machine, propellers, and minor organisms on the brain. May I tell "J. A." to strictly observe (although I do not) the usual injunctions of the doctors as to diet, &c., because for sleeplessness from indigestion simply the above remedy is useless? Carbonate of soda is more useful then (about a third of teaspoonful), as it is for neuralgia and toothache, which, nine times out of ten, are the result of a disordered stomach. EMPIRIC.

[72768.]—**Cement for Sealing Dry Battery.**—Nothing better than pitch mixed with a little beeswax. S. BOTTONE.

[72768.]—**Cement for Sealing Dry Battery.**—I think you have made a mistake when you say that the salt comes through the paraffin wax. You must see that your carbons are well sealed: if you can insure that, the rest is not very difficult.

Jack of All Trades.

[72769.]—**Lighting Gas by Electricity.**—You can easily light the burners from your house by simply pressing a push, or, for the matter of that, by a slight addition to the clock it can be made to light and extinguish the gas with absolute certainty at the required time. To do this you require an electric gas-igniting burner, coil, battery, and a push with wires from your house to the clock. I should advise the clock being made to light and extinguish the gas, as this would be the cheapest, since it would save the wire between house and clock. It would, moreover, insure the gas being lighted and extinguished at the proper time. If "Horology" is near here, I shall be pleased to show him these burners in action, and furnish any further information I can.

F. C. Allsop.

165, Queen Victoria-street, E.C.

[72770.]—**Electric Spark Gas Lighter.**—You would require at least three cells for this purpose, and in addition a primary induction coil and special gas-burner. The No. 2 agglomerate Leclanché cells are the best batteries for this purpose. See my reply to a similar query. F. C. Allsop.

[72772.]—**Consumption of Zincs in Battery.**—The rate of consumption of zinc depends entirely upon the amount of work put upon the battery—that is to say, the number of ampères it is made to deliver in a given time. Neglecting the waste from leakage or local action, which in a well-made Daniell cell should be but slight, every ampère of current given by a Daniell cell (irrespective of size) means a consumption of 18·84gr. of zinc per hour.

S. Bottone.

[72773.]—**Watch-Jobbing.**—In repairing verge work, the usual plan for a top or bottom hole is to fit a plug, having the hole for the pivot drilled a little out of centre. Having found that the balance runs true, place it in position, holding the cock lightly in its place, and by turning the plug round, it being an eccentric, you can generally place the balance upright at the first trial. The plug can then be cut off and riveted, if required, though I generally screw mine in, and the hole finished to the right depth, and its bottom squared. The balance being square with the plate and the escape (balance what it should be) parallel with it, the required adjustment is obtained by moving the dovetail slip in the potance. Horo.

[72774.]—**Electrical Conductivity.**—The conductivity of copper is ascertained by determining its resistance compared with that of silver, which = 100 per cent. conductivity. Sm.

[72774.]—**Electrical Conductivity of Copper Wire.**—In Ayrton's "Practical Electricity," 4th edition. p. 155, you will find the information you require, and on p. 147 a description of the apparatus employed. H. B.

[72774.]—**Electrical Conductivity of Copper Wire.**—In order to measure the conductivity of wires, it is usual to employ either a Wheatstone's bridge, in connection with a set of known resistances, which is precisely similar to the method of comparing weights by means of a pair of scales and weights, or a differential galvanometer. If you refer to Chapter IV. of Ayrton's "Practical Electricity," you will find the various methods fully detailed and explained. S. Bottone.

[72776.]—**Metal Wanted.**—Yes, and will have to be wanted I guess, unless you like to go in for platinum. Jack of All Trades.

[72776.]—**Metal Wanted.**—I am afraid you will have to want. The only things in practical use for concentrating sulphuric acid are glass and platinum. This latter does perfectly, but it is very expensive; there is, however, this advantage: that its value as scrap, when its has served its purpose, is just about the same as it was before. S. Bottone.

[72778.]—**Cancer.**—Extirpation by the knife will prolong existence, but a radical cure is undiscovered. Eos.

[72778.]—**Cancer.**—The term cancer is too indefinite to give a reply of any use; but if it is malignant cancer that is meant, there is no known remedy. There are several well-defined varieties or forms of carcinoma, and remedies applied in time may stave off the inevitable; but there is no "cure" for real cancer. Nun. Dor.

[72778.]—**Cancer.**—I do not believe there is any "cure" for cancer; but I know that an exclusive and judicious vegetarian diet and strict abstinence from alcohol will abate the worst symptoms and lengthen the life of the patient. I believe the wife of Dr. Nicholls, the well-known vegetarian, prolonged her life into the sixties or seventies, though inheriting cancer, and at last succumbing to it; and I was told not long since by Dr. Allinson, the Medical Editor of the *Weekly Times and Echo*, of cases in his practice which had surprised him, in which the destructive effects of the disease had been arrested by a brown bread and fruit diet. They would of course end fatally, Dr. Allinson said; but it was certain that comparative ease and a considerable extension of life were being secured. T.

[72778.]—**Cancer.**—There is no cure; but, as drowning people catch at straws, try Count Mattei's Cancer cure—his address is Rochetta, Bologna, Italy. Lady Paget gave a favourable account of his cures in the *National Review* for August. Dr. Kennedy, 22, George-street, Hanover-square, London, sells the medicines, and may be consulted on the subject.

Plymouth. B.Sc.

[72780.]—**Compound Dynamo.**—A properly compounded dynamo should work well between the two extreme loads. If yours does not do so, you can make shift by rigging up a resistance switch-board with movable finger, by which the resistance in circuit can be increased as the number of lamps is decreased. Or you might, as a very rough-and-ready expedient, rig up a rather long earthenware trough, with a lead plate in connection with one terminal at one end, and a movable lead plate in connection with the main circuit at the other. The trough being filled with water, the resistance can be increased at will by moving the movable lead plate farther from the fixed one, or drawing it partially out of the liquid. By having this latter attached to the shorter arm of a pivoted lever, the long end of which passes over a rough scale, it is possible, after a few trials, to regulate the output pretty exactly in proportion to the load of lamps in circuit. S. Bottone.

[72781.]—**Pneumatic.**—A fan of the right kind will do the work. Have you tried a Sturtevant fan? Sm.

[72782.]—**Arc Lamps.**—I should fancy the machine does not give sufficient E.M.F. to run the lamps. This would cause the lamps to behave as you mention. Perhaps the lamps are not properly adjusted. F. C. Allsop.

[72782.]—**Arc Lamps.**—From the fact that each lamp seems to run well by itself, and that the four do not run well in series, it is pretty evident that one of two causes is at work—(1) the lamps are not adapted to running in series, or (2) the E.M.F. of the dynamo is not sufficient to overcome the "back" E.M.F. set up in the arc lamps.

S. Bottone.

[72784.]—**Problem.**—This is a very important problem, as it is introductory to the celebrated "Kepler's problem," from which we can calculate the "equation of time" and other important matters. The whole will be found worked out in Tait and Steele's "Dynamics of a Particle," p. 138, fifth edition. In the query, however, the symbols have got a little mixed. The symbol *a* denotes the length of the semi-axis major of the ellipse, but sin. *a* and cos. *a* appear in two expressions which have no meaning if *a* represents the straight line; here, probably, the Greek Alpha was intended, but it will be better to use the symbol *u*, as Prof. Tait has done instead of alpha, which is so like our English *a*. Again the last expression is given in very clumsy form. If we divide num. and denom. by $\sqrt{1-e^2}$, we get

$$\sin. u = \sqrt{1-e^2}\,\frac{\sin.\theta}{1 + e\cos.\theta}$$

which agrees with Prof. Tait's result. I shall be happy to copy out the process from Tait's book, but it would probably not be of very general interest. The symbol *u* stands for the "eccentric angle," or the "eccentric anomaly" as Prof. Tait calls it.

Bath. M. I. C. E.

[72785.]—**Chinese Solder.**—Has "Experiment" seen any solder which could be melted by heating the "soldering tool" in boiling water?

Nun. Dor.

[72785.]—**Chinese Solder.**—By using more or less bismuth in the composition of your solder, you can render it as fusible as you can wish. Toy spoons made of this alloy used to be sold. On dipping them in any hot beverage they rapidly disappeared between the fingers. Eos.

[72787.]—**Magnet.**—Wind your H-shaped magnet with insulated wire round the central line of the H; pass a large current round it for a few seconds, breaking and making contact several times. You will find that the two uprights will be respectively N. and S. S. Bottone.

[72789.]—**Diamonds.**—Diamonds have been made artificially from a hydrocarbon by Mr. J. B. Hannay. It was not a commercial success.

Sm.

[72789.]—**Diamond.**—When charcoal was exposed by Sir H. Davy to intense ignition *in vacuo*, and in condensed azote, by means of very large and powerful voltaic battery, it slowly volatilised and gave out a little hydrogen. The remaining part was always much harder than before, and in one case so hard as to scratch glass, while its lustre was increased. This experiment may be regarded as a near approach to the production of diamond. As it required a battery of such immense power (640sq.ft. of surface), I think "Diamonds" will agree it was not a pecuniary success. It is supposed to consist of pure carbon, and Sir H. Davy demonstrated by his experiments that diamond affords no other substance by its combustion than pure carbonic-acid gas, and that the process is merely a solution of diamond in oxygen, without any change in the volume of gas. M. G. Einner.

[72789.]—**Diamonds.**—Very little, indeed we may say nothing, is known as to the manner in which diamonds have been produced naturally. They always occur in alluvial deposits in the vicinity of a certain kind of rock called itacolumite. This rock was first observed in the Brazils, and possesses the curious property of being very flexible when in thin plates. It is only of late years that diamonds have been found in the matrix, and Jeremejew has recently observed microscopic diamonds in a rock occurring in the Southern Ural. The main difficulty in producing diamonds artificially seems to lie in the fact that neither of the two ordinary methods by which a substance can be crystallised are available in the case of carbon. The element will not dissolve in anything, so that it cannot be crystallised from a solution like saltpetre, salt, sugar, &c. It will not melt at any given temperature, and hence the method of fusion which is applicable to many substances cannot be used. There is, however, no reason in the nature of things why diamonds should not be made artificially, and it is very probable that their artificial production will some day be accomplished. Indeed, this seems to have been done already, but on a very small scale, and it was not a pecuniary success on account of the exceeding minuteness of the crystals. Whether a development of that process would lead to better results can only be settled by experiment, and it is a research that would be very interesting and might be very profitable. I mean to take it up some day, and meanwhile would be glad to receive communications from readers interested in the subject. Wm. John Grey, F.C.S.,

Analytical Chemist.

Newcastle-on-Tyne.

[72789.]—**Diamonds.**—Mr. J. B. Hannay, of Glasgow, succeeded in making true diamonds by reducing paraffin and lithium at an enormous temperature and pressure in the presence of bone-oil distillate. The process was simply heating the materials in a reverberatory furnace, inclosed in a closed wrought-iron tube. As may well be imagined, the process was a fearfully dangerous one, and more than 90 per cent. of the tubes exploded. The net result was a few minute fragments of diamond, of little or no real commercial value. I should greatly like to hear of the repetition of the experiment with tubes made by the Mannesmann rolling process, a sketch of which has lately appeared in the "E. M." (vide letter 31747, p. 208). It would be well worth trying. There are numberless theories as to the natural formation of the diamond. "Nemo" must take his choice of them. Nobody really knows anything definite about it. Mr. Hannay's experiment seems to show that it might have been formed of gaseous hydrocarbons; Newton thought it a vegetable product. It is scarcely worth while to record all the guesses that have been made on the subject—for at best they are but guesses. If we knew of a solvent for carbon—which we do not—we might crystallise it in the form of diamond; but it might just as probably come out as graphite. The real difficulty in our way, in attempting to form any precious stone artificially, is that we must crowd the work over which Madame How took centuries into the space of a few hours. And we cannot expect to be often successful. Diamond dust we may make, perhaps, by many means; but a Koh-i-noor diamond I do not believe that we ever shall. It is a remarkable fact (perhaps only a curious coincidence, but this I doubt) that diamonds and gold seem always to be in company. Where the queen of gems is, there is the king of metals. Possibly the latter helped to make the former. Who can say?

T. Preston Battersby.

[72790.]—**Electrolysis of Water.**—The passage of one coulomb of electricity through water decomposes ·0000945gr., therefore it would take $\frac{7000 \times 10}{15{\cdot}432 \times {\cdot}000945} = 48{,}000{,}000$ coulombs to decompose a gallon. Wm. John Grey, F.C.S.,

Analytical Chemist.

Newcastle-on-Tyne.

[72791.]—**Telephonic.**—You could make two Bell receivers to speak over this distance. See Article I. of "Telephones: their Construction and Fitting." The Bell patent does not expire till December of this year; but you will find that the E.M. or membrane receiver will answer your purpose just as well. I have never heard of a Bell transmitter. The transmitter generally used in conjunction with the Bell receiver is the Blake, of which a description will be found in the articles mentioned above. F. C. Allsop.

[72792.]—**Quinine.**—"Arvol's" case is rare, but not unique, as he will find descriptions of similar idiosyncrasies in the *British Medical Journal* i. 1869, and in the *Berlin Klin. Wochenblatt*, 1887, p. 294. If he requires to take quinine I would recommend him to try it in another form than the sulphate—viz., the valerianate or the salicylate—possibly either of them would not produce the same curious effect.
Plymouth. B.Sc.

[72793.]—**Coils.**—To Mr. Bottone.—You will be able to fire cartridges or gunpowder with your coil if you attach two rather fine wires to the terminals and bring the fine ends of the wires opposite each other to the spark-striking distance. To puncture card or paper, use rather stouter wires, and bring the point of one wire to face the side of the other. Place the card midway between the two. The holes in this case are always very minute, and can only be seen if the card or paper be held between the eye and the light. If the crackling sound is heard in the spark, it is all-right; but, if heard from the body of the coil, it is the sign of a breakdown. S. Bottone.

[72794.]—**The Invention of the Block System.**—As soon as Mr. William Fothergill Cooke invented and introduced the electric telegraph, he and his coadjutor, Wheatstone, saw its value for controlling railway trains, and as early as December, 1839, the Great-Western Company telegraphed the arrival and departure of trains from station to station between Paddington, West Drayton, and Hanwell, and if a second train approached any telegraph station before the previous one was telegraphed as "arrived," it was stopped by signals. To all intents and purposes, this was the object and spirit of what we now call the block system. In 1841 Mr. Cooke introduced separate instruments, to be used only for train signals, and in which the needle was held over to the words "stop" or "go on." He also had an electric bell, to call attention. He further introduced the "obstruction" signal, which was to ring the bell violently in the same manner as the driver uses his whistle in case of danger. This use of the bell implied "danger," stop all trains in any direction. In 1842 Mr. Cooke wrote, and Messrs. Simpkin and Marshall published, an interesting book, "Telegraphic Railways." Having thus stated the facts of the case, it will be well for me to mention that a person named Little is now forwarding to various newspapers a letter, stating that he invented the block system in 1865. He has, it seems, the assistance of two members of Parliament and of a solicitor, and is trying to force the Prime Minister and other Government officers to "compensate him." The Government has very properly declined to do anything of the kind, and I trust it will adhere to the decision, for the person now trying to get money from the Treasury has no more claim to it than has any one of the numerous readers of the English Mechanic.
Clement E. Stretton, C.E.,
40, Saxe-Coburg-street, Leicester, Nov. 3rd.

[72796.]—**Ink.**—A highly-glazed paper will show the marks, if you write with water only. Use a dull surface. Sm.

[72796.]—**Ink.**—Do you not know that the purest water will leave a mark that is perceptible upon paper ever so lightly written?
Jack of All Trades.

[72797.]—**H.P. of High-Pressure Engine.**—Multiply the area of the cylinder by the average steam pressure and number of feet that the piston travels per minute, and divide by 33,000, and the quotient is the horse-power.
Jack of All Trades.

[72799.]—**Telephone.**—See Article I. of "Telephones: their Construction and Fitting," where you will find an illustration of both the Bell and E.M. receivers. The screws outside the case are for connecting terminals evidently, and the screw at the end of the magnet for adjustment. Wind with No. 38 or 40 B.W.G. double silk covered.
F. C. Allsop.
165, Queen Victoria-street, E.C.

[72800.]—**Trisection of an Angle.**—This is done for the Conchoid in Carr's "Synopsis of Mathematics," and in Gregory's "Examples of the Differential and Integral Calculi." Try also Peacock's "Examples," and De Morgan's "Differential and Integral"; or consult articles on "Limaçon," "Trisectrix" (not "Trisactric") in "Encyclopedia Brittanica." "Esne Caralita" may be interested in other modes of trisection; vide Taylor's "Modern Geometry of Conics," pp. 141, 189, 299, 377. "E. C." may understand it after this exercise. Let AOB be the angle to be trisected. Take a line, AC, perpendicular to AB; draw OP so that PM = LOA ($b = 2a$); bisect PM in L; then PL = AL = LM; and LM = LA = AO. $\therefore \angle ALO = \angle AOM$; but $\angle ALO = \angle APL + \angle PAL = 2\angle APL = 2\angle POB$.
W. J. Greenstreet.

[72801.]—**Water Motor.**—Your wheel is too large. You must know that these depend upon speed for an output, the same as a dynamo or motor-electric. Jack of All Trades.

[72801.]—**Water Motor.**—If you can get a pressure of 90lb. to the inch, you ought to be able to develop 1H.P., and this would be sufficient to light five or six lamps of 16c.p. Of course, if you can get water at this pressure free of cost, it will be cheaper than paraffin at 9d. per gallon.
S. Bottone.

[72801.]—**Water Motor.**—Since "Rural" gets his water for nothing, it quite alters the case, and I should certainly advise him to use a water motor to drive his dynamo. A small turbine would be best, and drive direct. I could not say positively whether you would be able to compete successfully with paraffin at 9d. a gallon; but the expenses of maintenance of your installation could almost be comprised in a small sum for oil and attendance.
F. C. Allsop.

[72801.]—**Water Motor.**—"Rural" can have plenty of power for his requirements; but the motor he proposes is far too large; an 8in. motor with 6in. pulley will be ample—larger will not do as well. He should have 1in. supply pipe from the main, a full aperture, valve, and jet tapered to ⅛in., opening at point. A gas-engine would not be as effective, would cost far more in the first instance; there would be in addition the consumption of gas; a very small dynamo will be required, and motor I give will probably give twice the power required. I have been getting 1½H.P. for the electric light for the past five years from a Thirlmere, but maker's advice I found no use, and had to experiment for six months myself before I got matters right; I had also to put in better bearings. As my light is most effective and a thorough success, will be glad to give an account of it if required. Whoroo.

[72804.]—**Repousse Work.**—There has been a small work advertised in the "E.M." respecting this; but the publisher I know not. It is backed up with pitch, and set down with blunt punches.
Jack of All Trades.

[72806.]—**Inhalation.**—Your question is far too general. It would require a small volume to give "information on the cure of lung disease by inhalation." What lung disease do you want to know about? Personally, I derive great benefit from the inhalation of carbolic acid and of turpentine.
Plymouth. B.Sc.

[72808.]—**Incandescent Lamp in Magic Lantern.**—You can use an incandescent lamp for this purpose, and will get very good results. The Edison and Swan Co. make a special lamp for this purpose. If you use an ordinary incandescent lamp, see that the lamp is turned so that the filament is end-on to the mirror. F. C. Allsop.

[72808.]—**Incandescent Lamp in Magic-Lantern.**—Incandescent lamps, at the best of times, are not well adapted for magic-lantern work. Messrs. Swan made some 200c.p., but the game was not worth the electric light. As to the light given by a 25c.p. lamp, why, it would not illuminate well a 4ft. disc. Remember that an ordinary 1in. wick in a paraffin-lamp gives 40c.p., and that an ordinary three-wicked lamp as usually supplied with optical lanterns, gives at least 120c.p.
S. Bottone.

[72809.]—**Magnetism.**—Watches are very readily affected by being brought close to dynamos at work, and, generally, the better the watch the more easily affected. You can get non-magnetisable watches. F. C. Allsop.

[72809.]—**Magnetism and Watches.**—Yes; unless the watch is protected by being placed in an outer case, it will become magnetised by proximity to a dynamo, when of course it will become erratic in action. See my advertisement in Sale Column, with reference to the demagnetisation of such afflicted watches. S. Bottone.

[72810.]—**Glow Lamp.**—I cannot answer this query satisfactorily, as I have not examined the lamps in question; but I may point out that it is impossible for an accumulator giving only 2 ampère hours to light a 2c.p. Edison lamp for 12 hours, even if it took only 0·25 ampère, since 12 by 0·25 equals three hours. S. Bottone.

[72811.]—**Boiler Query.**—Give us something to work from, diam. of cylinders, length of stroke and cut-off, or the average pressure, and you will find some one to help you. Jack of All Trades.

[72812.]—**Nickel Bath.**—To Mr. Bottone.—Cyanide of nickel dissolved in cyanide of potassium solution works well, but is more expensive than the ordinary ammonia-sulphate of nickel solution. Use a nearly saturated solution of ammonia-sulphate of nickel, which must be kept slightly alkaline by the addition of a little ammonia from time to time. If your bath is only turbid, add ammonia with constant stirring till clear. If otherwise spoiled, filter, and add a solution of common washing soda to the solution as long as a greenish precipitate is produced; filter away the water, and dissolve the precipitate in an excess of sulphuric acid, and then add ammonia until slightly alkaline.
S. Bottone.

[72816.]—**Analysis.**—You cannot do it yourself. It requires a professional analyst. Sm.

[72818.]—**Lantern Screen.**—Good white paper or calico is the best. Tracing-cloth is *too* transparent. Sm.

[72818.]—**Lantern Screen.**—The tracing cloth would do probably for what you want, but remember the more transparent a medium is the more light will pass though it without illuminating it, and this is the reason why such a medium as a good linen sheet is best. Let the sheet be well wetted first. F. G. Willatt.

[72818.]—**Lantern Screen.**—Would a sheet of ground glass, rubbed with mineral oil, answer. I exhibited such a screen before the Royal Society and the R.M.S., and it created considerable interest. The anatomy of the Daphna, or branch-horned water-flea, could be easily observed. The angle of lantern and screen must be carefully adjusted, so that the audience look direct through the centre of disc into the lantern. The great success of this arrangement is, that the surrounding illumination is not interfered with; that is to say, a lecture by the aid of the lantern can be given in a brilliantly lighted room. If "H. A." will communicate, I shall be glad to elucidate further, if necessary.
H. B.

[72819.]—**$KNO_3$.**—A good deal depends on the quantity. You would employ different processes for ounces and tons. Sm.

[72819.]—**Nitrate of Potash.**—A simple plan is reducing the crude nitre to powder and washing it twice with water. This nitre, which is called nitre of the first boiling, contains some common salt, from which it may be purified by solution in a small quantity of water, and subsequent evaporation. For nice purposes the solution and crystallisation of nitre are repeated four times.
M. G. Einner.

[72819.]—**Nitrate of Potash.**—Make a saturated solution of the nitrate of potash, add thereto a saturated solution of nitrate of silver, drop by drop, as long as a cloudy precipitate is produced; filter, evaporate in a clean porcelain dish, until a drop allowed to fall on a window-pane crystallises; then set aside in a cool place to crystallise. Collect the crystals, they will be free from all traces of common salt, NaCl. S. Bottone.

[72819.]—**Nitrate of Potash.**—Absolutely pure nitrate of potash can be obtained by dissolving metallic potassium in distilled water, neutralising with pure nitric acid and repeatedly crystallising. Very pure nitrate can be obtained by simply re-crystallising commercial nitrate—i.e., make a saturated solution of the crystals in hot water and allow to cool whilst stirring. The impurities remain in solution. Assoc.N.S.S.

[72820.]—**Richter's Dream.**—"Stella" will find this in Proctor's "Universe and the Coming Transit," p. 204; or in my "Scenery of the Heavens," p. 277. J. E. Gore.

[72820.]—**Richter's Dream.**—In reply to "Stella" on this subject (which, by the bye, has been once or twice under discussion this year already) the querist is referred to Mitchell's "Orbs of Heaven," edition 1860 (London: Routledge, Warne, and Routledge, Farringdon-street), in which book the dream will be found *in extenso* on p. 195. If "Stella" will advertise his, or her, address in the Address Column, I shall be very pleased to forward a verbatim copy of the dream, the length of which, though not very great, prevents it being inserted in the Replies to Queries. Autolycus.

## UNANSWERED QUERIES.

*The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.*

72208. G.W.R. No. 16 Broad Gauge 7ft. Coupled Loco., p. 20.
72211. Skin Perforations, 20.
72226. Working Time Tables, p. 21.
72236. Locomotive Speed, 21.
72247. Ivory Card Case, 21.
72258. Steam Coil, 21.
72260. Hydrostatic Problem, 21.

72436. Tent Making, p. 110.
72442. Steam Launch, 110.
72455. Bleaching Cotton Goods, 110.
72464. Steam, 110.
72474. Chime Clock, p. 111.
72476. French Book on Moulding, 111.
72477. Spur Gearing, 111.
72481. Multitubular Boiler, 111.
72489. Great Northern Loco. Sheds, 111.
72492. Light Hospital Ambulance Van, 111.
72499. Reduction of Focus of Lens, 111.

# QUERIES.

[72822.]—**Bicycle Power.**—Will some mechanic kindly answer the following query? Two bicycles or tricycles, equal in every respect and carrying riders of equal weight, are ascending an incline. One is pulled by a man in front with a rope, the rider being inactive, the other is driven by the rider. Is the tension on the rope in the one case equal to the tension on the driving chain in the other? I ask the question because it appears easier to pull a tricycle with a man on it up a hill than to drive it up sitting on it.—DOCTOR MED.

[72823.]—**Electric Lighting.**—I read a book on accumulators by Planté, and he states that 20 cells can be charged by the current from two Bunsen cells, if they are coupled for quantity for the charge, and in tension for the discharge. Now, it occurred to me that if a set of these accumulators were made up, electric lighting might be made more successful than by a primary battery. Will Mr. Bottone please tell me if this is practicable, and how long small accumulators charged in this way would light a lamp? Also will accumulators made as described in his book on "Electrical Instruments for Pocket Cells," answer as well as the coiled lead plates, if four plates are used parallel to each other?—F. A.

[72824.]—**Dynamo, Manchester Type, for Incandescent Lighting.**—Would Mr. Bottone or Mr. Allsop oblige me with the size and amount of wire to wind this machine as follows:—The coils are 10½in. long by 10in. wide, 3⅝in. core, 1in. cheeks, each end; the top is 10½in. wide, ⅝in. thick, 2ft. 3½in. long, rounded at each end; base 2ft. 3½in. long in centre, 22in. wide at ends, 6⅜in. thick, 2in. flange; round the base the size of armature must be 8¼in. wide, 8in. long. What armature would be the best (it is to give off 110 volts), and how many ampères to expect, and what H.P. to drive? The castings are of very soft iron. Any information to oblige—AN OLD READER.

[72825.]—**Municipal Engineers' Exam.**—Could any reader of "E. M." kindly give me any information as to the course of study, books, &c., required in preparing for the Association of Municipal Engineers' Exam. to be held in April, 1891?—STUD.INST.C.E.

[72826.]—**New House.**—Will some of "our" readers be kind enough to inform me by what means I can find out if a house is dry enough for occupation, and if I find it is not, what would be the best mode to hasten drying?—IGNORAMUS.

[72827.]—**Bichromate Solutions.**—When ordinary bichromate solution becomes used up, is there any method by which it can be renovated or refreshed, or must it all be thrown away as useless?—SAPPHO.

[72828.]—**Cat with Fits.**—I have a Tom cat, about seven months old, which has fits, but otherwise appears in good condition. He generally has his tongue partly out, and fits always come on when asleep. I had him when about five weeks old, and he had then already been made domesticated. Should be glad if any reader could inform me whether he is likely to outgrow them.—TABBIE TUBBS.

[72829.]—**Bleaching Fish-Oil.**—I see it mentioned in several practical works on oil-refining, the bleaching and deodorising of fish-oils — i.e., by passing steam through, and by chloride of lime. I have tried both of these with varying success, but have great difficulty in separating the water from the oil, with which (especially in the first instance) it forms a perfect paste. Could anyone give me a few hints how to do this, without subjecting the oil to a greater heat than about 120° Fahr.?—OMICRON.

[72830.]—**Electrical.**—The dynamo I use for my electric light is a series machine, and could not be more satisfactory in every way. Wanting to charge accumulators some time since for many uses, and a series-wound machine not being suitable, I bought a Manchester type No. 3 from H. Jones, Lambeth, specially for storing. Now although the series machine gives the correct output in ampères on the ammeter, Jones's machine does not affect the ammeter at all, and I can't tell its output. I may mention I can drive Jones's machine at any speed, as I have ample power.—WHOROO.

[72831.]—**American Organ.**—Can any of your readers give me instructions how to make the bellows, or can I procure any back numbers with the instructions already given? If so, kindly let me know. I should also like to know whether the ordinary harmonium reeds could be used for the American organ.—ORGAN.

[72832.]—**To "Eos."**—Will "Eos" or other experienced reader give me the temperature of the town's water at Bombay in December and the summer months? Also what simple means are, or can be, used to cool such water without using refrigerators which produce cold by artificial means? Also what kind of clothes are most suitable for a mechanic going out for about five months? The title of any book giving useful information to travellers to India will oblige.—SOE.

[72833.]—**Pampas Grass.**—How should Pampas grass be treated when intended for house decoration? I have lately had some cut which was tall and well-grown; but instead of having that loose and fluffy appearance which adds so much to its beauty, the flower is limp and hardly projects beyond the stem.—G. C. C.

[72834.]—**Chromic Acid.**—I purchased some chromic acid for battery purposes at two places, which have a totally different appearance. One is a deep red powder, and the other a beautiful crimson needle crystalline mass. This latter is the dearest, but they did not know of any other kind where I bought it. Can some reader please explain the difference, and if one is as good and used in the same way as the other for charging a battery?—BEWILDERED.

[72835.]—**Cubic Contents.**—Will any reader kindly answer the following question? I have a shaft of 90ft. diameter and 300ft. deep, and I require to know what is the amount of its cubic contents, the sum to be worked out in full.—P. K.

[72836.]—**Self-Exciting Voss Machine.**—Can any of "ours" kindly tell me how the self-exciting Voss machine supplied by Becker and Co., of Maiden-lane, Covent Garden, obtains its initial charge?—A. J. BULL.

[72837.]—**North-Eastern.**—Would some kind reader give cylinder and driving-wheel dimensions of the following engines? Also, if possible, their dates and designers' names:—N.E.R., 1160 (outside cylinder, four-coupled bogie), 779 (four coupled bogie, Worsdell's compound), 1240 (a queer looking four-coupled engine), 1463 (four-coupled, something like G.N.R.), 328 (Worsdell's), 40 four-coupled).—CH. H. O.

[72838.]—**Dynamo.**—Will any reader kindly advise me what size dynamo I could drive from an engine, 2¼ bore, 3½ stroke, at 40lb. pressure? I do not mind what make of dynamo it is to get the most light. Brief sketch, with amount and size of wire, will oblige.—PETRO.

[72839.]—**Cleaning Clock Case.**—Will some reader please say how to clean an old ash clock-case and finish in oil?—SKIP.

[72840.]—**Focussing Concave Lenses.**—Should be obliged if any reader would give me all the numbers of concave lenses as used for spectacles, and the numbers (in inches) of convex lenses that would neutralise them. Should also be glad to know of any book dealing with the subject of the different lenses as used for the eyesight. —H.

[72841.]—**Watch-Jobbing.**—Will any reader kindly inform me how staff is fixed for drilling up to replace new pivot, and if it is always necessary to remove balance?—W. J.

[72842.]—**Ancient Arithmetic.**—Is it known what system of arithmetic was in use by the ancient Greeks about the period when Euclid and Archimedes wrote their celebrated works, and how their computations were performed? About what period was our present system invented and when adopted by the European nations?—A. M.

[72843.]—**Electrical Query.**—Would Mr. Bottone kindly inform me how to make a voltameter also an ammeter, to fix on a small switch-board, and to register respectively 30 volts and 10 ampères? I have Mr. Bottone's excellent little book called "Electrical Instrument-Making for Amateurs," but I should like to make something better than those described. Unfortunately, I have not the use of a lathe. A sketch with measurements would oblige.—VOLTA.

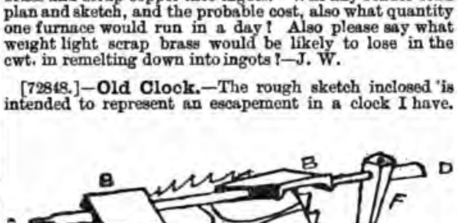
[72844.]—**Voltmeter.**—I wish to make a reliable voltmeter to read from 5 to 10 volts for testing electric-bell batteries, mostly for outdoor purposes and rough usage. —CRYMO BACH.

[72845.]—**L. and N.W.Ry. Co.'s Foot-warmers.** —Will any of "our" numerous readers give me some information upon this subject? I have been told that a chemical is used in the place of hot-water. When they become cool, by shaking them for a few minutes they become hot again, and the same operation can be repeated continually without re-charging. What are the chemicals employed, and all particulars?—THOMPSONION.

[72846.]—**Reversing Electric Motor.**—I should like to know how I could reverse a series-wound single-magnet motor. I have one driving an air propeller which I wish to reverse now and then, so as to draw in fresh air from the street. Also how could I measure it so as to get at its power? It takes 7 ampères to drive it on a 50-volt circuit.—VENTILATION.

[72847.]—**Furnace for Scrap Brass.**—I have been in great need of a plan for a furnace for running scrap brass and scrap copper into ingots. Will any reader send plan and sketch, and the probable cost, also what quantity one furnace would run in a day? Also please say what weight light scrap brass would be likely to lose in the cwt. in remelting down into ingots?—J. W.

[72848.]—**Old Clock.**—The rough sketch inclosed is intended to represent an escapement in a clock I have.



Driven by a spring A, 'scape-wheel moves horizontally, B.B. flat pallets, C front pivot, D knife-edge, E piece of fine wire passing through steel block F, which latter is made in one piece with the escapement arbor. This piece of brass wire is broken off short, just below the block. As all other parts of the movement appear perfect and little worn, I want to know the proper length and style of pendulum and bob, so that I may perhaps give the ancient one a new start in life.—TINTOM.

[72849.]—**Moles in Ireland.**—Can readers resident in Ireland state whether there are any moles in that country?—NUN. DOR.

[72850.]—**Milk.**—I am informed that at the exhibition of dairy produce, lately held in London, there was an apparatus to preserve milk, &c., by freezing, and keeping it frozen by quite a new method, not costing one-fourth of what the older method does. If any of "our" readers know anything of this method, I shall be glad to have an explanation of it in detail, and perhaps where it can be seen in operation.—CARINO.

[72851.]—**Organ.**—Could any of the readers of your valuable paper tell me what is the objection to supplying 32ft. tone reeds to the pedal board of an American organ —large size? A certain maker of these instruments refuses to supply them to an organ he has estimated for, but I cannot see the force of his objection. They are supplied, I know, for a gentleman of my acquaintance has one which he bought from an exhibition, and finds no fault with it. I shall be glad of the opinions of those of your readers who understand these matters, as the specification quoted for contains 16ft. tone on each manual, and 32ft. on pedals.—PEDALS.

[72852.]—**L. and S.W. Tank Locos.**—Can C. F. D. Marshall inform me if 131 and 133 are the same class as 130 and 132? I recollect seeing them some time ago, but do not remember the design; they seem to have left Nine Elms, unless they are in the works. How many of this class are there? I know of eleven—viz., 46, 123, 124, 130, 132, and 374 to 379, all by B. Peacock 1879. There is a fine new express bogie No. 577, just turned out of N.E. works; it is 4-coupled rear with leading bogie. I should like some particulars. What has become of "Fireball" class? Are they broken up, or running as 073, &c., like Styx 084?—LOCOMOTIVE.

[72853.]—**Clock.**—I have an American eight-day ship's lever clock which looses when full wound, and gains when half-way down and near the end of the week. No manipulation of the hair spring will correct it. Is the balance at fault as to weight or size? The clock is perfect, as it is quite a new one. I have had it to pieces and examined depths, &c.; all are correct. When it has gone five days balance makes 125° of motion; fully wound it vibrates 380°.—JEW.

[72854.]—**To Mr. Allsop.**—Erection of telephone line on posts:—Length about half a mile, one span of about 100yds. to take a public road obliquely. I should feel obliged if Mr. Allsop would say what description of wire should be used for gauge, &c. I contemplate using fir posts about 4in. through, with 12ft. above ground. At what distances apart should the posts be placed? What would be the best method of fixing wire to insulators? Also whether a magnetic receiver can be connected up with signal bell battery, &c., and if so, how? What would be approximate cost of wire and insulators?—B. A.

[72855.]—**Watchmaking.**—Will some subscriber tell the number of teeth and leaves of pinions required in a regulator to beat seconds to have a Denison gravity escapement, or how to calculate a train?—JEW.

[72856.]—**How to Become a Professional Astronomer.**—I have a boy with a liking for astronomy. Is there any chance of his becoming a professional astronomer, and are such berths capable of yielding a subsistence? Would it be a good preparation to apprentice him to a good optician, or how could he best make a start? Would some good astronomer, like "F.R.A.S.," or some good optical instrument maker, like Mr. Calver, give a hint?—O.

[72857.]—**Shocking Coil.**—Would some electrical reader kindly tell me if No. 26 for primary and No. 3 for secondary is the proper wire for small shocking coil 3in. long, with ½in. core, and brass tube slipping over it, and how much wire (in weight) of each sort should I require, and is it necessary to put paraffin waxed paper between each layer of primary as well as secondary wire? How is the end of core fixed, so as to get magnetised? Please say proper way to connect up.—A BEGINNER.

[72858.]—**Horse.**—I have a horse that is very devotional, particularly on going down the least incline. He is just the same after being newly shod. Can you tell me any remedy? Would a curb on bit be of any help, or anything to rub into joints? Also what will produce hair on knees? I have tried gunpowder and lard, burnt leather and lard, sheep ointment, and hair restorer without avail. Any hints will oblige.—PUZZLED.

[72859.]—**Dented Drawing Board.**—The other day I was persuaded to allow my large drawing-board to travel in a railway luggage van. Although I had asked the officials to take great care of it, I found on getting home that there were two ruts across it at right angles to the grain, caused by great pressure on the string which tied it in the brown paper. The dents are about 4in. long, and are, in the deepest place, about 1-32in. below the surface of the board. How can I get rid of them?—T. G. L.

[72860.]—**Depositing Copper on Brass Castings.**—Can any reader assist me with a simple inexpensive method of obtaining a deposit of copper upon some small brass castings (not larger than a crown piece)? I do not require a thick coat, as there is no wear, and having only a few at a time to do, an expensive plant would be useless. —SCOTT.

[72861.]—**Pulley.**—Would some reader be good enough to say whether power is transmitted from one pulley to another by means of friction between the belt and the face of the pulley, or by adhesion of the belt to the face of the pulley?—BELT.

[72862.]—**Boiler Tubes.**—I wish to put some cross-tubes, about 2in. diameter, in a saddle boiler, and do not see how I can get the flanges of the tube tight if they are cast on both ends of the tube. I could do it if one end is made with a loose flange socket bolted on the boiler, but do not know what to caulk the tube into the socket with that will stand the fire. There is something that will do it, as I have a boiler with tubes fixed in that way. A dark red composition is used, not red lead. Can anyone tell me what it is?—SADDLE.

[72863.]—**Microphone.**—To MR. ALLSOP.—I am about to make a transmitter. Will you please give me the size of pine board and thickness, and should there be cork all round or only at the corners, and whether the board ought to be screwed down tightly? Which is the best form of carbons, the Crossley or the Gower, and whether the bell should ring at the other end when the automatic switch is up and the receiver is off at this end? —MICRO.

[72864.]—**Solution of Lime.**—I have seen it stated that by the addition of sugar, water may be made to dissolve more than seven grains to the ounce. I shall be much obliged if anyone will inform me the exact amount of sugar required to effect this? Also I should be glad to learn whether lime is soluble in glycerine, and if so, in what proportion?—CALCIUM.

[72865.]—**Boiler.**—Will some reader give me a drawing and sizes for a vertical boiler suitable for engine, 1¾ bore by 3½ stroke? Also force-pump to feed same. Engine is horizontal.—ZINKENITE.

[72866.]—**Lathe, Divided Face-Plate.**—I have fitted a brass face-plate to my lathe, 5in. diam. Will some reader kindly tell me how I may divide it into the following numbers?—56, 60, 72, and 80. I wish to cut the teeth of clock-wheels by its aid. I shall also be glad of information as to how I may erect a cutter on the lathe to work with bow or line.—CLOCKMAKER.

]—**Organic Analysis.**—Will some reader
efer me to a work giving details of methods for
titative analysis of concentrated food as regards
owing proximate constituents?—Albumenoids
e), albumenoids (indigestible), peptones, ex-
natter.—Albumenoid.

|—**Spiral Drills.**—Could any reader give me
ow the centre line is made on spiral drills? Also
are backed off (whether before or after harden-
achinery? Rough sketches or any information
ould oblige.—Amateur.

|—**To Mr. Bottone.**—I am going to run
.c. wires behind the skirting of a new house.
tell me whether I should put zinc tubes behind
n the wires through? Also if I do not put tubes
ill gas hooks do to keep the wires up? Would I
tter results if I made the battery wire of No. 18
and line wires of No. 20 B.W.G. instead of all
E. Wilson.

]—**Gong.**—I have been told of a very simple
ive steel gong which is made by bending a bar
mewhat at an obtuse angle. The one I heard
de of a steel bar about 3ft. by 1¼in., and was
y an eye at the end of the long arm. What I
now is:—1. What should be the relation between
ess and length of the bar? 2. Relation of long
ort. 3. Length of bar for gong to be used in an
med house of two stories.—M. J.

|—**Seaside Plants.**—Could any kind reader tell
trees, shrubs, and plants I could cultivate as a
background in a garden which is often exposed
ay of sea-water? It would greatly oblige.—Old

|—**Dynamo Winding.**—I have made up
ings bought a Manchester dynamo 120c.p. I re-
light six 20c.p. lamps, and give 45 volts and 8
shunt-wound. Now how to wind it puzzles me.
ook on dynamo making which says 12lb. No. 18
and 3¾lb. No. 18 on armature. Another writer
No. 20 on fields, and 6lb. No. 18 on armature.
says neither is right; there must be four sizes
in the wire. Now which shall I be guided by?
ant to have to rewind it. Who of our readers
e such a dynamo, and will put me right, which
will help me out of a fog?—Monte Christo.

|—**Astro. Telescope.**—Will someone kindly
uctions how to make an astronomical telescope,
2in. or 2½in. aperture? I cannot afford to pay a
for one, so unless I can make it myself, I shall
o without. I have heard that a good telescope
ade by mounting the lenses in cardboard tubes.
e will give the focal lengths of the lenses, their
cost, and a few hints on mounting them, it will
boon.—A. E. W.

—**Cyanogen.**—What is the cheapest form of
? Any compound containing upwards of 20 per
ld be suitable. I require it in half-ton lots, and
glad to know the names of firms who make
compounds a speciality.—A. A.

—**Chemical Analysis.**—If sulphur dioxide
into milk of lime until the clear solution has a
ravity of 1·05, what would be the probable com-
f the liquor, and how can I estimate separately
ity of free and combined $SO_2$, also the CaO?—
Analyst.

—**Microscopy.**—Would Mr. Bottone inform
vacuum in inches of mercury is found sufficient
the air from objects intended for the microscope?
ess to a laboratory air-pump worked by town's
d desire to know if this is the best form. I
e to know also how to construct a ringing
would be reliable in always getting the slides
tre.—W. J.

—**Engine Cylinder.**—I am designing an
inder, but should feel obliged for a little informa-
m making the steam ports 2in. by ⅜in., and I
o give the valve ⅝in. steam lap, and 1-16in.
ap. Am I right in lap? Consequently the dis-
ween the ports will be 9-16in. Is this right—the
ort ⅛in. wider than steam port? I also propose
eam-chest. On what clearance shall I require
g, or in other words, length and breadth of valve
sive of clearance, the steam port to enter the
in. from the end? Will this be sufficient? I
ecuring cylinder covers with six ⅜in. bolts.
e steam-chest cover require four or six bolts
of cylinder, when bored ¾ to be safe at 100lb.?
pressure 60 to 70, bore 4½in., stroke 8in. I
o like a good design for a piston, thickness of
l, and the best mode of securing rod to piston.
er.

—**Model Boiler.**—Would some kind reader
me where the fault lies in locomotive boiler of
dimensions? Depth of firebox 5½in., width
height 6½in., with seven ⅝in. tubes 13in. long.
et sufficient draught for the above to burn coal
operly. I may add that chimney, which is 4in.
is led direct into kitchen flue. Entire length of
n.—T. Webb.

—**Microscopy.**—Will some reader help me to
ent other than water in reducing to a solution
sulphates, crystals, and so on of copper, iron,
imony, manganese, salicylic acid, benzoininic
the various materials at hand for recrystalisation
dip with or without polariser, or say where such
be obtained?—Crystal.

—**Recorder for Piano.**—Could any reader
vith sketches or ideas to make a recorder which
adapted to a piano, so as to obtain a record of the
ed impromptu?—Amateur.

|—**Waterproofing Vellum.**—What is a
hod of waterproofing vellum without injuring or
g it?—E. J. S.

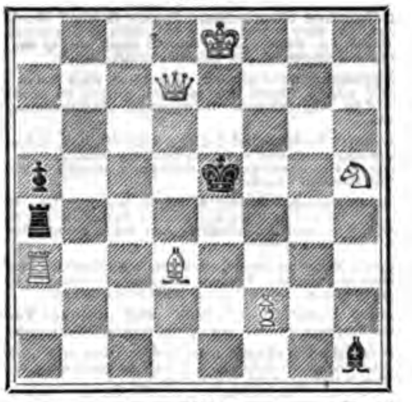
TEM of "telephoned messages" is to be
l in Paris. For a fee of 50c. a message may
oned to any one of eight central offices in
quarters of the city, after which it will be
to its address by special messenger. The
is not to exceed 100 words.

## CHESS.

All communications for this department must be addressed to "J. Pierce, Knollside, Yawl, Lyme Regis, Dorset."

### PROBLEM MCCXXVII.

*Black.*



*White.* [6 + 4

White to play and mate in two moves.

Solution to 1225.

| *White.* | *Black.* |
|---|---|
| 1. P-B 4. | 1. P takes P (e p.) |
| 2. Kt mates. | |

Also 1. R (Kt 4)-Kt 5.

### NOTICES TO CORRESPONDENTS.

Correct solutions to 1225 by F. W. N. Lambert (2), W. L. Martin (author's), T. H. Billington (2), Sighee (2), Biene (2), W. Gleave (2), E. P. (second solution), White Knight (2) (very crude, not up to Tourney pitch), W. Jay (2), C. P. P. (2), W. J. Greenstreet (second solution), J. H. Eastwood (2), W. A. Clark (2), A. Fellows (2), Fr. Fernando (2), Lieut. Col. Ryan (2), J. Kistruck (2), Link (author's), and M. Kelly (second solution); to 1224 by J. Kistruck, W. Gleave (very nicely arranged, and not too easy), W. Jay, White Knight, F. W. N. Lambert, and Link.

J. F. Moon.—We quite agree with you as to 1223.

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**6s. 6d. for Six Months and 11s. for Twelve Months, post free to any part of the United Kingdom. For the United States, 13s., or 3dol. 25c. gold; to France or Belgium, 13s., or 16f. 50c.; to India (via Brindisi), 15s. 2d.; to New Zealand, the Cape, the West Indies, Canada, Nova Scotia, Natal, or any of the Australian Colonies, 13s.**

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|---|---|---|
| **Thirty Words** .. .. .. .. .. .. | **2** | **6** |
| **Every Additional Eight Words** .. .. .. .. | **0** | **6** |

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| | s. | d. |
|---|---|---|
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| **For every succeeding Eight Words** .. .. : | **0** | **3** |

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|---|---|---|
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***** It must be borne in mind that no Displayed Advertisements can appear in the "Sixpenny Sale Column." All Advertisements must be prepaid; no reduction is made on repeated insertions, and in cases where the amount sent exceeds One Shilling, the Publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.**

**The address is included as part of the Advertisement, and charged for.**

**Advertisements *must* reach the Office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.**

**Holloway's Pills** possess the power of expelling all pestilential humours from the human system, and therefore they become necessaries in every household at those times when epidemics, as cholera, diarrhœa, dysentery, and influenza, are threatening pain, danger, and death. Full instructions are wrapped round each box to guide every invalid.

## ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

### HINTS TO CORRESPONDENTS.

**1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.**

***** Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

**The following are the initials, &c., of letters to hand up to Wednesday evening, Nov. 5, and unacknowledged elsewhere:—**

T. Cape.—T. B. Etty.—Lexty.—W. H.—Romeo.—T.—J. R.—Puzzled One.—Norfolk Horologist.—H. H. Headworth.—C. H. Bingham.—Jack Straw.—A Fellow of the Royal Astronomical Society.—J. T. B.—Leo.—Inventor.—Power.—J. Chasseur.—A. B.—C. C. Ellison.—Billy Hooks.—Novice.—Marienberg.—G. B. M. R.—Abertify.—Amateur Electrician.—T. G. L.—Tom Moore.—H. Wilson.—F. Varley.—A. J. Dew.—F. G. Willatt.—R. J. Urquhart.—Iran.—Horo.

J. C. Siphon. (If the sketch gives a correct idea, it will be possible to siphon all the water into the deeper shaft, as that is more than twice as deep as the shaft A. If the pipe connections are sound, it might be possible to start the action by means of the mouth applied to a stop-cock, so as to exhaust the air, or, at least, to sufficiently disturb the equilibrium as to cause the water to run over the bends and through the horizontal pipe. The principle of the siphon can be found fully explained in the numerous textbooks of physics. The bottom of the long pipe must be plugged, or stopped, in some way to exhaust the air, and when the water has completely filled the pipes the plug can be removed. The stopcock is closed directly the water reaches it. You can try on the small scale with a glass of water and a piece of rubber tube.)—J. C., Five Years' Subscriber. (The action is known simply and accurately as "creeping," and if the oil-can is half-empty, you must tilt it to use it. Some oils are more expert creepers than others—paraffin-oil, for instance. There is no really practical method of preventing the action; but a little baffling ridge might be soldered round the inside near the top edge.)—Paddy. (Several recipes for different kinds of sealing-wax can be found on p. 136, No. 1073. Rosin or pitch is used instead of shellac for the cheap bottling waxes.)—R. W. Tweedy. (Dissolve the desired aniline colour in alcohol, dilute with water, and add glycerine until of a suitable consistency. Several recipes have been given.)—Electron. (Which one do you mean? The portable electric gas-lighter was described not many weeks back in answer to a query. It is "permanent," so long as the materials of which it is made last. Illustrations in No. 1033. See also other forms in No. 1206.)—J. H. Curtis. (Please see the indices of recent volumes. There are quite a number of dynamo designs in them, with instructions as to quantities of wire, method of winding, &c.)—J. W. C. (The composition supposed to be used was given on p. 150; but we suspect the exact proportions are known only inside Edison's factory. See indices of back volumes. The diaphragms are of thin glass, mica, talc, or of oiled silk. Particulars have not been published.)—Zarema. (We do not think they are on sale; but surely you can inquire at some of the shops in Dublin.)—Amateur. (Yes; such an instrument was exhibited about seven or eight years ago at the Crystal Palace, and also, we think, at the Inventions Exhibition. Query inserted.)—A Leeds Cloth Drawer. (New houses are not to be recommended; but have good coke fires and keep the windows open.) — S. E. P. (Better consult a surgeon, and see if he cannot reduce the hernia. At any rate, he can advise, after examination, whether it will be wise to treadle the lathe. Have nothing to do with the treatment mentioned.)—Novice. (It will always leave a "grease spot.")—Fixity. (Marine glue will do; but ordinary pale glue with acetic or nitric acid might answer the purpose. Try adding a few drops of the acid to, say, a spoonful of the dissolved glue.)—J. W. (If so bad as that, you will have some trouble; but if you can get oil into the holes it will kill the insects. The furniture could be sent to the upholsterers and be "cured," while the woodwork of the house might be fumigated with sulphurous fumes. See the indices of back volumes. 2. Depends on what is wanted to be done. 3. If you refer to back numbers, you will find that grip chucks are not in much favour, except for light work. See an article in No. 1191.)—A Future Resident. (The climate is healthy. We do not know the highest mean temperature in the shade; but the city is near or upon the isothermal line marked 60° in the charts.)—B. (Please see the articles on Telephones now running through the numbers, and refer especially to p. 367 last volume. The microphone cannot be said to have been "brought out"; it was described by Prof. Hughes in a paper read before the Royal Society, which was the earliest published account of the invention.)—L. (Yes, we believe so; but see Hints No. 4 above, and look through advertisements. We do not know whether the insurance companies regard them as an extra risk. It would depend on the surroundings.)—Q. (Surely you can say whether they are arc or incandescent at sight. The electrician will tell you what candle-power he estimates them.)—M. T. (The best way is to take a few lessons, and then practise frequently. There are many useful books, most of which you can see at the music-sellers' shops).—B. B. (Try the effect of a little paraffin oil round the slides, placing the instrument so that it can creep down the slide. When separated, clean well. If the tubes can be filled with rosin, the dents may be brought out by gentle hammering with a wooden mallet; but in some parts it may be necessary to solder a wire in them and pull them out.)—4th Wheel. (Price is usually a good guide; but it is impossible to form an opinion without experience and knowledge.)—X. Z. (Red-lead putty well caulked would stand some time under the low-pressure system.)—E. J. S. (Try paraffin wax. 2. The Nos. containing "Cart and Wheelmaking" are out of print, and some of the volumes. The articles appeared in Vols. XXXII. to XXXVI.)—R. C. C. (We do not think there is anything patentable in your device so far as we understand it; but you can register a design. If you prefer to take out a patent, no one can prevent you; but you would act wisely by employing an agent. There are several cowls of the kind in the market.)—Brassy. (No such process as cold brazing—the recipe in the books giving brass filings, fluoric acid, &c., being simply a hoax. Read up your back numbers. There is a process of cold soldering done with a copper amalgam; but it is of little use, and is in no sense what is meant by the term brazing.)—W. B. G. H. (Frequently answered. The tube requires cleaning, most likely, and the mercury must be warmed to drive out air. See answer to "H. H. H.," p. 196, and the indices of back volumes. No book on the subject.")—R. B. S. (Sketches of sunspots sent are too rough for reproduction.)—Railway Ticket Snapper. (All the evil is due to the badly ventilated place where you work. Snuffs and drugs are utterly useless to cure colds. We have sent on your query to Dr. Allinson, the Medical Editor of the *Weekly Times and Echo*. Look out for his reply in that journal.)—C. J. B. (We have no more space just now for the discussion of the trisection of an angle. You will find plenty about it in back volumes.)—A Constant Reader. (There is not, and there never will be, any such thing as "perpetual motion.")

**Caution to Invalids.**—The unparalleled success which has attended the efforts of Mr. C. B. Harness and the Medical Battery Company Limited (of which he is president) to supply the public with genuine curative electrical appliances and perfect methods of treatment, has led to the most bare-faced piracy of their goods, and also to the unscrupulous imitation of their title and advertisements. The Company consider it necessary, therefore, to warn the public against purchasing bogus toy appliances, which have nothing "electric" about them but the name, and are utterly useless for curative purposes. Harness' Electropathic Belts are the only genuine Electric Belts which are guaranteed to imperceptibly generate mild continuous currents of Electricity, and are recommended by the highest living authorities. Every appliance can be seen scientifically tested before being purchased, and, if any of our readers are at all sceptical, they are cordially invited to call at the Company's Electropathic and Zander Institute, 52, Oxford-street (at the corner of Rathbone-place), London, W., and thoroughly satisfy themselves Consultations and pamphlets free.

## OUR EXCHANGE COLUMN.

*The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.*

Grand model **Screw Steamer**, cost £12. Accept any reasonable offer in very old foreign Postage Stamps, a collection preferred.—Westhorp, 1, Spring-road, Ipswich.

**Anything useful or saleable taken in exchange for** Music or Musical Instruments.—Address The Midland Music Agency, Measham, Atherstone.

**Astro. Telescope**, 6½in O.G., Cooke, six eyepieces, finder, equatorial mounted, no circles. Exchange. 4in. wanted.—Bassett, 82, High-street, Stoke Newington.

**The Chenies-street Exchange** offers greatest choice. Entire stocks and single instruments purchased. Best market. Particulars first.—Caplatzi, Chenies-street.

**Steam Launch**, 16ft., complete inventory. Injector, pumps, all highest class; vertical multitubular boiler, working pressure 100lb., speed about 8 miles. Must part (for no fault). Will take in exchange 1H.P. Otto Gas-engine, small Milling or Shaping Machine, best make.—Hawley, Malton, Yorks.

**Steam Launch Hull** or Vertical Boiler will be exchanged separately. What offers? Dynamo, Steam fittings, Engineering Tools, Safety Bicycles, as above.

1-horse **Engine**, and six Tubular Boiler, good as new. Exchange for screw-cutting lathe, gap-bed preferred.—Ogden, 99, Oxford-street, Manchester.

¼H.P. **Horizontal Engine Castings**, cylinder bored, steamways made, slides planed, bed complete. Exchange powerful Motor.—A. Carver, 412, Gorton-road, Reddish, Stockport.

"**English Mechanic**," Nos. 1,131 to 1,261. Exchange anything useful in Models.—Smith, 5, Leonard's-avenue, Bedford.

Wanted to exchange **Vertical Boiler Shell**, all fittings, for 15 pint Daniell's Cells; offers.—Apply, A. S., 4, Broseley Villas, Wood Green, London, N.

4in. **Slide-Rest**, new; Fret Saw Machine, several small Steam Gauges, small Planing Machine. Exchange. Stamp reply.—Fredk. Cooke, King-street, Southsea.

14lb. **Vermilion**, 11lb. Rose Pink, dry colours, all copper 1½ gallon Glue Kettle. Anything useful.—Photographer, Raunds, Northa.

**Chemical Cabinet**, large mahogany, well stocked, almost new, cost £5. Exchange Musical Box, Gun, or any offers to value of 50s.—Malloch, Castle Donington, Derby.

**Safety Bicycle**, balls throughout, including pedals, cost £11 June, little used. Exchange American Organ; approval.—Thomas, 15, Suffolk-road, St. Ann's-road, Stamford Hill.

Two **Electric Pistols**, Henley's Dischargers, several Insulating Stands, Spark Plates, and other Apparatus; three Bichromate Batteries, six Leclanchés. Useful offers.—E. W. Young, Aylesbury.

**Gas Engine**, half-horse "Hugon," £16. Would exchange for one-horse Steam-Engine and Boiler. What offers?—W. M., Lime Villa, Charlton.

**Steel Oxygen Cylinder**, 10 by 20in., valve wants repairing. Exchange to value 25s.—H. Cassal, 105, Adelaide-road, N.W.

**Vertical Copper Boiler**, 10in. by 26in., three tubes, steam and water gauges, &c., complete. Exchange for good Biunial Lantern with dissolver.—H. E. Shrimpton, 4, Hillside-road, Roupell Park, Tulse-hill.

**Air-Pump**, two horizontal cylinders, cog-wheel action, cost £15. Accept anything useful.—B., 12, Albert-terrace, Harringay-road, West green, N.

Newtonian **Reflecting Telescope**, 14ft. focus. Exchange for Microscope, Refracting Telescope, Lantern and Accessories, Photo. Apparatus, Harmonium, or anything useful. Offers—Houldershaw, Liversedge.

**Hughes' Grand Triple Lantern**, furnished with nine different foci lenses, by Ross, cost over £100. Exchange first-class Piano or American Organ.—Houldershaw, Liversedge.

**To Science Students.**—Highly finished Electrical Machine, 12in. plate, almost new, four Leyden jars, universal and hand dischargers, thunder-house, Pithball stand, cost £5 10s. Any exchange.—Microscopist, 344, Caledonian-road, London.

**Microscopic.**—Polished pine Case with trays containing 36 selected Objects, well mounted, suitable for exhibiting, value 17s. 9d. Any exchange.—Microscopist, 344, Caledonian-road, London.

6in. centre back-geared **Lathe** with 4ft. bed, slide-rest, strong milling attachment, and small Vertical Drilling Machine. Will exchange for 4½in. screw-cutting Lathe.—Apply, after 6 p.m., 70, Hill-side-road, Stamford Hill, N.

Slide-rest wanted, to suit 3½ centre bench lathe. Good exchange. Electric Bell Set, Copper and German Silver No. 36 S.-covered Wire, small Galvanometer, and Watch Turns.—Purves, 23, Cramer-street, Gateshead.

**Loco.**—Superior model express, with 6-wheel tender, burns fuel, perfect order. Valuable exchange.—Particulars, Loco, 4, Charlmont-terrace, Tooting, Surrey. Seen by appointment.

Wanted, Davis's Miner's Dial. Will exchange Violoncello and Copying Apparatus.—Jas. Ford, Parkgate, Rotherham.

Rippingill's **Oil-Stove**, quite free from smell, shows red light, been used for bedroom, cost 25s. Exchange offers wanted.—Taylor, Wakefield-street, Warrington.

Useful 5½ **Lathe**, 4ft. iron-plated bed; slide-rest, several tools, chucks, and sundries. Exchange Safety, value £5. Offers.—Charles Adams, Beverley-road, Colchester.

Complete **Castings** of horizontal slide-valve Engine ½in. bore, 1in. stroke. Exchange for 8in. Flywheel.—A. H. Hatton Point Park, Uddington, near Glasgow.

Wanted, good wrought-iron Parallel Vice for Knitting Machine or Wild-fowl Gun.—A. Halls, Tool Maker, Great Yarmouth.

**Bench Lathe**, 9½in. centre, gunmetal collar, face-plate, four chucks, carrier, two tool-rests, heavy two-power flywheel, and crank, almost new.

Will take **Forty-Five Shillings** for above, or exchange for any kind of good Scientific Apparatus to value.—Martin, 75, Forest-lane, Forest Gate, Essex.

**Locomotive**, 2ft. long, by Faulkner, inside cylinder, link motion, single driver, 6in. dia.

The above is fitted with a **Copper Tubular Boiler** to burn charcoal, steam and water gauge.

**Advertiser** having no time to see to it. Cost £20. Exchange to value of £9. No rubbish.

**Machinery** and tools, good Lathe, &c., preferred.—Loco, 102, Teviot-street, Poplar, E.

10c.p. **Dynamo**, armature and field-magnets wound, bearings drilled, brush blocks; cash 8s. 6d., or offers electrical.—Creasey, 4, Sandon-terrace, Harrowby-road, Grantham.

Wanted, 20c.p. Dynamo, in working order. Will give ¼H.P. Water Motor in exchange.—Walton, 9, Queen Anne-street, Stoke-on-Trent.

**American Clock Movement**; also German strikers, one timepiece ditto, large size horizontal watch ditto. Exchange anything useful.

**Locomotive Boiler**, one tube, 9in. long, firebox, steam dome; horizontal engine, cylinder ½in. bore.—Address Lamont, 43, Thompson-street, Govan.

**Telescope Equatorial**, 12½in. With reflector. slow motion R.A., 2in. finder, 6 eyepieces, Barlow's lens, diagonal set of stops. Photo 12 stamps.—Below.

**Transit Instrument**, 2¾ o.g., silver circles, striding level, collimating eyepieces; photo 6 stamps. Photometer by Hilger, micrometer by Grubb, astronomical books and instruments.—Below.

**Barometers**, 2 aneroid, Patterns for Equatorial stands, dynamos, tricycle, Cromartie lamp, new ebonite Wimshurst machine, 9in. spark; lantern photos. List stamp.—Box 20, Liversedge.

**Boiler**, 2ft. by 13in., over 1cwt. weight, no fittings. Want Treadle Lathe, about 3½in. or 4in. centres, with slide and back-gear rest, about 3ft. iron bed.—John Harris, Ventonleague, Hayle, Cornwall.

American Organ wanted, with several rows reeds, would do out of repair. Good exchange given. — Schofield, 292, Stubbins, near Manchester.

Wanted, Autograph Letters of Celebrities, or picture books, or anything relating to coaching. Exchange Magic Lantern, &c.—Collector, 18, Lowbaxter, Bury, Suffolk.

**Oil**, one cask American cylinder, 1s. 2d., delivered free, cost 2s. 6d. Sample sent. Wanted, Photo Lens or small Lathe.—30, Worsley-road, Patricroft.

Allen's Portable Steam and Medicated **Vapour** Bath, Zither, Magnetic and Electrical Experimental Apparatus Exchange for Photographic Apparatus or Lantern Slides. List.—Electrical, 72, Price-street, Birkenhead.

What offers for 7 bound volumes of "**English** Mechanic," and 26 numbers of "Cassell's Popular Educator" to date?—Gordoni, 47, Arbery-road, Bow, E.

Wanted copper riveted **Boiler**, for boat 6¼in. wide, sound, cheap, pressure 50lb., internal fire-box. Offers. Sundries.—Gordon, 47, Arbery-road, Bow, E.

Wanted a 3½in. **Sliderest**, Emery Wheel, and Spindle. Good exchange.—D. T. Williams, Gwyn-street, Alltwen, Pontardawe, near Swansea, Glam.

Exchange useful **Foot Lathe**, 4in. centre, 5ft. bed, for Photographic Apparatus or offers. Photo, two stamps.—E. Smith, 41, South Beach, Blackpool.

**Dynamo**, weight 40lb., armature finished, gunmetal fittings, only wants fields wound; value 40s.—Exchange for Lantern Slides.—Clark, 2, Buckingham-road, Wood Green.

A set of **American Organ Keys** (celluloid), good as new, F scale. Wanted Joiner's Cramps, Violin, or offers.—B. Martin, 13, Overton-road, New Humberstone, Leicester.

5in. **Sliderest**, also Horizontal Boiler, 15 by 24, in good condition. Exchange offers invited. No cards.—Mechanician, Landore R.S.O.

Wanted Violin or offers for model **Engine and** Boiler, value 25s., new. Weir Sewing Machine, Chromatic Accordion, by Keith Prowse.—Gannon, Chelmsford.

3½in. **Lathe**, 39in. iron bed, faceplate, bell chuck, rest, drills, centres, &c., four-speed wheel and crank. Offers. Worth 60s. Photo 2d.—Gannon, Chelmsford.

**Tricycle**, genuine Humber, first-class condition. Exchange for "Engineering Dictionary," "Gas Manufacture," and other scientific books.—Urquhart, Chorlton-cum-Hardy.

What offers in exchange for Henly's **Magneto**, 3 double relays, galvanometer, small induction coil, 13 Post Office switches.—Huddleston, 21, Upham Park-road, Chiswick.

2 **Sounders**, with galvanometers, 2 Local Sounders, 9 Sounders with relays, 7 single-needle keys. What offers?—Huddleston, 21, Upham Park-road, Chiswick.

Shunt-wound **Dynamo**, by Patterson and Cooper, Siemens Dynamo, Voltmeter and Ammeter by Ayrton and Perry. What offers?—Huddleston, 21, Upham Park-road, Chiswick.

18 **Electric Bells**, without cases, job lot of Burglar Alarms and Pushes, also few Incandescent Lamps. What offers?—Huddleston, 21, Upham Park-road, Chiswick.

11 **Lun Ammeters**, for currents up to 20 ampères, three Indicators, 24-cell Daniell Battery. Exchange offers.—Huddleston, 21, Upham Park-road, Chiswick.

Exchange a 54in. **Bicycle**, balls both wheels, International saddle, for a pair 6in. back-geared Lathe Heads.—G. F., 15, Bennerley-road, Clapham Junction.

**Insect Cabinet**, 13 draws, corked and glazed, Giving up collecting. Cash offers. Folding doors, lock and key.—Sutton, 34, St. Andrew-street, Wandsworth-road.

52in. Coventry Machinist Company's **Bicycle**, good condition. Exchange offers. ½-horse Boiler wanted, or three-jaw chuck.—Sutton, as above.

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Small **Lathe**, divided head, steel collar, iron bed on iron standards, heavy flywheel, fitted with treadle motion complete, with several chucks. What offers in exchange?—Williams, 23, De Beauvoir-road, London, N.

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*Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.*

**New Illustrated Price List of Screws, Bolts and** Nuts for Model Work, drawn to actual size, sent on receipt of stamp.—Morris Cohen, 132, Kirkgate, Leeds.

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"**Roll Call" Pipes**, post free 1s. 2d. and 1s. 8d.—Dewsnap, 268, Upper Brook-street, C. on M., Manchester.

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**Machine Engraving and Dividing** on brass, ivory, and ebonite. Style and price unsurpassed.—Gilkes, Engraving Works, Reading.

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The English Mechanic
ND WORLD OF SCIENCE AND ART.
FRIDAY, NOVEMBER 14, 1890.

## IOW TO CONSTRUCT A QUARTER CHIMING CLOCK.—III.

### 3.—The Fusee.

THE functions of the fusee will be seen from Fig. 2. It consists of a cone-haped brass pulley, having a continuous ght-handed spiral groove of sixteen complete turns. This is mounted rigidly on a teel arbor, on which the great wheel revolves reely. The fusee and great wheel are connected by means of a ratchet and click placed n a hollow between them, which allows he chain or gut to be wound upon the fusee, while the great wheel remains stationary. ome clocks are provided with an arrangement for maintaining the forward pressure n the great wheel, while the fusee is eversed in the act of winding; but no such naintaining power is necessary in the clock efore us, and would only add unnecessary omplication.

I venture to say that few amateurs will ossess the necessary tools to cut the fusees, hough with a certain amount of manœuvring he operation can be performed with a good crew-cutting lathe and slide-rest. As ready-ut fusees, mounted upon rough spindles, an be purchased very cheaply, it will not be worth anyone's while to make them.

The same can be said of the brass wheels hroughout the clock. There may be a few ho would cut their own wheels, but such ill need no instructions from me. The ajority of amateurs will do well to obtain he complete set of rough wheels ready cut.

The great wheel, with which we are just ow concerned, is $2\frac{1}{4}$in diam. outside points teeth, and is made from brass full $\frac{3}{16}$in. ick. It has 96 teeth. On the inner side a recess nearly $\frac{1}{8}$in. deep and $1\frac{5}{8}$in. diam. receive the ratchet, click, and click-spring, ig. 16. The ratchet is of brass, nearly $\frac{1}{8}$in. ick and $1\frac{1}{2}$in. diam., and should contain bout 30 teeth. The click is of tempered eel, nicely polished so as not to cut the tchet, and strongly pivoted in the great heel, but not fixed to it. The click-spring semicircular form, is of hard brass.

The fusee itself measures $1\frac{1}{2}$in. long, $1\frac{3}{4}$in. am. at large end, and $\frac{3}{4}$in. at small end. t the small end there is a projection as own in Fig. 17, which prevents the clock ing over-wound. It will be seen that the op-finger is bevelled off on the outside to a edge.

Having purchased or made the body of the isee, it must be turned smooth and flat at oth ends, and all roughness taken off lges. As the fusees are bought, the stop-inger is cast on; but should anyone make it or themselves, it would be better to make a teel piece as shown in Fig. 18, and screw it o the face of the fusee with two screws. he precise action of this stop-finger will e shown when the wheels are planted in the lates.

fig 18

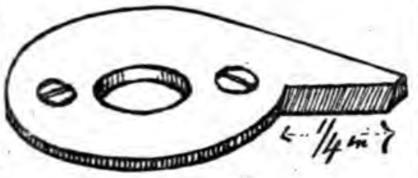


fig 16

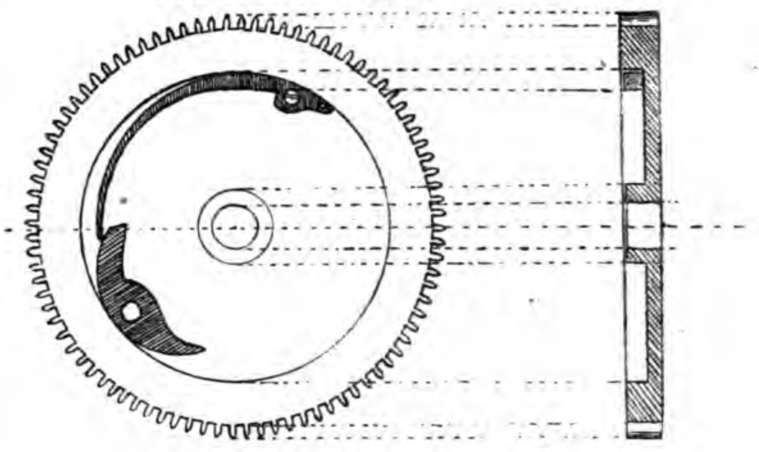
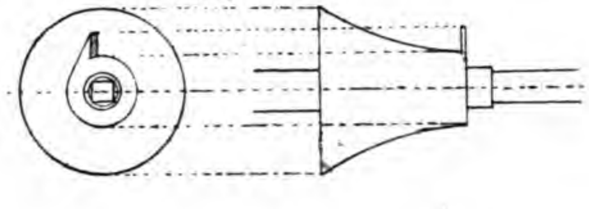


fig 17



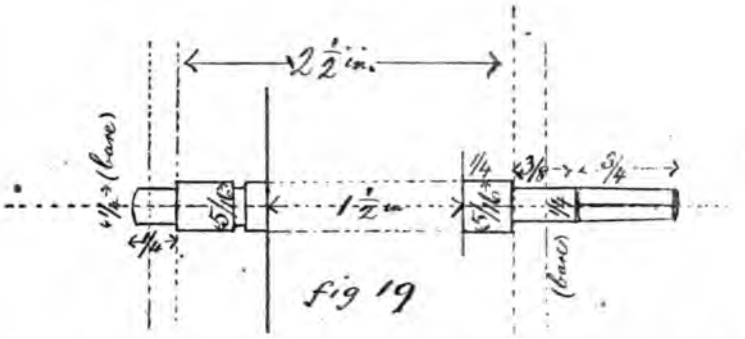


fig 19

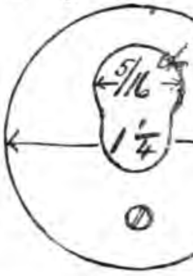
The arbor can now be turned to an even ickness of $\frac{5}{16}$in. throughout its entire ngth. The front pivot (small end of fusee) must be formed $\frac{1}{4}$in. from the brass, and should be nearly $\frac{1}{4}$in. thick and $\frac{3}{8}$in. long; from this point it is formed into a square $\frac{3}{4}$in. long, and slightly tapered throughout (see Fig. 19). The brass ratchet must now be opened out large enough to be passed on the arbor at the large end of fusee, and knocked on tight. Two holes are drilled about $\frac{1}{8}$in. in from the teeth, right through ratchet deep into the fusee brass, and two steel pins lightly hammered in and turned off level. These pins must be tight enough to hold the ratchet firmly, but must admit of its being removed, if required, without damage. The usual way is to fix the pins tightly into the ratchet and easy in the fusee, so that when the ratchet is removed the pins come with it. Let it be remembered that the fusee winds *to the right*, or perhaps the ratchet may be fixed wrong way about.

It must now be mounted in the lathe, and a piece $\frac{1}{2}$in. diam. cut clean out of centre of ratchet, exposing surface of fusee brass all around the arbor. This recess is to accommodate the loss left on centre of great wheel (Fig. 16).

Centre of great wheel must now be turned out to fit fusee-arbor. The readiest way to do this, and at the same time keep the hole quite central, is to screw a piece of beech or other hard wood in the lathe, and turn out a sink about $\frac{1}{2}$in. deep to exactly fit the wheel, which can be lightly tapped in with a mallet. The contact of the teeth with the wood will hold it sufficiently tight to allow the centre to be turned. The wheel should revolve freely on arbor, but without any play. The boss on centre must be reduced to a trifle under $\frac{1}{2}$in. diam., so as to go into recess in ratchet without touching, and should be slightly lower than outer edge of wheel to free it from the fusee brass. The outer edge of wheel alone should touch fusee brass.

To hold great wheel in position a circular brass key is used, shown in Fig. 20. A groove about $\frac{1}{16}$in. deep is turned on arbor, into which the key fits. When in position it is fixed to great wheel by a small screw, as shown. The key should be hammered slightly hollow (concave side to wheel) to give it a certain amount of spring, and should hold wheel against fusee brass without any play, but allow it to be turned easily by the hand in the act of winding. Fig. 21 shows large end of fusee and section of great wheel, key, &c., when in position. A is the great wheel, B the ratchet, C key, D space for click and spring (not shown).

fig 20



The click and click-spring will now be fitted. The click, as before stated, is of hardened and tempered steel, nicely polished, of the shape shown in Fig. 16. Its total length is $\frac{3}{4}$in. It must be of such a thickness as not to bind against either fusee brass or great wheel, but must have very little shake. It has a hole in centre, and is pivoted easily on a steel stud fixed in great wheel. The click is simply dropped on this stud, and is not fixed in any way. The stud is of hardened and tempered steel screwed tight into great wheel from the inside, riveted over

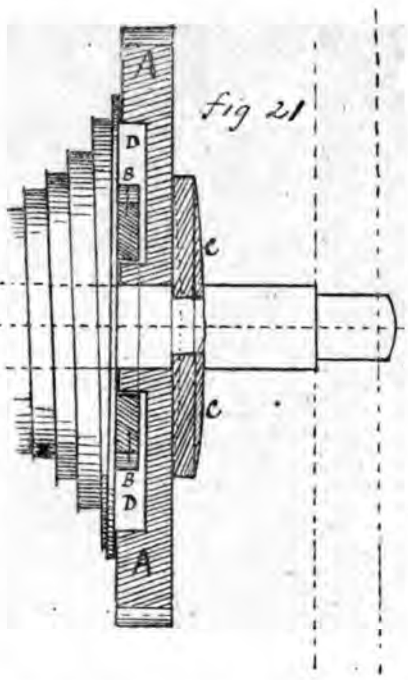


fig 21

on outside, and turned off smooth. The click-spring is of well hardened brass of shape shown in Fig. 16, fixed to the great wheel by a small screw and steady-pin, as shown. The ratchet, click, and click-spring all lie in recess in the great wheel, and are not visible from outside of complete fusee.

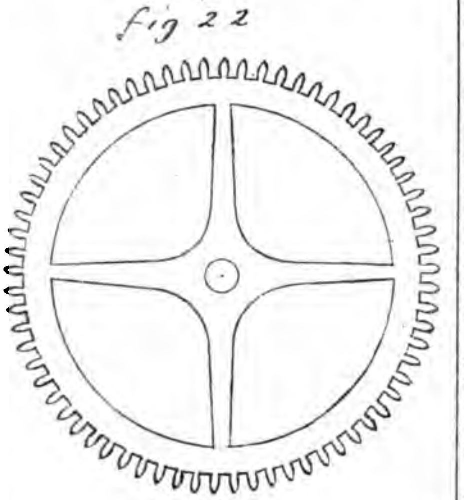
The back pivot can now be cut on fusee-arbor. It should be made of same diam. as front pivot, but only just long enough to come well through the plate, and should be rounded off at the end.

The entire arbor and square can now be polished, and the fusee is complete. The general outside appearance is shown in Fig. 2.

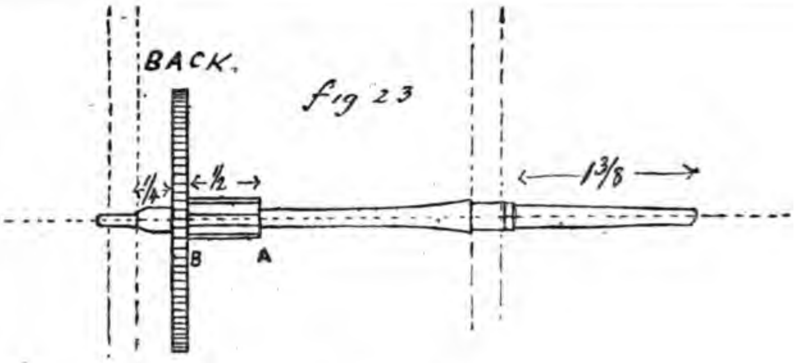
### 4.—The Centre Wheel.

This is the next wheel in the going train. It measures 2in. diam. and $\frac{3}{32}$in. thick and has 84 teeth. All the train wheels,

fig 22



after the fusee, are made as light as possible, and are therefore "crossed out," that is, they have four arms, the intermediate spaces being cut away and the rims being left as thin as is consistent



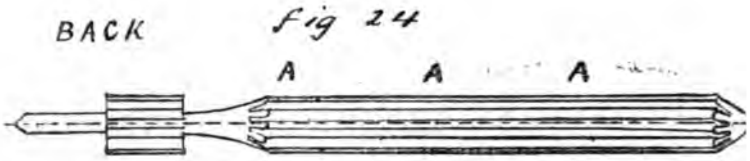
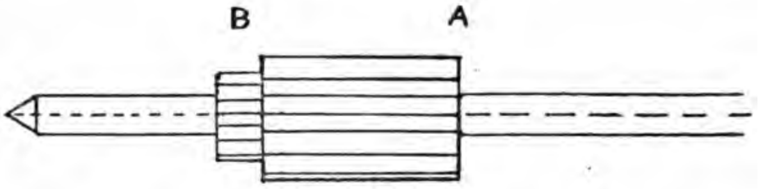


fig 25



with safety. The thickness of the arms, &c., can be judged from Fig. 22, it being drawn exactly to scale. The centre wheel is mounted on a pinion and arbor, as shown in Fig 23.

The pinions are generally made from drawn pinion-wire, which is obtainable in lengths, though they are sometimes turned from solid steel and cut in the same manner as a wheel. However, ordinary drawn pinion-wire is quite true enough for a clock such as we are now constructing, cut pinions being seldom used for anything but the highest-class regulators and the very cheap clocks made in large quantities by the aid of special machinery.

Clockmakers have arbitrary methods of calculating diameters of pinions from diameters of wheels and the number of teeth they contain. The instrument used to gauge them is a "sector," or proportional measuring gauge. This is used by all dealers in clock materials, &c. If, therefore, the wheels are taken to a material warehouse, wire of the correct diameter will be supplied without any trouble. The centre-wheel pinion contains eight teeth or leaves.

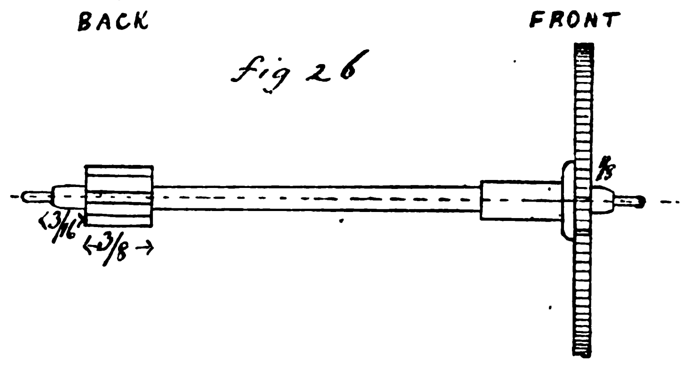
Having obtained the wire, cut off a piece 4½in. long, centre it accurately in the lathe, and turn the leaves away from either side of the pinion for a short distance, as shown in Fig. 24. On examining Fig. 23, it will be seen that the portion of centre-wheel arbor near the front pivot is considerably larger than the solid portion of the pinion itself. To form this part the pinion-wire must be heated, and the leaves of the portion A A A (Fig. 24) hammered down to thicken the arbor. It must, in fact, be all welded together into one solid mass and forged to the required shape. Care must be taken to keep it quite straight, and as round as possible.

When this has been done, cut it to exactly 4¼in. in length (the hammering most likely will have made it nearly 5in.), and again centre it carefully in the lathe. If not quite straight, bend it till it is so. See also that the pinion end runs quite true. This done, harden it, and temper to a blue. The hardening requires great care, so as not to

distort it or burn the leaves. If it i
in a blow-pipe flame to a dull red, to
heat from end to end, and plunged v
into cold water the instant it lea
flame, there will be very little disto
burning. Avoid all special hardenin
tions. Nothing beats cold water.

When hardened and tempered, re-c
the lathe, and make sure that the
part runs quite true. If the arbo
straight, file it slightly on the *conca*
with a worn-out file, resting it on a
wood, and using considerable pressu
will have the effect of straightening
must now be turned to the size an
shown in Fig. 23. The front pivo
be $\frac{3}{16}$in. thick. The short squa
beyond it $\frac{1}{16}$in. long and $\frac{1}{8}$in. square;
this the arbor is round, and tapered
to the end. The pinion-face marke
turned quite square, the end B wh
wheel is mounted has a shoulder
upon it, as shown in Fig. 25: this s
to be square, and half the depth
leaves. The outer face is turned ho
facilitate riveting. Upon this s
the wheel is mounted quite tigh
the ends of the pinion-leaves
they were turned hollow are rivet
into the brass of the centre of the
This effectually prevents it turning
on the pinion. Before the wheel is m
it is polished, first with a fine eme
(emery paper on wood), then with
stone and oil, with brush, then chal
with soft brush. This will bring it
nice polish. The back pivot is lef
size, there being a good deal of p
upon it.

The arbor can be polished all o
described in No. 2. The pinion-lea
be polished first with a piece of boxw
thin at one end, and charged with o
dust and oil. Only use this just en
take off any roughness there may be
may damage the pinion; after thi
red-stuff and oil on a boxwood poli
they have a brilliant lustre. The
all wheels may be vigorously brush
a brush composed of fine brass wire



ırrs that may be left from the cut-
ւ good way to make such a brush is
7s :—Get a bunch of fine brass bind-
, wind one end tightly with iron or
7ire to form a kind of handle. Cut
sh level. It will then present the
nce of a stumpy shaving-brush.

### 5.—Third Wheel.

:hird wheel, shown in Fig. 26, is
diameter, $\frac{3}{32}$in. thick, and contains
1. Its pinion has seven leaves.
ons are given in the figure. The
this wheel are made very thin, and
as light as possible. It is polished
› way as centre wheel (No. 4).
of being mounted on the pinion
t is fixed on to a brass collet driven
on the arbor, as shown in the
This collet is made roughly, driven
› arbor, then turned. The shoulder
e wheel is formed with great care.
el is fitted tight, and the edge of the
let riveted over it, the face of collet
rned slightly hollow for that purpose.
ng out the centres of wheels, always
ıe method described in No. 3 on the
r they will not run true. I have
en a self-centring chuck true enough
purpose; besides which, they are
damage the teeth.
d or two as to the turning of pinions,
is an awkward job for those not
ıed to it. First centre them while
turn away portions on either side of
on, as shown in Fig. 24. Then
nd temper them, and centre again
they run quite true. Break off the
vith pliers, or similar appliance,
ot required, file off rough edges of
nd turn arbors down to required
ons. Where collets are to be knocked
the arbor very slightly taper. In
tempered steel pinions, a fairly high
ıst be maintained. The cutter must
sharp, and kept so, the edge being
up, if required, at every few cuts.
rs themselves, after the leaves have
noved, must be turned as *slow* as
If these few points are borne in
ıere need not be much difficulty in

ıird-wheel pivots are rather small,
is no great strain on either.

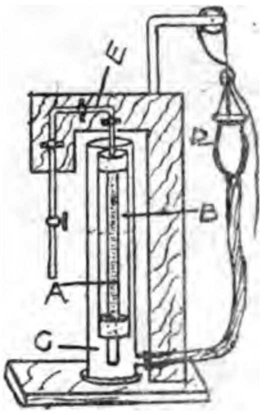
## HEAPEST FORM OF LIGHT.

ather curious and certainly interesting
tigations have been made by Prof. S. P.
nd Mr. F. W. Verey at the Allegheny
ry, Pennsylvania, as to the cheapest
ght, and they have recently published
*ıerican Journal of Science* a memoir on
t which should attract the attention of
f photometry as well as naturalists, for
from the observations that the light of
y (Pyrophorus noctilucus) is the cheapest
ght, as tested by Prof. Langley's in-
ıd marvellously delicate instrument the
Studying the radiation of the Fire-
vestigators found that Nature had a
producing light without heat other
ın the light itself, and that these pro-
ature are cheaper than our industrial
ones to a degree hitherto unrealised. By "cheapest" is meant the most economical in energy; but as a given amount of heat can be produced by a known expenditure of fuel and at a known cost the word may be taken in its ordinary sense with little error. In all industrial methods of producing light, however, there is involved an enormous waste, which is greatest in sources of low temparature, such as a candle, a lamp, or even in gas illumination, not more than 1 per cent. of the radiant energy being available or utilised for actual illumination. In sources of high temperature, such as the electric arc and the incandescent lamp, the "waste" amounts, under the most favourable conditions, to very much the larger part. It would appear from the researches of Prof. Langley and Mr. Verey, that the greatest intrinsic brilliancy amongst the luminous insects is found in the Fire-fly of Cuba (and some other tropical parts), which is known as the Pyrophorus noctilucus of Linnæus, which is about 37 millimètres (say an inch and a half) long by 11 millimètres (·4in.) wide, and has three light reservoirs, two in the thorax and one in the abdomen. No sensible heat accompanies the light which this Fire-fly is able to give, although a temperature of 2,000° Fahr. would have to be employed to obtain its equivalent by any of the usual artificial processes. Prof. Langley and Mr. Verey have made photometrical, thermal, and spectroscopical observations, a full account of which we cannot give, but their conclusions may be summed up in the statement that nature in the case of the P. noctiluca, produces the cheapest light at about 1-400th part of the cost of the energy which is expended in a candle-flame, and at but an insignificant fraction of the cost of the electric light or the most economic light which has yet been devised. These statements, made on the authority of recognised experts, give much food for reflection, for, as they themselves say, there seems to be no reason why we are forbidden to hope that we may yet discover a method of obtaining an enormously greater result than we do now from our present means of producing light. Such a method exists in nature, and is in use on the small scale, and further investigations may disclose the secret of the Fire-fly's light, which it produces at so little expenditure of energy. The experiments which led Prof. Langley and Mr. Verey to the conclusions arrived at are fully set forth in their paper, with plates showing photometric and energy curves of the electric arc, solar, gas, and the Fire-fly's light. They find that the insect spectrum is lacking in the ray of red luminosity, and presumably in the infra-red rays, usually of relatively great heat, so that it seems probable we have in the Pyrophori Nature's method of giving light without heat—that is, without other heat than that which the luminosity itself comprises, and which is but another name for the same energy. Many scientists, naturalists, and others have cogitated on the cause of the light emitted by insects, and the consensus of opinion points to the theory that the light is not indissolubly associated with vital processes, but is rather a result of certain chemical combinations; and if that is so, we may one day succeed in producing it in the laboratory.

## GAS ANALYSIS APPARATUS.

THE accompanying sketch represents a simple modification, arranged by Mr. Jno. Parry, F.C.S., of the gas analysis apparatus, described in the ENGLISH MECHANIC of Oct. 31st, 1890, which allows of the water-levels being readily and very accurately adjusted, and also possesses the advantage of being portable.

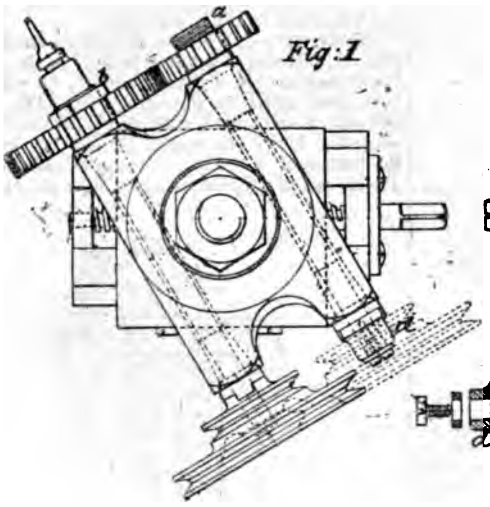
Briefly, it consists of a graduated measuring tube, A, inclosed in a water-jacket, B, the whole being contained in a glass cylinder, C, which is connected with the glass globe, D. The upper end of A is connected with a capillary tube, E, while the lower end passes through the cork in the bottom of B. The gas is drawn into, as also driven out of, the measuring tube A, and the water-levels in A and C adjusted by raising or lowering D. As is obvious, the water-level in A will correspond with the level in C. The absorption apparatus employed is similar to that used with the apparatus described in the "E. M." of Oct. 31st, 1890; as also is the manner of conducting the analysis.

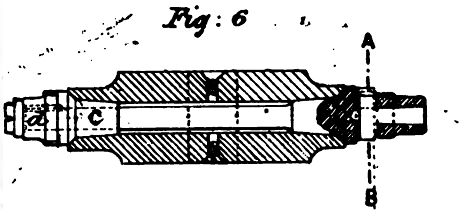


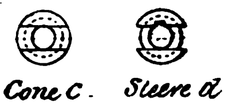
## LATHE ATTACHMENTS.

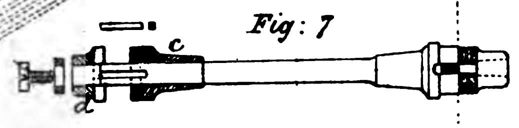
### Geared Milling and Drill-Spindle, Reversible.

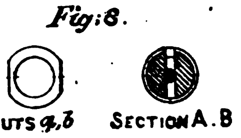
THIS tool is a very useful addition to an amateur's, or, indeed, to a shop lathe, as, by its use alone, or in conjunction with other attachments, any ordinary drilling or milling, polygonal, or curvilinear work may be readily performed. The accompanying drawing fully illustrates one, adaptable for either high speed, ornamental work, or, according to the size of lathe, comparatively heavy milling. It can be used on any lathe slide-rest providing that the tool-table is fitted with a central bolt for fixing the tool-holder. No dimensions are given, as these will necessarily vary according to the use of lathe, and the vertical distance or height between the tool-table and lathe centres, suffice it to mention that these drawings were made from a tool adapted to a 3in. self-acting lathe and are drawn to $\frac{3}{4}$ full size. It will be seen from the drawings that the tool fits over the tool-holder bolt, that it can be turned over on either side, and fixed at any angle from 0° to 90°. It is assumed that the bed of the tool-rest is perfectly parallel to the lathe-bed and plane of centres, If not, the sooner any such error is rectified the better. In the accompanying drawings, Fig. 1 is a plan, Fig. 2 a side elevation, Figs. 3 and 4 front and back end elevations, Fig. 5 a cross section through bolt-hole, Fig. 6 a section through centre of working spindle, and Figs. 7 to 10 show details of construction. The body of the tool is made of tolerably hard cast iron; the one from which this description is taken is a mixture of Welsh and Derbyshire metals, hard, very close in the grain, but not too hard to work; it has been in use nearly ten years, and although it is not fitted with steel collars, it shows very little sign of wear in the fit of the spindles; the gears only have a very little backlash. It will be seen from the drawings that there are two spindles, of which one is the working or cutter spindle, the other simply a driver. They are each fitted at the working end with cut gears of mild steel in the proportion of 1, $1\frac{1}{2}$, or more, as required. These gears are interchangeable, so that with a two-speed pulley, six changes of speed can be obtained. The spindles are made from old mule spindles, and have very long bearings (2 diameters), and are hardened and tempered at the bearings only. The driving pulley, two speeds, is of cast iron, but may be of gunmetal or steel, and it fits by a clutch on to the steel sleeve C, as shown in Figs. 6, 7, and 9; this pulley is made to fit either spindle. A

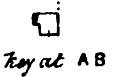


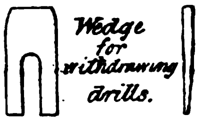


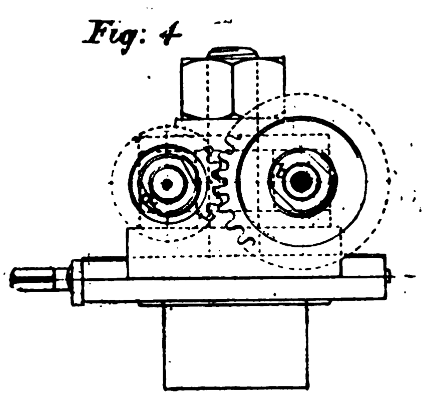


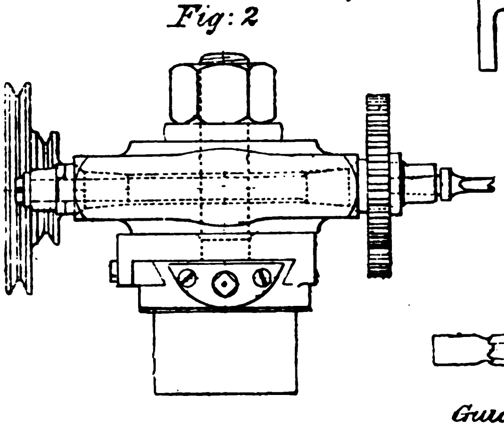


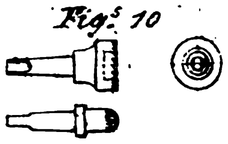


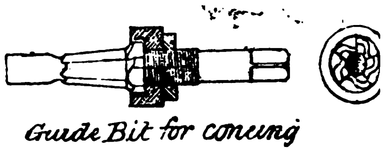


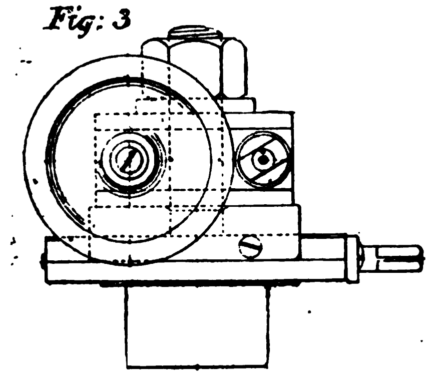


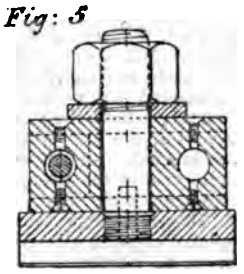


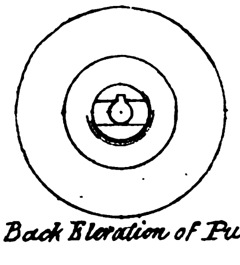












second short sleeve is, however necessary to keep the other loose cone up to its work when both spindles are running. When the working spindle only is in use, say for light work, the other, or driving spindle, may be entirely withdrawn from the working end, or the gear-wheel may be removed, whichever is most convenient—it is immaterial which, the only object being to save wear on the driving spindle; the pulley is arranged so as to work clear of each, on whichever it is running. In making the pattern for the body and pulley, choose some hard wood, such as plane, or sycamore, both being very suitable where clean, sharp castings are required. When finished, coat them with either shellac varnish or sealing-wax dissolved in methylated spirit. If the tool is intended for a lathe over 4in. centres, core prints for the bolt-hole may be fixed on the pattern but for any smaller size it is best to bore the hole out of the solid, either on the face-plate or the drilling machine; the former is, however, preferable, as giving a truer hole, and also that one side can be faced true at the same time. The hole is to be bored an easy fit over the tool-holder bolt, but not a loose one. Having bored to fit, and surfaced the flat bearing, take the work off the plate and square up both sides and both ends, *true* with *the flat surface just turned.* We now have some true planes to work from. Take off the tool-holder, and in its place fix the new work and screw down to a fairly tight bearing. Have your lathe centres nice and sharp, and traverse the four end faces against the mandrel and poppet-head centres so as to scribe them for spindle centres; turn the work round end for end, and repeat the operation. If the centres come to the same lines the tool-table is parallel with the axis of lathe centres; but it may not be so square to the lathe axis, and therefore the new work must be swivelled round square to bed, and tested with scribing block from lathe-bed; if the scribed lines agree, the tool-table is in accurate plane adjustment with lathe-bed and centres, and the new work can be proceeded with. Take the new work off the rest and place it on edge (always use the same) on the surface plate, or, if you do not possess one, on your lathe-bed, which will be sufficiently true, and with the scribing block, set to coincide with the already scribed lines, mark as intersections each end, and slightly mark with fine centre-punch; then, with spring dividers, from drawing, take distance between spindle, and, with centre-punch marks as centres, set off on either end the distance for second spindle centres. Next, replace the work on slide-rest, and test all four intersections to agree with lathe centres; if all agree, mark all four centres with centre-punch deep enough for drilling. The next operation will be to either turn or file up the other face round bolt-hole, which is an easy operation; but care must be taken to test by the four centres on the s
plates during the progress of the work, an
to keep the two surfaces equidistant fro
plane of spindles, otherwise the spindle
only come true to lathe centres on one side,
if reversed or turned over, they will be
slightly above or below. The next ope
will be to drill up the punched centres
small (say, from $\frac{1}{16}$in. to $\frac{3}{32}$in.) twist-drill
ning perfectly true. Fix the new work
on the tool-post, see that the centres agre
mandrel and poppet centres—this is essen
run on your drill chuck, and drill leading
in each punched centre, about $\frac{1}{2}$in. deep, f
very gently, and being careful to keep dril
Having done this, fit a twist-drill in chuc
a little larger (say $\frac{7}{16}$in.) than the middle di
of spindles, as in drawing. With this bor
through at once, or from either end, if pre
and if the work has hitherto been carefully
the holes will meet true; but should the
trifling ridge at meeting, it can be recti
broaching, or may be left as the drill le
as the spindles do not bear at this point
the space round them serving as an oil ch
Having drilled the two spindle holes succe
we now have to cone them for the two be
This is best accomplished by the use of a
guide-bit, taper, half-round, or fluted, th
part turned to accurately fit the bore-h
sketch of this bit is shown. It is to ru

he, one end on centre, the guide end in bore-hole.
ie author, for driving this tool, uses a pulley-
rrier with four screws, like a bell-chuck, drives
om overhead, feeds from leading screw or
ppet-head—preferably the latter—and works
om either end—i.e., one end of bit running on
ndrel centre; then change over, and run on
ppet-head centre, feeding as before, but in
ch case gently. This being done, it only
mains to turn up the four ends square, and
amfered or rounded corners to taste of operator;
drill oil-holes at centre or middle of each
indle-hole, and to grind in the spindles and
el counter-collars in places. The spindles next
im our attention. It is assumed that, before
mmencing the work, a proper drawing has
en carefully made, and also carefully dimen-
ned; assuming this, we will proceed. The
thor has found, after many years' experience,
t for cone bearings for this class of light high-
ed machinery, an angle of 12° for the entire
e, or 6° on either side of the centre-lines, to
the most suitable. To this is added the usual
ulder bearing, making a cone of 45°. (The
ide conical bit above mentioned should there-
e be made to these proportions), and the length
cone bearing from 1¾ to 2 diameters at base.
ese proportions give a very large surface for
ar, and yet, if carefully made, run very light.
ving cut the steel for spindles to proper
gth, proceed to rough them out, leaving at
st 1-32in. diam. to remove at cone and nose
ls; finish cylindrical part below cone to
e, and lay aside. We must now proceed
make the counter-cone sleeves from round
r steel; cut them to proper length (or
two may be turned and bored in one piece
d cut in two when nearly finished), and begin by
illing right through with a twist-drill, and finish
le with a half-round bit to suit the size of
indle-shanks, on which the sleeves have to
ide, a good, but not a binding, fit; turn down
e cone seats very nearly to size; cut in two,
d proceed to file up the clutch-tooth), which is
engage into a corresponding notch on the
lley-hub. The pulley must now be taken in
nd: mount it, hub outwards, on a scroll chuck,
d grip tight; bore out and finish hole same as
r cone-sleeves, face end of hub, and turn up as
ch of the pulley as is possible without un-
cking; then, while still held in chuck, file out
d fit the notch to receive the protruding tooth
cone-sleeves (the same work must be done on
short, extra sleeve); remount on lathe, and
the lathe is suitable, proceed to cut the key-
ooves as shown in Fig. 9. The author does
slotted work in the lathe, the work being held
id, and even without spring, by an arrange-
nt which will be described in another article;
slotting-tool being clamped on the tool-
le, and the necessary motion obtained by
rking the saddle, either by the winding pinion
d rack, or by a rod and level working on a
crum, which can be fixed at any part of the
he-bed to suit the work (this will also be
cribed later on). A key seat must also be cut
the end of each spindle, and into both pulley
d spindle-grooves; when in place, steel
s are to be well fitted. These keys are, of
se, not fast with the spindles; otherwise, the
e sleeves could not be slipped on or off, but
y are held in place by the washers and screws
end of spindles. The best way to cut these
ts is in the lathe, either with a square-edged
ling-cutter mounted on the "cutting-frame"
ndle, or by a slot-drill carried in the
rill-spindle." The seats should be cut
ut ⅛in. longer than the pulley-hub, to
w for "taking up" for wear of cones,
l the washers, when all is in place, should be
k enough to protrude about $\frac{1}{16}$in. beyond end
pindle. They should also be grooved to fit
r key, so as to prevent them from turning,
thus working the end screw loose. If pre-
ed, the end of spindles can be threaded or
wed and fitted with a nut, instead of the
w tapped in: it is immaterial which. The
ley, after being grooved, and the clutch fitted,
y be finished either on a mandrel, or on its
n spindle. If the key slotting in pulley, &c.,
not be done on the operator's lathe: the best
y will then be to file them out, and for this
pose, what are termed "kit files" are the best.
y are to be obtained of Buck, in Tottenham-
rt-road; they are small—about 4in.—and vary
thickness from $\frac{1}{16}$in. to $\frac{3}{16}$in., and are cut on
edges only. The nose or working end of the
l-spindle is, of course, bored up to receive the
s; the hole may be either taper or cylindrical

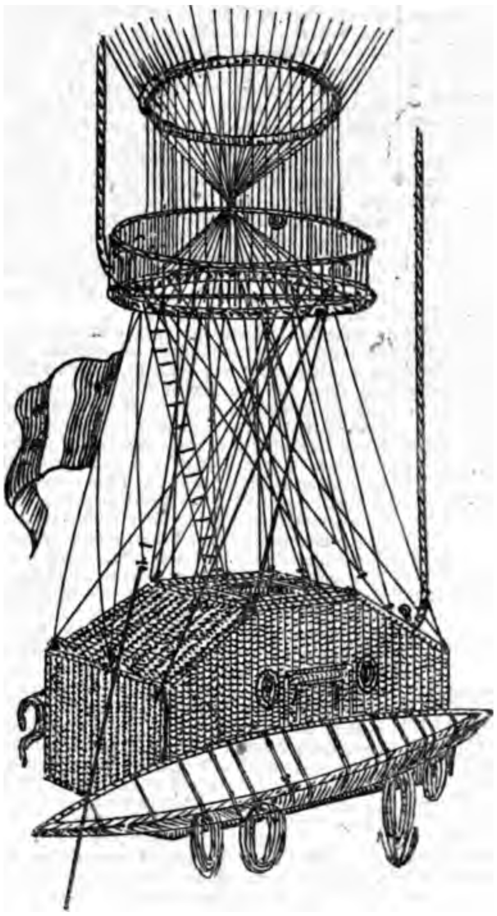


FIG. 1.

FIG. 2.

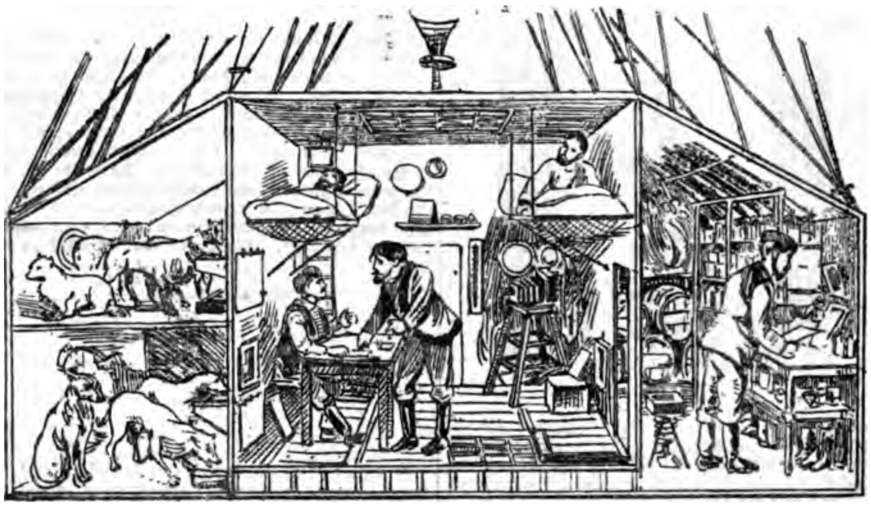


FIG. 3.

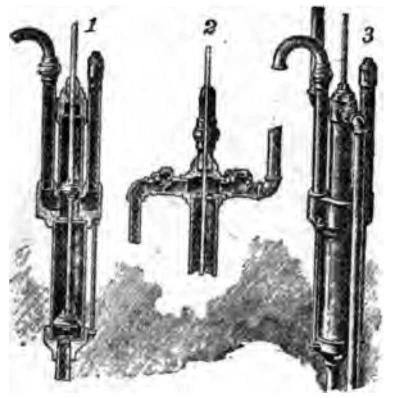
—the former being the best; a mortise is cut quite through, and shown in Figs, 6, 7, and 8, and finished with a drift. Into this mortise, and the key seat cut as shown, is fitted and driven in tight the key shown at A B. The hole for the tools is not to be drilled deeper than the front edge of mortise; a leading hole may, however, be previously entered, the diameter of which must not exceed the width or thickness of mortise and key, to suit end of tools, as shown, Fig. 10. The screw-thread on the nose of both spindles is a fine one, 48 per inch; on these are fitted the nuts *a* and *b*, as shown, to keep the steel gears in place. For hardening the cone ends of spindles, heat them to cherry red, quench them in cold linseed-oil, then heat them over a gas-flame till the oil still remaining on them takes fire; let this burn quite off, but away from the gas-flame, and then cool in cold water. This mode of tempering, called "flaring," leaves the steel remarkably tough, sufficiently hard to resist wear, and just soft enough for a good Stubb's graver to attack it when finishing off between centres, after tracing. When grinding in the spindle-cones and counter-cones, use only Turkey-stone dust and oil, and finish with finely-powdered pumice-stone; on no account use emery, as it beds into the metal, and soon causes the bearings to run slack. Careful fitting and little grinding is best. The gears were cut, in the original, from some large "burrs" which had been sent to the author as samples of metal and clean punching from one of our large shipbuilding firms. They were punched out of ½in. mild steel "ship plate," were 2¼in. diam., and were remarkably clean cut and good specimens of work and metal. This is mentioned merely to show how useful even "scrap" is; even 1in. or ½in. punched burrs of mild steel are very useful. Such, however, is not the case with iron, the burrs being nearly always laminated round the edge, and therefore useless.

## OVER THE NORTH POLE IN A BALLOON.

TWO young Frenchmen, members of the High School of Aërial Navigation, Paris, seriously propose to examine the North Polar regions from the car of a balloon, which they hope to be able to navigate from the northern part of Spitsbergen to some part of Alaska, passing along a line which runs between Cape Barrow and the Wrangel Islands, and, so going directly over the North Pole, touches Northern Alaska. The cost of the expedition is estimated at £20,000, a portion of which has, we believe, already been expended in building a vessel to take the adventurers and their aërial ship to Spitzbergen, whence they hope to start by the aid of favourable winds in the early summer of 1892. The aëronauts are M. Bisançon and M. Hermite, both skilled balloonists, and fully aware of the risks they run. The balloon is to be spherical in shape, 90ft. in diameter, and will be made in two skins of Chinese silk, having an impermeable varnish as a coating, and will be inflated with hydrogen. The arrangement of the "car" and suspending ropes is shown in Fig. 1, while Fig. 2 represents one of several small balloons suspended round the circumference of the large one, to be used as occasion may require for dispatching with messages or for other purposes. Fig. 3 is a section of the "car," which, it will be seen, is a sort of cabin with a store and laboratory on one side and kennels for Eskimo dogs on the other. If only the aëronauts can catch a favourable wind, they expect to float over the icy regions in about nine days, and may probably return by one of the sealing schooners which frequent Behring's Straits.

## THE DACUS AËRATING PUMP.

THE pump shown in the illustrations has been devised and patented by Mr. R. H. Dacus, of Dardanelle, Arkansas, U.S.A., for the purpose of aërating water as it is pumped into cisterns or other vessels. The pump acts either as "lift" or "force," and may be found useful in connection with well and other waters, as aëration undoubtedly helps to purify them. It consists of two single-acting pump barrels and pistons arranged in vertical alignment, one above the other, the piston rods being joined together. Fig. 1 shows this arrangement in section. The lower piston contains a valve opening upward, and a similar valve closes the lower end of the lower cylinder. On the right of the section is seen a closed pipe that acts as air reservoir, on the left is the water discharge pipe. This combination represents the ordinary force pump, and works accordingly. The cylinder and piston which surmount it form an air pump. In Fig. 2 the arrangement of the valves and connections of the upper cylinder is shown. The pipe on the right, which extends up to the surface of the ground, with valve opening inward, admits air to the cylinder on the down stroke of the piston. The pipe on the left, with valve opening outward, leads down to the bottom of the well. On the up stroke of the piston, the air from the cylinder above it is expelled through this pipe, bubbling through and aërating the water in the well. The two pump chambers are connected by a chambered union coupling, and in Fig. 3 the method of assembling the parts is illustrated.



## THE ELECTRO-MAGNET.—V.*

### General Principles of Design and Construction. — Principle of the Magnetic Circuit.

WE have now to discuss the law of the magnetic circuit in its application to the electro-magnet, and in particular to dwell upon some experimental results which have been obtained from time to time by different authorities as to the relation between the construction of the various parts of an electro-magnet, and the effect of that construction on its performance. We have to deal not only with the size, section, length, and material of the iron cores, and of the armatures of iron; but we have to deal also with the winding of the upper coil, and its form; and we have to speak in particular about the way in which the shaping of the core and of the armature affects the performance of the electro-magnet in acting on its armature, whether in contact or at a distance. But before we enter on the last more difficult part of the subject, we will deal solely and exclusively with the law of force of the magnet upon its armature when the two are in contact with one another; in other words, with the law of traction.

Now this law requires to be written out in a form that can be used for future calculation. To put it in words without any symbols, we must first reckon out from the number of turns of wire in the coil, and the number of ampères of current which circulates in them, the whole magneto-motive force—the whole of that which tends to drive magnetism along the piece of iron—for it is, in fact, proportional to the strength of the current and the number of times it circulates. Next we must ascertain the resistance which the magnetic circuit offers to the passage of the magnetic lines. I here avowedly use Joule's own expression, which was afterwards adopted by Rowland, and, for short, so as to avoid having four words, we may simply call it the magnetic resistance. Mr. Heaviside has suggested as an advisable alternative term, magnetic reluctance, in order that we may not confuse the resistance to magnetism in the magnetic circuit with the resistance to the flow of current in an electric circuit. However, we need not quarrel about terms; magnetic reluctance is sufficiently expressive. Then having found these two, the quotient of them gives us a number representing—I must not call it the strength of the magnetic current—I will call it simply the quantity or number of magnetic lines which flow round the circuit; or if we could adopt a term which is used on the Continent, we might call it simply the magnetic flux: the flux of magnetism being the analogue of the flow of electricity in the electric law. The law of the magnetic circuit may then be stated as follows:

$$\text{Magnetic flux} = \frac{\text{magneto-motive force}}{\text{reluctance}}$$

However, it is more convenient to deal with these matters in symbols, and therefore the symbols which I use, and have long been using, ought to be explained to you. For the number of spirals in a winding I use the letter S; for the strength of current, or number of ampères, the letter $i$; for the length of a bar, or core, I am going to use the letter $l$; for the area of cross section, the letter A; for the permeability of the iron which we discussed in the last lecture, the Greek symbol $\mu$; and for the total magnetic flux, the number of magnetic lines, I use the letter N. Then our law becomes as follows:

$$\text{Magneto-motive force } \frac{4\pi\,\mathrm{S}i}{10}$$

$$\text{Magnetic reluctance } \Sigma\frac{l}{\mathrm{A}\mu}$$

$$\text{Magnetic flux} \ldots\ldots\ \mathrm{N} = \frac{\frac{4\pi\cdot\mathrm{S}i}{10}}{\Sigma\frac{l}{\mathrm{A}\mu}}$$

If we take the number of spirals and multiply by the number of ampères of current, so as to get the whole amount of circulation of electric current expressed in so many ampère turns, and multiply by $4\pi$, and divide by 10, in order to get the proper unit (that is to say, multiply it by 1·257), that gives us the magneto-motive force. For magnetic reluctance, calculate out the reluctance exactly as you would the resistance of an electric conductor to the flow of electricity, or the resistance of a conductor of heat to the flow of heat; it will be proportionate to the length, inversely proportional to the cross-section, and inversely proportional to the conductivity, or, in the present case, to the magnetic permeability. Now if the circuit is a simple one, we may simply write down here the length, and divide it by the area of the cross-section and the permeability, and so find the value of the reluctance. But if the circuit be not a simple one, if you have not a simple ring of iron of equal section all round, it is necessary to consider the circuit in pieces as you would an electric circuit, ascertaining separately the reluctance of the separate parts, and adding all together. As there may be a number of such terms to be added together, I have prefixed the expression for the magnetic reluctance by the sign of Σ of summation. But it does not by any means follow because we can write a thing down as simply as that, that the calculation out of it will be a very simple matter. In the case of magnetic lines we are quite unable to do as one does with electric currents to insulate the flow. An electric current can be confined (provided we do not put it in at 10,000 volts pressure, or anything much bigger than that) to a copper conductor by an adequate layer of adequately strong—and I use the word "strong" both in a mechanical and electrical sense—of adequately strong insulating material. There are materials whose conductivity for electricity as compared with copper may be regarded perhaps as millions of millions of millions of times less; that is to say, they are practically perfect insulators. There are no such things for magnetism. The most highly insulating substance we know of for magnetism is certainly not 10,000 times less permeable to magnetism than the most highly magnetisable substance we know of—namely, iron in its best condition; and when one deals with electro-magnets where curved portions of iron are surrounded with copper, or with air, or other insulating material, one is dealing with substances whose permeability, instead of being infinitely small, compared with the iron is quite considerable. We have to deal mainly with iron when it has been well magnetised. Its permeability compared with air is from 1,000 to 100 roughly; that is to say, the permeability of air compared with the iron is not less than from $\frac{1}{100}$th to $\frac{1}{1000}$th part. That means that it is quite possible to have a very considerable leakage of magnetic lines from iron into air occurring to complicate one's calculations, and prevent an accurate estimate being made of the true magnetic reluctance of any part of the circuit. Suppose, however, that we have got over all these difficulties, and made our calculations of the magnetic reluctance; then dividing the magneto-motive force by the reluctance gives us the whole number of magnetic lines.

The law of traction has been verified by experiment. The most conclusive investigations were made about 1886 by Mr. R. H. M. Bosanquet, of Oxford, whose apparatus is depicted in Fig. 15.

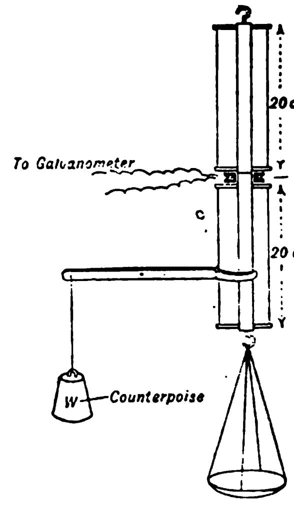


FIG. 15.—Bosanquet's Verification of the Law of Traction.

He took two cores of iron, well faced, and surrounded them both by magnetising coils, fastened the upper one rigidly, and suspended the other one on a lever with a counterpoise weight. To the lower end of this core he hung a scale-pan, and measured the traction of one upon the other when a known current was circulating a known number of times round the coil. At the same time he placed an exploring coil round the joint, that exploring coil being connected, in the manner with which we experimented, with a ballistic galvanometer, so that at the moment when the two surfaces parted company, or at the moment when the magnetisation was released by reversing the magnetising current, the galvanometer indication enabled you to say exactly how many magnetic lines went through the exploring coil. So that, knowing the area, you could calculate the number per square centimètre, and you could therefore compare B² with the pull per square centimètre obtained directly on the scale-pan. Bosanquet found that even when the surfaces were not absolutely perfectly faced, the correspondence was very close indeed, not varying by more than 1 or 2 per cent., except with small magnetising forces, say forces less than five units. When one knows how irregular the behaviour of iron is when the magnetising forces are so small as this, one is not astonished to find a lack of proportionality. The correspondence was, however, sufficiently exact to say that the experiments verified the law of traction, that the pull is proportional to the square of magnetic induction through the area, and integrated over that area.

Now the law of traction being in that way established, one at once begins to get some light upon the subject of the design of electro-magnets. Indeed, without going into any mathematics, Joule had foreseen this when he in some instinctive sort of way seemed to consider that the proper way to regard an electro-magnet, for the purpose of traction, was to think how many square inches of contact surface it had. He found that he could magnetise iron up until it pulled with a force of 175lb. to the square inch, and he doubted whether a traction as great as 200lb. per square inch could be obtained. If you want to design an electro-magnet to carry a load of one ton, divide the ton, or 2,240lb., by 150, and that gives the requisite number of square inches of wrought-iron, namely, 14·92, or say 15. Of course one would work with a horse-shoe shaped magnet, or something equivalent—something with a return circuit—and calculate out the requisite cross-section, so that the total area exposed might be sufficient to carry the given load at 150lb. to the square inch. And, as a horse-shoe magnet has two poles, the cross-section of the bar of which it is made must be 7½ square inches. If of round iron, it must be about 3¼in. in diameter; if of square iron, it must be 2¾in. each way.

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* Extracted from the Cantor Lectures delivered by Prof. SILVANUS P. THOMPSON, B.Sc., before the Society of Arts.

That settles the size of the iron, but not the length. Now, the length of the iron, if one only considers the law of the magnetic circuit, ought to be as short as it can possibly be made. Reflect for what purpose we are designing. The design of an electro-magnet is to be considered, as every design ought to be, with a view to the ultimate purpose to be served by that which you are designing. The present purpose is the actual sticking on of the magnet to a heavy weight, not acting on another magnet at a distance, not pulling at an armature separated from it by a thick layer of air; we are dealing with traction in contact. The question is—how long a piece of iron shall we need to bend over. The answer is—take length enough, and no more than enough, to permit of room for winding on the necessary quantity of wire to carry the current which will give the requisite magnetising power. But this latter we do not yet know; it has to be calculated out by the law of the magnetic circuit. That is to say, we must calculate the magnetic flux and the magnetic reluctance as best we can; then from these calculate the ampère-turns of current: and from this calculate the needful quantity of copper wire, so arriving finally at the proper length of the iron core. It is obvious the cross-section being given, and the value of B being prescribed, that settles the whole number of magnetic lines, N, that will go through the section. It is self-evident that length adds to the magnetic resistance; and therefore, the longer the length is, the greater have to be the number of ampère-turns of circulation of the current; while the less the length is, the smaller need be number of ampère-turns of circulation. Therefore you should design the electro-magnet as stumpy as possible—that is to say, make it a stumpy arch, even as Joule did when he came across the same problem, and arrived, by a sort of scientific instinct, at the right solution. You should have no greater length of iron than is necessary in order to get the windings on. Then you see we cannot absolutely calculate the length of the iron until we have an idea about the winding, and we must settle, therefore, provisionally, about the windings. Take a simple ideal case. Suppose we had an indefinitely long, straight iron rod, and we wound that from end to end with a magnetising coil. How thick a coil, how many ampère-turns of circulation per inch length will you require in order to magnetise up to any particular degree? It is a matter of very simple calculation. You can calculate exactly what the magnetic reluctance of an inch length of the core will be. For example, if you are going to magnetise up to 16,000 lines per square centimètre, the permeability will be 320. You can take the area anything you like, and consider the length of one inch; you can therefore calculate the magnetic reluctance per inch of conductor, and then you can at once say how many ampère-turns per inch would be necessary in order to give the desired indication of 16,000 magnetic lines to the square centimètre. And knowing the properties of copper wire, and how it heats up when there is a current; and knowing also how much heat you can get rid of per square inch of surface, it is a very simple matter to calculate what minimum thickness of copper the fire insurance companies would allow you to use. They would not allow you to have too thin a copper wire, because if you provide an insufficient thickness of copper, you still must drive your ampères through it to get a sufficient number of ampère-turns per inch of length; and if you drive those ampères through copper winding of an insufficient thickness the copper wire will over-heat, and your insurance policy will be revoked. You therefore are compelled, by the practical consideration of not over-heating, to provide a certain thickness of copper-wire winding. I have made a rough calculation for certain cases, and I find that for such electro-magnets as one may ordinarily deal with, it is not necessary in any case of practical work to use a copper-wire winding the total thickness of which is greater than about ½in.; and, as a matter of fact, if you use as much as ½in., you need not then wind the coil all along, for if you will use copper-wire winding, no matter what the size, whether thin or thick, so that the total thickness of copper outside the iron is ½in., you can without over-heating, using good wrought iron, make 1in. winding do for 20in. length of iron. That is to say, you do not really want more than $\frac{1}{40}$in. of thickness of copper outside the iron to magnetise up to the prescribed degree of saturation that indefinitely long piece of which we are thinking, without overheating the outside surface in such a way as to violate the insurance rules. Take it roughly, if you wind to a thickness of ½in., the inch length of copper will magnetise 20in. length of iron up to the point where B equals 16,000. If, then, we have a bar bent into a sort of horse-shoe in order to make it stick on to a perfectly-fitting armature, also of equal section and quality, we really do not want more than 1in. along the inner curve for every 20in. of iron. An extremely stumpy magnet, such as I have sketched in Fig. 16, will, therefore, do, if one can only get the iron sufficiently homogeneous throughout. If, instead of crowding the wire near the polar parts, we could wind entirely all round the curved part, though the layer of copper winding would be ½in. thick inside the arch, it would be much less outside. Such a magnet, provided the armature fitted with perfect accuracy to the polar surfaces, and provided a battery were arranged to send the requisite number of ampères of current through the coils, would pull with a force of one ton, the iron being but 3¼in. in diameter. For my own part, in this case I should prefer not to use round iron, one of square or rectangular section being more convenient; but the round iron would take less copper in winding, as each turn would be of minimum length if the section were circular.

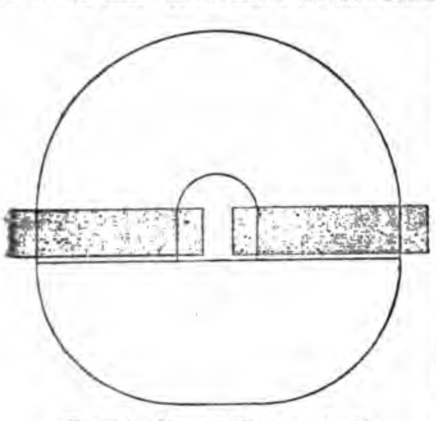

FIG. 16.—Stumpy Electro-magnet.

B was found in the following way: Take the pull in pounds, and the area in cross-section in square inches; divide one by the other, and take the square root of the quotient; then, multiplying by 1,317, gives B; or, multiplied by 8,494, gives $B_{''}$. We have, therefore, a means of stepping from the pull per square inch to $B_{''}$, or from $B_{''}$ to the pull per square inch. Now the other rule of the magnetic circuit also enables us to get from the ampère-turns down to $B_{''}$, for on p. 891 we have the following expression for the ampère-turns:—

$$S\,i = N \times \Sigma\,\frac{l''}{A''\mu} \times 0{\cdot}3133,$$

and N, the whole number of magnetic lines in the magnetic circuit is equal to B, multiplied by $A''$, or—

$$N = B_{''}A''.$$

From these we can deduce a simple direct expression, provided we assume the quality of iron as before, and also assume that there is no magnetic leakage, and that the area of cross-section is the same all round the circuit, in the armature as well as in the magnet core. So that $l''$ is simply the mean total path of the magnetic lines all round the closed magnetic circuit. We may then write—

$$S\,i = \frac{B_{''}l''}{\mu} \times 0{\cdot}3133;$$

whence—

$$B_{''} = \frac{\mu \times S\,i}{l'' \times 0{\cdot}3133}.$$

But by the law of traction, as stated above—

$$B_{''} = 8{,}494\sqrt{\frac{P\ (\text{lbs.})}{A\ (\text{sq. in.})}}$$

Equating together these two values of $B_{''}$, and solving, we get for the requisite number of ampere-turns of circulation of exciting currents—

$$S\,i = 2{,}661 \times \frac{l''}{\mu} \times \sqrt{\frac{P\ (\text{lbs})}{A\ (\text{sq. in.})}}$$

This, put into words, amounts to the following rule for calculating the amount of exciting power that is required for an electro-magnet pulling at its armature, in the case where there is a closed magnetic circuit with no leakage of magnetic lines. Take the square root of the pounds-per-square-inch; multiply this by the mean total length (in inches) all round the iron circuit; divide by the permeability (which must be calculated from the pounds-per-square-inch by help of Table VI. and Table II.); and finally multiply by 2,661: the number so obtained will be the number of ampère-turns. One goes then at once from the pull per square inch to the number of ampère-turns required to produce that pull in a magnet of given length, and of the prescribed quality. In the case where the pull is specified in kilogrammes, the area of section in square centimètres, and the length in centimètres, the formula becomes—

$$S\,i = 3{,}951\,.\,\frac{l}{\mu}\sqrt{\frac{P}{A}}\,.$$

As an example, take a magnet core of round annealed wrought iron, ½in. in diameter, 8in. long, bent to horse-shoe shape. As an armature, another piece, 4in. long, bent to meet the former. Let us agree to magnetise the iron up to the pitch of pulling with 112lb. to the square inch. Reference to Table VI. shows that $B_{''}$ will be about 90,000, and Table II. shows that in that case $\mu$ will be about 907. From these data calculate what load the magnet will carry, and how many ampere-turns of circulation of current will be needed.

Ans.—Load (on two poles) = 43·97lb.
Ampere-turns needed = 372·5

N.B.—In this calculation it is assumed that the contact surface between armature and magnet is perfect. It never is; the joint offers additional resistance to the magnetic lines, and there will be some leakage. It will be shown later how to estimate these effects, and to allow for them in the calculations.

# SCIENTIFIC SOCIETIES.

## LIVERPOOL ASTRONOMICAL SOCIETY.

THE second general meeting of the society was held in the rooms of the Royal Institution, Colquitt-street, Liverpool.

In the absence of the President, Mr. W. C. Hutchinson, F.R.A.S., of The Observatory, Liversedge, Yorks, Captain Jefferey, F.R.Met.Soc., occupied the chair. A number of papers were presented. Mr. I. C. Quinn read one on the subject of "Giant Suns." Mr. J. E. Gore, F.R.A.S., and the Rev. J. Mitchell, B.D., read one from Mr. S. E. Peal, of Sibsagar, on the "Solar Influence on the Lunar Equator," in support of his theory of lunar glaciation, both of which elicited considerable discussion of a most interesting kind.

The first number of the *Journal* for the session 1890-1, containing the president's address and six other valuable papers, with three pages of illustrations, was issued before the end of last month; and the secretary intimated that the council had made arrangements to have the *Journal* issued on the same—or at least, the following—week to that on which the meetings are held. The meetings are held in the rooms of the above institution on the first Monday of each month at 7.30 p.m.

The following are the officers and members of council for the present session. President: Mr. W. B. Hutchinson, F.R.A.S., Liversedge, Yorks. Vice Presidents: Mr. R. C. Johnstone, F.R.A.S., Hackin's Hey, Liverpool; Mr. J. Gill, F.R.A.S., 2, Beech Mount, Liverpool; Lieut. J. McNab, R.N.R., 10, Sandown-street, Liverpool; Commander J. T. Bragg, R.N.R., Lorton Lodge, Birkdale. Council: Rev. Canon J. Honeyburne, F.R.A.S., Princes Park, Liverpool; Rev. John Mitchell, B.D., 57, Parkgrove-road, Chester; Mr. Geo. Higgs, F.R.A.S., West Derby-road, Liverpool; Mr. C. A. Defieu, Sandston-road, Stoneycroft, Liverpool; Mr. R. McMillan, Everton, Liverpool; Mr. J. C. Quinn, Gateacre House, Liverpool; Mr. S. H. Coventy, Crowborough, Sussex; Rev. P. H. Slade, F.R.A.S., Westcott-street, Hull. Secretary: Mr. A. W. Jefferey, F.R.Met.Soc., "Plym," Temple-road, Birkenhead. Librarian: Mr. J. L. Coxen, 3, Brunswick-square, Kirkdale, Liverpool. Treasurer: North and South Wales Bank, Liverpool.

## WESTERN MICROSCOPICAL CLUB.

ON Monday week this club held its first meeting for the new session. The hon. secretary, Mr. A. W. Stokes, F.I.C., introduced the subject of "The Microscope in Food Analysis." He pointed out and illustrated by slides the use of the microscope not only in determining the presence of adulteration, but also in some cases showed that it was the only instrument for determining also the extent of the adulteration. Thus in the cases of starch admixtures, such as barley with oatmeal, the microscope is the only instrument that can be employed. Having found that the admixture has taken place, mixtures containing known weights of two starches are made and shaken up with the same quantities of water. A drop of each mixture is placed on a slide ruled into minute squares. Under the microscope the number of each starch is counted on some dozen squares. The sample in question is treated with the same quantity of water, and counted off on the same slide. That mixture giving the same relative proportion of different starch granules, shows the extent of admixture. In moist sugar, the microscope often shows the presence of the *Acarus saccharinus*, to which the "grocer's itch" is attributed. To find whether rice or potatoes have been used in bread-making, it is necessary to examine the dried flour from outside the loaf, and to search for the little nodules of unwetted flour occasionally found inside the loaf. Examinations of these will show the distinctive starch granules; but in the part wetted by water, microscopical examination is useless, since the starch granules have all swollen up and burst. In milk the microscope will occasionally show the colosteum, pointing out that the milk comes from a recently-calved cow. Very rarely blood globules, and even pus, are found, indicative of the cow's teats having been injured in some way. Infective germs have not yet been microscopically detected. In the examination of butter the microscope is especially useful; using the polariscope with crossed Nicol prisms, a sample of the butter mixed with butterine is at once seen to polarise, while butter does not polarise. On some thousands of samples of butter, Mr. Stokes has never found this test to fail. No butter that passed this test was afterwards chemically found to contain foreign fat. In coffee, reference was made to the fact that no scalariform, spiral, or large-celled tissue was to be found in coffee, nor was any starch present; this at once separated it from the various adulterants, chicory, dandelion, turnip, or other roots, as well as from burnt beans, peas, acorns, and other seeds—all that is necessary being to decolour, by means of chloride of lime, a small part of the mixture and examine it microscopically. The absurdity of allowing vendors to pass off on customers who ask for "coffee" a mixture containing usually from 60 to 70 (and sometimes as much as 90) per cent. of chicory, was pointed out. Many magistrates hold that this may be done if only the magic words "sold as a mixture" appears somewhere amongst the voluminous lot of advertisements in which the material is wrapped. The trade, of course, take advantage of this license. In cocoa the microscope at once shows, if a slide is made with alcohol instead of water, the presence of sugar and foreign starch, usually arrowroot. In "homœopathic cocoa" the cocoa is truly homœopathic; the bulk consists of arrowroot and sugar—what little cocoa there is has been deprived of its fat. In water, an examination of the sediment often gives very valuable information, the presence or absence of infusoria, &c., are indications of moment. The method of putting up the object for examination is all important. Let anyone put up a slide of mustard in water and one in glycerine, he would hardly recognise them as the same object; while the superiority of the glycerine mount is immediately obvious. The ordinary adulterants, wheaten flour and turmeric, come out very plainly. The polariscope is too little used by analysts. In such a substance as pepper it will distinguish between ordinary "long pepper," and will make obvious the presence of rice or of "poivrette" (ground olive stones) if the material be mounted in glycerine. For medicines and other samples whose composition is unknown, a drop evaporated on a slide and then examined microscopically may show peculiar crystals, or at times show that the fluid contains no solid matter. Usually, if it be a vegetable extract, pieces of vegetable tissue, or spores, may be found in the sediment. All these give clues which may be followed up chemically. In the examination of diseased or parasite-infested meat the microscope has no substitute, nor can the mass of jams be otherwise examined.

EXTENSIVE seams of coal have, it is stated, been discovered on the Duke of Portland's estate at Gringley Carr, North Notts. Two labourers came upon a deposit at a depth of 4ft., and if experimental borings now going on should warrant, a shaft is to be sunk. The district is not yet opened up by a railway.

**Edible Fungi.**—The following is a list of the edible fungi exhibited for sale in the market of Modena during 1889:—Amanita cæsarea, A. avoidea, A. strobiliformis, Lepiota excoriata, L. naucina, Armillaria mellea, Pleurotus ulmarius, P. glandulosus, Entoloma Rhodopolius, Pholiota mutabilis, P. Aegerita, Psalliota campestris, Morchella esculenta, M. conica, M. rimosipes, Helvella monachella, H. crispa, Peziza vesiculosa, P. cerea, P. Acetabulum, Tuber magnatum, T. æstivum, Balsamia vulgaris. The greater number of these species are also natives of Britain. On the other side the Berlin police have issued a caution to the public against so-called "dried mushrooms," which are being sold, and which very frequently contain poisonous fungi. The caution calls attention to the fact that edible mushrooms when dried remain white, while poisonous varieties acquire a bluish tint.

# SCIENTIFIC NEWS.

WE understand that Barnard's Inn, Holborn, E.C., has been selected as the quarters of the British Astronomical Association, and the forthcoming meeting will be held there, in the large hall, on Wednesday, the 26th inst. Barnard's Inn is a few yards west of the Holborn end of Fetter-lane, and is within easy reach of the underground system of railways, and of the L. C. and D. Railway and lines in connection, while there is a good service of 'busses to all parts. The number of members now exceeds 300.

In Circular No. 27 of the Wolsingham Observatory the Rev. T. E. Espin says that "the star D.M. + 33°: 470; R.A. 11h. 28m. 16s. Decl. + 33° 38′ (1855), mag. 9·2, was observed on Nov. 7 as 7·5, Or. III. type. The star is probably variable."

For the benefit of those who have the optical means of observing D'Arrest's Comet (Barnard *d* 1890) we append the position for Greenwich midnight on Nov. 16: R.A. 21h. 53m. 32s., S. Dec. 26° 1·4′; but it is scarcely likely that anyone will pick it up through the clouds over this country.

An appendix to Vol. L. of the *Monthly Notices* of the Royal Astronomical Society has been issued, containing "comparison of the places of the moon, deduced from Burckhardt's and Hansen's tables, for every Greenwich mean midnight during the years 1847-62, together with a corrected comparison of Hansen's tables with the Greenwich Observations during the years 1847-61." The introductory remarks are by Prof. J. C. Adams, M.A., F.R.S.

At a recent meeting of the Paris Academy of Sciences, M. Perrotin, of Nice, presented a note on the rotation of Venus, based on observations, made on 74 days from May to October, which support the conclusions of Signor Schiaparelli. M. Perrotin finds that the rotation of the planet is very slow, and is made in such a way that the relative positions of the spots and terminator do not experience any notable change during many days; that the time of rotation of the planet does not differ from its sidereal period of revolution (about 225 days) more than 30 days (his observations will easily accommodate themselves, however, to a rotation of which the period is from 195 to 225 days); that the axis of rotation of the planet is almost perpendicular to the plane of its orbit. The displacement of the white region observed at the northern edge indicates that the difference does not exceed 15°, as stated by Schiaparelli.

The *Journal* of the Liverpool Astronomical Society for October contains several interesting papers, amongst them one by E. M. Antoniadi, on solar observations made at Constantinople.

The death is announced of the distinguished ophthalmologist, Johann Nepomuk von Nussbaum, of Munich, a city in which he was born on Sept. 2, 1829, and where he has since (with the exception of abscences for study in Berlin and Paris) continued to work as an operator and teacher, being appointed professor of surgery and ophthalmology to the University in 1860.

The following is the list of names recommended by the President and Council of the Royal Society for election into the Council for the year 1891, at the forthcoming anniversary meeting on Dec. 1:—President, Sir William Thomson; treasurer, Dr. J. Evans; secretaries, Prof. Foster and Lord Rayleigh; foreign secretary, Dr. Geikie; other members of the Council, Prof. Ayrton, Mr. W. H. M. Christie, Prof. Boyd Dawkins, Dr. Glaisher, Dr. Müller, Prof. Alfred Newton, Sir W. Roberts, Mr. Roberts-Austen, Prof. E. Schäfer, Sir George Stokes, Lieut.-General Strachey, Prof. Joseph Thomson, Prof. Thorpe, Sir William Turner, Prof. Vines, and General Walker.

Mr. Osmund W. Jeffs, the secretary to the Geological Photographs Committee of the British Association, has issued a circular inviting co-operation in furthering the work of the committee, of which Prof. Jas. Geikie, LL.D., F.R.S., is chairman, and which was appointed to arrange for the collection, preservation, and systematic registration of photographs of geological interest in the United Kingdom, so as to form a national collection of photographs illustrating the geology of this country, to be deposited in a centre where the collection will be available for purposes of study and comparison. To secure uniformity of action on the part of the helpers, a circular of instructions has been drawn up, copies of which will be supplied on application to the secretary of the committee, Mr. Osmund W. Jeffs, 12, Queen's-road, Rock Ferry, Cheshire. Photographers and others who may not take special interest in geology are also invited to send for the form to be filled up, as some of their prints may be of considerable value.

University College, London, is now equipped with all that is necessary for the study of botany, new laboratories having been erected, while the old ones have been refitted and enlarged. A large room has been provided for advanced work, and there is a dark chamber which has been specially constructed for teaching in the advanced branch of botanical work. A conservatory has been erected on the roof with heating-apparatus, so that special work on the physiological properties of plants can be carried on, while seedlings can be raised, and selected plants be cultivated for lecture-room demonstrations.

An Australian now in this country has offered to give £5,000 as a contribution to the Antarctic expedition which it is proposed to send out from Australia. A condition, however, is that it should be got up on an adequate scale.

A curious scientific surgical instrument was exhibited the other day at Barton-on-Humber in a coroner's court. The deceased had been subject to fits and paralysis, and allowed a Hungarian to try his "patent cure" on him. The instrument was an arrangement consisting of 32 needles worked by a spring, and the patentee said that into the punctures he rubbed natt oil. He did not know what the oil was. The Coroner said he narrowly escaped being committed for manslaughter. He had cruelly tortured deceased for no good purpose, and he was getting money under false pretences. Dr. Sissons said the deceased was punctured in about 6,000 places, which would be dangerous to a strong man, but there were sufficient evidences of diseased brain and paralysis to account for death.

Prof. Koch's "lymph" is, it appears, not exactly what has been guessed at, for it contains inorganic substances together with attenuated cultures of bacillus. But nothing definite will be known until the professor speaks out, which he may do at the meeting of the Berlin Medical Society next month.

A fast war-ship for the Argentine Government has been recently tried. Built by Messrs. Armstrong, Mitchell and Co., and engined by Messrs. Humphrys, Tennant and Co., the 25 *de Mayo*, as the vessel is called, is believed to be the fastest war vessel afloat, as, with natural draught, she made a mean of 21·237 knots, and with forced draught, 22·43 knots.

The Italian Minister of Public Works has decided to submit a project for a navigable canal to connect Rome with Civita Vecchia to a mixed commission, which will consider it from nautical, commercial, and strategical points of view.

The Commissioner of Fisheries in Queensland recently returned to Brisbane from a visit to Torres Straits and along the northern coast of the colony, and he reports a successful experiment in the cultivation of pearl oysters, and regulations are being compiled to provide for the leasing of suitable areas for their cultivation.

The next meeting of the Royal Microscopical Society will be held at 20, Hanover-square, W., on the 19th instant, when papers by Mr. Arnold T. Watson on "Tube-building Habits of *Ter bella littoralis*," and Surg. V. Gunson Thorpe on a "New Marine Annelid," will be read; also an adjourned special general meeting will be held to consider an alteration of the by-laws.

MESSRS. PYKE AND HARRIS, electrical engine are introducing a novelty in the matter of electri illuminating. They employ vacuum tubes, w which the most beautiful results are obtained. They also propose to use their system for advertising, by constructing the tubes in the form o letters. The necessary current is obtained by the use of transformers instead of by the old battery Ruhmkorff coil, and the electro-motive force use is 20,000 volts, with which a number of tubes ca be lit in parallel. Owing to the small currents employed, the use of this high tension involves n danger whatever.

# LETTERS TO THE EDITOR.

*[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]*

*All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

*All Cheques and Post-office Orders to be made payable to* J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

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## THE ASTRO-PHOTOGRAPHIC CONGRESS—EUROPEAN OBSERVATORIES AND ASTRONOMICAL INSTRUMENTS—SATURN—THE CHIEF SPECTRAL LINE IN THE NEBULÆ—PARADOXERS—THE LIVERPOOL ASTRONOMICAL SOCIETY—THE POLARISCOPE—"GIRLS" IN THE BIBLE—RICHTER'S DREAM—MARS AND M. FLAMMARION—OCCULTATIONS OF STARS BY THE MOON—δ CYGNI—PROFESSIONAL ASTRONOMY—MAKING A TELESCOPE.

[31778.]—IT is but rarely that a merely scientific report presented to a Government department possesses the amount of popular interest and instruction embodied in "Appendix I. to the Washington Observations for 1885." This very able production takes the form of a report by Lieut. Albert G. Winterhalter, of the United States Navy, to the Superintendent of the Naval Observatory at Washington on the Proceedings of the International Astro-Photographic Congress held in Paris in 1887 (to which Mr. Winterhalter proceeded as a delegate), and a description from actual observation of nearly every observatory of any importance in Europe, and of the works of some of the leading astronomical instrument-makers there, &c. It fills no less than 354 closely-printed quarto pages, and its value as a repertory of information on the subjects with which it deals can hardly be overestimated. Of the proceedings of the Astro-Photographic Congress there is no need to speak at any length. Their results are by this time familiar enough to all interested in the gigantic celestial chart about to be commenced. Those, however, who wish to learn the arguments for and against the methods and processes finally decided on and adopted will find an admirable *précis* of them in the volume now before me. It is to Lieut. Winterhalter's admirable description of the great European observatories that I would invite especial attention; for, assuredly, for completeness and value there is nothing in existence equal to it in the English language. In this country he visited and describes the Royal Observatory at Greenwich; both the Radcliffe and University Observatories at Oxford; Cambridge Observatory; and those of Dr. Huggins and Mr. Common, and the Meteorological one at Kew, as well as paying a visit to the workshops of Messrs. Troughton and Simms. In France he, of course, went to the National Observatory at Nice, Meudon, &c.; in Belgium to the Royal Observatory at Brussels, and that at Liège; in the Netherlands to Leyden; in Denmark to Copenhagen; in Germany to the Royal Observatory in Berlin; as well as to others too numerous to be set down here; and he also inspected the factories of the Messrs. Repsold at Hamburg, as well as Mr. Hechelmann's manufactory of nautical instruments in the same city; and that of Dr. Steinheil in Munich. In Austria he, of course, saw the University Observatory in Vienna, with others, and the Observatory of the Hydrographic Office at Pola. He describes in more or less detail not only the buildings, but every instrument in the long list of institutions visited, such descriptions being supplemented in numerous cases by beautiful engravings of the instruments, and of the Observatories themselves; and he concludes with a section on "Sundry Astronomical and Nautical Constructions and Processes," invaluable to the practical observer. This remarkably able work furnishes an enormous mass of the most useful possible information to the working astronomer; as reference to its pages will at once show the reader the size and character of the instruments with which published observations have been made in any European Government observatory—to say nothing of numerous private ones. It reflects as much honour on Lieut. Winterhalter as it does upon the State Department at whose instance and under whose auspices it has been given to the astronomical world; and I can scarcely give it higher praise.

And if Appendix I. to the Washington Observations is thus valuable and instructive, Appendix II. possesses an interest of a different sort, but of a very high order indeed notwithstanding, for it consists of a detailed record of Prof. Asaph. Hall's observations of the planet Saturn made with the 26in. refractor of the Washington Naval Observatory from 1875 to 1889 inclusive. Prof. Hall's very numerous observations must be read *in extenso* to be thoroughly appreciated. All I can do within the limits of a letter like this is to note some of his most salient results. *Imprimis*, then, in December 1876 a white spot appeared on the globe of Saturn, by the observation of which the rotation period of the planet was determined with great accuracy, and found to be 10h. 14m. 23·8s. ± 2·30s. mean time. Sir William Herschel's observations gave him a period of 10h. 16m. 0·4s.; but in some way the time 10h. 29m. 16·8s. seems to have got into more recent astronomical books. Further, Mr. Hall makes out that Cassini's division in the rings is very far from being *black*, but is seemingly rather grey, as though it were not void of discrete matter of some sort. Encke's division—as a division—he does not believe in. His measures of the whole system, ball and rings, will be very useful to future observers. Three fine large lithographic plates exhibit the aspect of the planet in 1884 and 1885. But surely Prof. Hall never in his life saw the crape ring C so brilliant as it is depicted in the engravings before me?

Should any astronomical brother-reader of the ENGLISH MECHANIC be sufficiently weak-minded not to subscribe annually for the *Observatory* (which I hope is not the case), I would strongly advise that brother-reader to invest one shilling in the purchase of the November number of your contemporary, for the sake of several excellent and interesting articles it contains. From among them I may select two as each worth the entire price of the whole number. The first, a purely scientific one, is by Mr. E. W. Maunder, on Mr. Keeler's essay on the "Motions of the Planetary Nebulæ in the Line of Sight" (of which I myself spoke in paragraph two of letter 31735 on p. 206). So anxious is Mr. Maunder to be judicially impartial that he points out that *if* the sun is travelling through space at the rate of 36 miles a second, and *if* nebulæ in the region which he is leaving show a different displacement of the chief nebular line, "it is still *possible* that the eventual result may favour Mr. Lockyer's theory." I fancied myself that Ludwig Struve's exhaustive researches had shown that the velocity of translation of our Solar system in space is, in all probability, = ± 16 miles per second; but, of course, in one sense this is as purely hypothetical as the "magnificent theory" itself.

The second paper, of which I have spoken above, is by one of the editors of the *Observatory*, Mr. H. H. Turner, and is as clever and really humorous a one as I have seen for some time. It is on "Paradoxers," and relates his experience at the Royal Observatory of the circle-squarers, Star of Bedlamites, cosmographers, angle tri-sectors, and the rest of the noble army of martyrs who waste their sweetness on the desert air of Greenwich officialism. Some of Mr. Turner's illustrative examples are very fine. Nothing so funny as his Elderly Gentleman of the Seafaring Persuasion has, I am sorry to say, appeared in *Punch* for a very long time. Nor would it be easy to surpass the dictum of another inspired person who delivered himself of this remarkable aphorism: "I say that the earth, from the evidence of nature, ought to have as many motions as it possibly can have." My goodness me! If Carlyle or Ruskin had enunciated this pregnant sentence, how his admirers would have stood dumb before the esoteric wisdom embodied in it.

I am delighted to find, from the issue of No. I. of Vol. IX. of the *Journal* of the Liverpool Astronomical Society, that that association has risen, like the Phœnix, from its ashes, and gives good promise of again rendering valuable service in the promotion of a taste for astronomy by bringing observers into communication, and by the dissemination of accurate astronomical information. Long may it flourish!

"W. J." (queries 72759 and 72760, p. 214) should really read up some rudimentary book on the microscope to learn the use of the selenite, which in one position of the polariser and analyser gives a green field and in another a red one. It is impossible to construct a *spectroscope* with Nicol's prisms. Those used in the instrument referred to are triangular prisms of glass. Moreover, sugar solutions are examined with the polariscope, and not with the spectroscope.

"G. A. B." (query 72763, p. 214) will find the word "girl" in Joel iii. 3, and "girls" in Zechariah viii. 5.

"Stella" (query 72820, p. 215) should consult Vol. IV. of *Knowledge*, where on pp. 288 *et seq.* Richter's dream—i.e., De Quincey's translation of it—is given *in extenso*. It appears in the number for November 9th, 1883.

In paragraph eight of letter 31735 (p. 206, column three) I referred to an allegation in a Californian newspaper, that M. Camille Flammarion had been advancing the idea that the changes (real or imaginary) which have been observed upon the surface of the planet Mars must have had their origin in the work of sentient beings like ourselves. I wrote the sentence which I have just repeated solely on the authority of the San Francisco *Examiner*, whose words I here reproduce, *verbatim et literatim*, in my own justification:—

"Now, during the past opposition (or comparatively close approach) of Mars several observers have detected changes in the brightness of the surface of that planet. According to the dispatches this bare statement has been sufficient to excite M. Camille Flammarion—the French Proctor—into the belief that these *changes of brightness* are 'light signals from the [purely imaginary] inhabitants of Mars.'"

This morning's post, however, brings me a letter from the famous French astronomer himself, in which he repudiates the interpretation placed upon his words, and says: Je n'ais pas de tout attribué aux habitants de Mars les dédoublements observés cette année par M. Schiaparelli sur le lac de soleil, le lac Tithonius, le Détroit Herschel II. et plusieurs canaux; j'ai simplement signalé ces observations assurément extraordinaires, et j'ai demandé si les habiles astronomes de l'observatoire Lick munis de leur gigantesque œil astronomique ont constaté les mêmes faits pendant la dernière opposition de Mars, et s'ils se forment une opinion quelconque sur la nature de ces canaux, de ces lacs, et de ces dédoublements." This, it must be admitted, puts things in a very different light to that in which they are presented in the words of the Californian newspaper, because it simply embodies questions of very high astronomical interest, without making any suggestions or assertions as to matters of fact beyond those postulated in the appellations "canaux" and "lacs." Moreover, the same post brings me a pamphlet by that most indefatigable Belgian observer, Dr. Terby. "Sur de Nouvelles Observations des Canaux de Mars et de leur Gemination," which contains the first intimation that I have received that our own well-known zenographer and general observer, Mr. Stanley Williams, on several occasions during the last opposition of the planet observed and drew many of the most conspicuous of the double "canals" and other features discovered by M. Schiaparelli. Two very fine drawings by M. Schiaparelli himself, and eight of equal beauty by Mr. Williams, illustrate Dr. Terby's pamphlet. I have written thus at length in common justice to the great Frenchman who shares with the late Richard A. Proctor and Prebendary Webb the honour of having done mote to promote the popular study of astronomy, and to implant and foster a taste for our science among the public at large, than anyone who has arisen during the present generation; and I trust, now that I have given the source of my misapprehension of his meaning, that my esteemed *confrère* will accept this *amende honorable* in the spirit in which it is offered.

To say nothing of any other objection to the hypothesis of stellar projection on to the moon's limb during occultations propounded by "Luna" in letter 31757, p. 223, does not your correspondent see that if there were any truth in it, *every* star that is occulted by the moon's bright limb ought to exhibit this phenomenon, instead of its being, as it really is, a rare one? That the light from the moon's limb, at the instant of its apparent contact with the star, will also take 1½ second (more rigidly 1·28 second) to reach the observer's eye is, of course, a detail quite unworthy of notice!

In connection with paragraph six of letter 31761, on p. 224, I should like to ask Mr. Davies whether he has observed—or attempted to observe—δ Cygni in twilight? Because, under that condition, I have no difficulty in seeing the *comes* with a 4½in. refractor; which, however, fails to show it at night, on account, I fancy, of the companion falling on a bright diffraction ring.

In reply to "O." (query 72856, p. 236), the number of professional astronomers in this country is so limited that the chances of any individual obtaining employment in that capacity are but small indeed. At Greenwich the Assistants' salaries vary from £200 to £450 a year, and the competitive examination is a very severe one. Moreover, these appointments are seldom vacant. What "O.'s" son requires is not a technical knowledge of the construction of instruments, but a sound mathematical education. Hence apprenticeship to an optician would be utterly useless for the end in view. A man with a University degree in honours always has an advantage in seeking a berth in a public Observatory. It is an accurate theoretical knowledge of his subject that he requires; not personal ability to turn the pivots of a meridian circle true in the lathe. The details of observing, transit-taking, micrometer-reading, *et id genus omne*, are acquired in the Observatory itself, and, as in everything else, practice makes perfect in them. Probably the most feasible plan (and that is not saying much) would be for my querist's son to go to some good mathematical tutor and acquire a competent knowledge of plane and spherical trigonometry, conic sections, and the differential and integral calculus, and then to [illegible] "[illegible] Spherical and Practical Astronomy," after which he might possibly get a billet as assistant to the owner of some private observatory. If, while thus occupied, a vacancy occurred either at the Royal Observatory, or one of those at the Cape, Edinburgh, Dublin, or elsewhere, he would be in a fairly favourable position to compete for it.

Why does not "A. E. W." (query [illegible], p. [illegible]), buy, beg, or borrow the back volumes of the English Mechanic? He will find in them the most explicit directions for making and mounting every sort and size of telescope known. But it is absurd for anyone to talk of constructing a refractor who knows so very little indeed of the subject as to contemplate mounting his lenses in cardboard tubes! And furthermore, [illegible] is almost, and in truth, too small an aperture for an astronomical telescope to be of the slightest use.

**A Fellow of the Royal Astronomical Society.**

## BRITISH ASTRONOMICAL ASSOCIATION.

[illegible]—In view of the support you have already so kindly afforded this association, I will ask you to allow me, in order to remove any misapprehension, to inform the readers of the English Mechanic, on the part of the secretaries, Mr. Arthur Cottam, of Watford, and myself, that all persons desirous of joining can, by sending in their names and by payment of the first annual subscription of [illegible], be enrolled as original members. After December 31, 1890, it will be necessary to be proposed and elected in accordance with the rules passed at the general meeting. The entrance fee will also be obligatory. **P. F. Duke.**

Hendon, Middlesex, Nov. [illegible].

## POSITIONS OF CERTAIN STARS BETWEEN - 10° and - 15° DECLINATION.

[illegible]—I give below the positions of those stars of the U. Arg. in my letter No. 31706, p. 165, which Rev. Mr. Espin does not refer to in his letter [illegible]. The positions are taken from the U. A. catalogue; epoch 1875·0. The remaining stars being identified in Lalande or other catalogues, I presume Mr. Espin can obtain their positions without trouble. I have not them by me to refer to. I am much indebted to him for the interesting spectroscopic observations which he has already given, also for the magnitudes.

| | R.A. h. m. s. | Dec. ° ′ |
|---|---|---|
| Gould 107 Piscium ...... | I. 0 23 | + 7 59·0 |
| „ 165 Ceti .......... | I. 27 25 | − 7 39·8 |
| „ 96 Eridani ...... | III. 24 16 | −12 4·4 |
| „ 22 Tauri ........ | III. 46 29 | + 7 24·1 |
| Lal. 11,227............ | V. 49 25 | − 4 48·6 |
| „ 12,125............ | VI. 22 14 | −13 5·0 |
| „ 12,138............ | VI. 22 32 | −12 58·6 |
| „ 12,147............ | VI. 22 49 | −12 58·2 |
| „ 16,240............ | VIII. 11 13 | + 3 10·7 |
| „ 16,247............ | VIII. 11 18 | + 3 18·4 |
| Gould 33 Hydræ ...... | VIII. 27 42 | − 1 43·6 |
| „ 123 Ophiuchi .... | XVII. 13 28 | + 2 16·2 |
| „ 142 Aquilæ (*a*) .... | XX. 25 58 | + 1 47·9 |
| „ „ „ (*b*) .... | XX. 26 1 | + 1 42·7 |
| „ 143 Aquilæ ...... | XX. 27 55 | − 6 16·2 |
| „ 238 Aquarii ...... | XXIII. 22 33 | − 9 57·1 |
| „ 248 „ ...... | XXIII. 29 5 | − 8 9·4 |
| „ 239 „ ...... | XXIII. 23 4 | − 5 12·7 |

*Note.*—Under head of Southern D.M. − 1° 4057, on p. 167, the word "companion" should read "comparison."

Haulbowline, Nov. 2. **E. E. Markwick.**

## OCCULTATION OF STARS BY THE MOON.

[31781.]—I have read with interest what your correspondent, "Luna," says (letter 31757) respecting the occultation of stars by the moon. I fear, however, that his theory will not hold, as it appears to be based on a fallacy—viz., that whilst a ray of light from an occulted star requires 1½sec. to traverse the distance from the moon to the earth, a ray of light from the moon requires *no time* to traverse the same distance. The rays of light which reach the eye from the star and moon after the occultation has taken place, each occupy 1½sec. in travelling from the moon, and consequently indicate the position of both star and moon just previous to occultation. The phenomenon of projection must therefore be due to some other cause.

**Star.**

## BURNHAM 648—REFLECTORS.

[31782.]—"Tenebris" (letter 31758) has not seen β 648, if he means the *comes* is *n.p.*; but I confess to some doubt as to the meaning of "a trifle north of one preceding."

I am unable to help Mr. Davies (31761) *re* dewing of plane, since I have never seen a vestige of dew yet on either plane or flat, not even when a refractor working side by side had to be removed as useless from the deposition of dew faster than it could be wiped away. I do not ventilate my tube, however, for that appears to me to be simply turning my tube into a flue or chimney, and the best way of producing air currents and admitting dew. I have never had any tube currents, either, in the course of a number of years.

It is impossible to say why Mr. Davies gets no good definition on Jupiter with 250 on 9½in. My instrument is 9in. mirror by Cooper, and flat by Linscott, and I never use less than 275 on Jupiter at all. If his observations have been only during this season, the low altitude of the planet is the probable cause of poor definition.

If his telescope does not show discs and diffraction rings with 550, and his eye is good, he may rest assured the telescope is defective, no matter who the mirrors are by. 600 would be better to look for the discs with; but I am prepared to say that any 9in. reflector that will not show λ Cygni double on an average of three nights out of four is imperfect. I do not regard λ Cygni as a difficult star at all. Stops never improve my definition.

I believe many reflecting telescopes are condemned on account of faulty flats, and I am not without some experience of flats. If any reader finds his telescope fail him, I say *distrust the flat.* With a high power it will always disclose its imperfections just before coming to focus. Instead of closing up neatly circular, it may be elliptic or irregular, and then follows a persistent flare, which no amount of adjusting will remove. It needs more skill to make a perfect flat than a parabolic mirror. I am not at liberty to disclose all I know on this matter, but I can say nine times out of ten the fault lies in the flat.

"W. S. P." (31756) asks if the size of star discs in equally good refractors and reflectors would not be identical. No. The reflector would have *smaller* star discs than a refractor of same diameter. I am glad to see *he* gets good discs with a high power on a mirror.

*Re* fixing flats in mounts: I find they are often loose, and if not loose, are held by pressure on back. I hold mine firmly, without the least shake, strain, or pressure, in a very simple manner. Having put the flat in the mount, so that it rests loosely against aperture, I melt a little paraffin wax, and paint it with camel-hair brush at the point of junction of the flat and containing tube, all round the flat on the back. It immediately solidifies, and there is no need for any packing. It is safe and firm, but it will not make a faulty flat perfect. **H. E.**

## SOME EARLY OBSERVATIONS UPON THE VARIABLES NEAR THE CLUSTER 5 M LIBRÆ.

[31783.]—My attention has been called to some early observations made upon the stars near the cluster 5 M Libræ, in the "E.M.," Vol. XXXVII. pp. 265 and 335. The anonymous writer appears to have seen both of these mysterious objects; but failed in detecting their variable character.

The remarks of "Another F.R.A.S." (letter 31684), in response to my note upon this subject (letter 31599) are entirely erroneous and misleading, and I would warn your readers against their acceptance. This tendency in certain quarters to snub the work of amateurs is heartily to be deprecated. Let us hope the new British Astronomical Association may crush this tendency, and give each persevering amateur the justice which is his due, and so encourage him to prosecute his researches with refreshed energy.

Nov. 8. **D. E. Packer.**

## THE TAIL OF A COMET.

[31784.]—I think letter 31739, signed "J.S.L.L.," deserved a little more than the scant attention bestowed upon it in last week's issue. The theory is open to objections, no doubt; but surely not to those put forward by "Hammer," whose blow, by the way, falls a bit wide of the mark. Where the absurdity of assuming a comet to be surrounded by a luminous nebulosity comes in, I do not quite see—in fact, I suppose a good number of us are of that opinion.

The second part of "Hammer's" letter is true as regards the sun and non-luminous bodies; but the question here is one of comparison. The sun and the comet are both luminous, but the luminosity of the comet, like the light of a candle in daylight, is eclipsed, except when the sun's light is cut off by the opaque body of the comet.

**Dubito.**

[31785.]—Referring to letter 31739 (p. 207), I think most readers will rejoin me in assuring "J. S. L. L." that the light of the sun would tend to strengthen the luminous aspect of the solar side of the comet, were it entirely surrounded by gases, instead of obliterating it. And "J. S. L. L." does not offer any explanation of the fact that his theory would require the shadow to be cast in a curve corresponding to that curvature produced throughout "J. S. L. L.'s" supposed rotation of comets. Why should this rotation make a difference to the "luminous shadow if it be entirely surrounded," since light remains true to its law?

May I be allowed to offer what, to my mind, seems an explanation to this phenomenon? Let us admit that comets and the sun are similarly electrified: as the comet approaches the sun, the repulsion which exists between two similarly electrified bodies would have to fight against gravity; but gravity overcomes the repulsion, which acts on the lighter part of the comet—i.e., the nebulous matter surrounding the head, thus keeping it in the form of a train behind the head, which, being the heaviest, is more able to overcome the solar repulsion.

Rotary motion might explain the curvature of the tail.

I have noticed that when the negative pole of a magnet is brought near a small quantity of iron-filings magnetised by the same magnet, those particles that are repelled the farthest from the pole are the smallest. I should be obliged if someone would tell me if this opinion could be shown to be possible. **F. Varley.**

## THE ROTATION OF VENUS.

[31786.]—The following observations were presented to the Paris Academy on Oct. 27 by M. Perrotin, of the Nice Observatory, and, though apparently confirming the observations of Schiaparelli in many respects, yet it leaves the question of the rotation period still unsettled, as there is a wide margin between the range of 195 to 225 days. Would not the shorter rotation period of 20h. 45m. to 24h. also answer the conditions of these observations?

Venus, observed 74 days between May 15 and Oct. 4. The whole of the observed facts leads M. Perrotin to the following conclusions:—

1. The rotation of the planet is very slow and is made in such a way that the relative position of the spots and terminator do not experience any notable change during many days.

2. The time of rotation of the planet does not differ from its sidereal period of rotation (about 225 days) more than 30 days. The observations easily accommodate themselves, however, to a rotation of which the period is from 195 to 225 days.

3. The axis of rotation of the planet is almost perpendicular to the plane of its orbit. The displacement of the white region observed at the northern edge indicates that the difference does not exceed 15°, as was admitted by Schiaparelli.

Would "F.R.A.S." kindly give us his opinion as to the rotation period? **Terbyitus.**

## ASTRONOMY IN AUSTRALIA.

[31787.]—It is very gratifying to hear of the doings of our brother amateurs at the Antipodes, and especially such a good account as that given by Mr. Wooster (letter 31760) in last week's "E.M." There is evidently plenty of native talent available for the work which requires to be done in the southern hemisphere, if its energies are properly developed and organised. This, I venture to submit, can best be accomplished through the medium of a society whose object is the association of observers for mutual help, and this is especially applicable to a large continent like Australia, where great distances must necessarily divide the scattered workers, and the want of some bond of sympathy is acutely felt. Such a society is the recently-formed "British Astronomical Association," which has made such astonishing progress here during the last two or three months.

Though primarily intended to benefit amateurs resident in the United Kingdom, its scope is cosmopolitan enough to include English-speaking observers in all parts of the globe, and it is hoped that our Colonial friends will not be slow to avail themselves of its advantages. By its means distant observers would be brought into direct communication with those of kindred tastes at home, a union which should prove mutually advantageous, as well as placing themselves "in touch" with most of what was being done in the astronomical world. Then, again, we greatly need Southern workers in our "sections," eight of which have already been formed for the prosecution of particular departments of observation. Speaking for the "coloured star" section, I can only say that it is impossible to thoroughly complete our programme without the help of observers in Southern latitudes; and they have a practically unbroken field to work upon. **W. S. Franks.**

62, Belgrave-gate, Leicester.

## EROSIVE ACTION ON THE MOON.

[31788.]—I am sorry Mr. Stooke (letter 3155[illegible]) has not read my letter on p. 512 more carefully, also my former letters in the "E. M.," papers in the *Journal* of the L.A.S., and, above all, the published abstract of my views. For some seven or eight years I have been insisting that the moon has passed through an "era of erosion" like ours,

perature, air, water, rivers, and sedi-
ıck formation, and has now, being a
be, cooled down and reached the glacial
olar caps having coalesced at the equa-
s, air and water gone. At this stage
lenly asks, "Now has it occurred to this
ıtleman that an 'age of erosion' and
y rock formation may actually have
our satellite?" This is really too-too,
would try our Editor's patience too far
all here, so I trust Mr. S. will look the
He will not find many contradictions
ry, I think, or in my letters, which I
write two or three times over, or even
to be sure all is in, and expressed tersely
. My letter in No. 1,266, June 28, 1889,
ctually wrote out five times ere I was
t was "Where did the Ring of Schiller
?" Though I have been a professional
an, I eschew (needless) illustrations;
noney and waste space—e.g., as where
ughton, through not studying Proctor,
a big and most needless diagram on

ghly reciprocate Mr. S.'s sentiments in
aragraph, and am not at all inclined
e "poor infatuated Darwin and poor
Huxley" of the Noah's comet corre-

magnificent view of Bailly (sunset) at
morning, the air absolutely steady, and
ond well seen, to the east. A great pity
formation is not figured more. One
d fifty miles across, a true circle, very
and enormous ring, fairly continuous, it
big nut for the volcanic theory. What a
it would make, to be sure!—about cover
It joins the craters to M. Crisium

, Asam, Oct. 10. **S. E. Peal.**

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## MSEY OBSERVATORIES.

—I AM not surprised at Mr. Mason
is letter to the ENGLISH MECHANIC this
there is some "confusion" in the plans
. of "Chambers's Handbook of Astro-
s the author of these plans, I need hardly
much annoyed I was to find when I
e volume that they had all been put into
without properly placing the cardinal
ach section. I sent to Mr. Chambers the
n and S. elevation each on a separate
l properly oriented, and I am not
for the E. elevation of transit room
rsed by the engraver. The door of the
y is on the N. side and the transit room
side. As to segments of wall-plate, I
hem so that no joint should come over
osts of support. I fitted them and those
e ring on the stone floor of a barn, only
ogether half the circle, and *thus* got it
building, joining the two halves of the
level lawn. I consider the 2¾ by 2⅝in.
much better than a light one of 1in.
if the writer will examine my plans he
at it *is* fixed by the main rafters *i i i* and
hat the shutter falls back on to the iron
xed outside the dome as shown, and is
ar of the telescope, and can quite easily
and closed by means of the iron rod, as
I did my best to make the plans and
clear and serviceable, and am sorry they
so "botched" by the publishers of Mr.
s book by being all put on to one sheet
e cardinal points of the compass having
erly attached to each section. My own
y, for which I drew the original plans, and
hose in Mr. Chambers's book are reduced
been in constant use for six years, and I
o hitch in any way with it. I can revolve
with one finger, and the roof is as perfectly
s it was when built in 1884. I shall at
e pleased to show it to anyone who is
in these light forms of observatories.

**T. R. Clapham.**

k Hall, W. Yorkshire, Nov. 7.

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## OBSERVATORY.

—ABOUT five months ago I had a new
y put up for my 9¼in. equatorial, some-
r the time of Romsey in Chambers.
ons connected with my tenancy, it had to
a portable form; the whole can be taken
-seventeen—and put up again in about
s. The shape is polygonal, and each
nortised into the floor, which is in two
he top of the sides support a wooden
hich are six or eight wheels, on which the
lves. The dome itself is of Willesden
rafters, and like the floor, is in two
he transit is in a separate place. I have
building quite weather-proof, and most
le. The internal diameter is 12ft. Should
ar Edinburgh want an observatory, they
do better than apply to the builders who
, Messrs. R. R. Shillinglaw and Son.
happy to give any further information I

**F.R.S.E.**

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## SCREW-CUTTING.

[31791.]—HAVING just finished some gear for my 3½in. lathe, which answers well, query 72637 induced me to send description to "E. M."

The top slide of my rest will swivel right round, and has a right-handed ⅜ Whitworth-pitch screw, which is sometimes to be replaced with a square-threaded screw of 12 per inch. The drawings are not to scale. Fig. 1 shows front of head-stock, with apparatus fixed; Fig. 2 shows arrangement for inside screw-cutting. The wheel on mandrel has 32 teeth, or twice the number of threads per inch on S.R. screw, cut, as are all of the wheels, except intermediate wheels, out of good ⅛ iron plate. The mandrel-wheel is faced-up, and has a little peg in it, to prevent it shifting. The pinion fixed on front of intermediate wheel has half its number of teeth. The wheels used on S.R. screw all fit the little boss, Fig. 3, and have twice as many teeth as threads required per inch when used as Fig. 1; as Fig. 2, the number of threads is, of course, doubled.

Fig 1

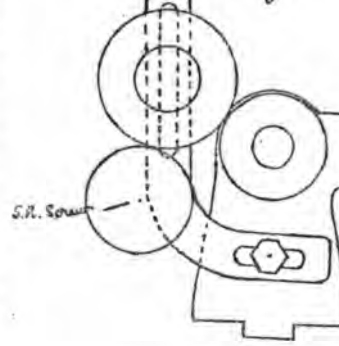


Fig 2

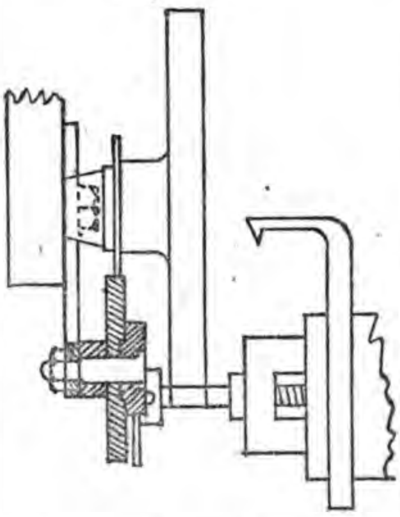


Fig 3

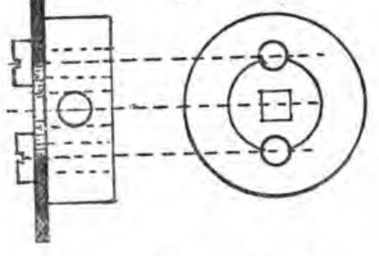
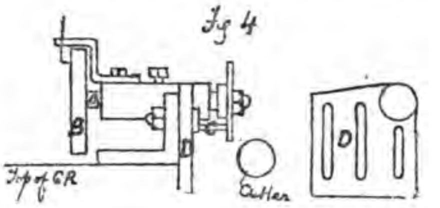


Fig. 4 shows how I cut the wheels (having no overhead, &c.) A is the mandrel on which they are turned; B is a disc, made of hard, close-grained wood, with the numbers which are required carefully marked on it with dividers; C is a stud, to take the pressure of cutter on edge of this wheel. The gear, as shown, will not operate on a piece longer than the rest; but I intend making a special wheel, which I can fix on any diameter work where required, and bolt the slotted bar (shown in Fig. 1) up against it on angle plate.

It might be said these wheels are a lot of trouble to make. If a thread has to be cut, something has to be made to do it with, and these wheels do better work than a pair of chasers would do. I am not putting this forward as equalling a regular screw-cutting lathe; it has, however, answered my purpose well, and I trust it may be of some use to readers of "E. M."



Peterhouse, Cambridge. **A. J. Dew.**

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## LATHE MATTERS.

[31792.]—I WISH Mr. Ellison would write oftener. Anyone who saw his work at the Mansion House must be aware that there are few who have attained such perfection in ornamental turning with lathe, or rose engine.

I have received from Mr. Massa, of N.J., U.S.A., a photo., which some turners would give, if not their ears, at least, one of their chucks, to see. Mr. Massa has used his geared rose engine to produce a column of quasi-square section, and has actually succeeded in arranging the reciprocator so as to cover this quasi-square surface with bold cutting in zigzag. I have never heard of such a thing before, and think it is quite a new departure. The photograph shows the method adopted, which is complicated. I fear it would cost too much to reproduce it, and if not done perfectly, it would be quite unintelligible. **F. A. M.**

[If you like to send it on, we will do our best.—ED.]

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## DRY CELLS.

[31793.]—I READ with much interest Mr. Ball's letter on his experience with dry cells, only to have my curiosity aroused concerning the construction of his cells or cell giving 3½ volts, which, for some reason or other, he does not give.

My experience with dry cells has not been a long one, but it has been long enough to convince me that there is not a single dry cell in the market that can claim one advantage over the Leclanché or Fuller battery, other than portability.

Yet even here the Leclanché can be made as portable as dry cells by sealing, and the insertion of a porous peg for the liberation of gas. Two primary conditions must be looked for in a dry cell—viz., constancy and power. The Dr. Gassner dry cell is, I believe, the best form of dry cell at present in the market. As a constant-current battery, I believe it is one of the best of its kind; but to me it lacks power, and when a heavy, continuous current is required from it, it soon runs itself down, and has to be regenerated by passing a current into it. I manufacture a wet cell which has an E.M.F. of 2·40 volts, a very low I.R., and a complete absence of local action; one cell will do the work of two Leclanchés, and last as long or longer; it can then be regenerated by passing a current into them. This I believe to be the most powerful, constant, and practical cell in the market, either for electric bell or light purposes.

I hope Mr. Ball will not think me asking too much by letting us into the secret of how he makes, and what materials he uses in constructing, his cell that gives 3½ volts for one week. If, however, he considers his invention too good to give away, or declines to have it tested by some authority on galvanic batteries, I hope he will excuse me saying that I think his cell giving 3½ volts must have been an imaginary one. **J. R.**

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## RULE FOR ELECTRIC-BELL AND ALARM WIRING.

[31794.]—APROPOS of Mr. Allsop's letter last week, on page 2 of "Practical Electric Bell Fitting" I find (speaking of wire), "This should be obtained in two different colours, all the return wires from the pushes being kept of one colour, and the outgoing of the other." This can scarcely, I think, be called a rule, since the choice of colours is left to the fitter. One man might use red for his + battery wires, and another man use the same colour for his – battery wires; so that a fitter would have no guidance, at first glance, in repairing someone else's work. A man doing repairs in the top floor of an hotel, e.g., would have to pay a visit to the battery to make sure whether red meant + or –.

There are many cases in which the return battery wire is of an appreciable length, and when, therefore, the distinction not only between "connecting" and "battery" wires, but between "+ battery wires" and "– battery wires," as given by my rule, becomes a matter of necessity.

**W. Perren Maycock, A.M.Inst.E.E.**

Milber, Stafford-road, Waddon, Croydon,
Nov. 10.

### SAP IN TREES.

[31795.]—I WILL leave "J. S." (letter 31771) to try his pet experiment by procuring the two pieces of land, one low-lying, adjoining a river, and frequently flooded; the other on a higher level, and never flooded. Instead of growing osiers on each piece, I advise him to grow wheat, barley, oats, cabbages, rhubarb, pumpkins, figs, and grapes; "and after an interval of from three to five years, he may be able to give his fellow men some valuable information as to the relative pecuniary advantages of the two sites": and also (it is to be hoped) acquire some sound practical knowledge for himself. Osiers are grown in very moist lands because nothing else will, and they are emblems of extreme weakness, like very puny infants, born to breathe but a few hours.

No doubt "J. S." advises his fellow men not to drain wet land, because that reduces its pecuniary value, and costs money into the bargain.

Instead of my advocating any pet theory, as "J. S." calls it, I have simply published a considerable number of facts, based upon experiments and observation on the growth of trees and other plants, leaving readers to draw their own conclusions. **J. A. Reeves.**

### THE REFLECTING TELESCOPE.

[31796.]—Mr. DAVIES, in your last issue, refers to what is occasionally a source of great annoyance to users of reflectors—the dewing of the flat. This might be considerably lessened by the obvious remedy of lengthening the tube. In my telescope (8½in. With) the flat is nearly 12in. inside the end of the tube, and unless in very heavy dew indeed, I am able to use it for hours before dewing takes place. Directly I notice it I stop observing, cover large mirror, leave off the cover of the flat, but put a tin cover on the open end of the telescope tube, and leave it till morning, when, if the weather is favourable, I open the observatory and telescope tube and find generally that the flat is clear, or, if not, that a half-hour clears it, and with little or no permanent deterioration. The lengthening of the tube also lessens the disturbance which must be caused by the warm air from the observer's face passing in the mouth of the tube.

While referring to air currents, I may say I have long been intending to try the experiment of mounting my mirror in a tube of perforated iron, or a framework of iron covered with perforated zinc. It has struck me that this will have all the advantage of mounting without a tube, as far as air currents are concerned, and that the perforated metal will prevent the dewing of mirror or flat. There would, of course, be a shield needed around the eye-tube to prevent the observer's breath entering the tube. Want of time has prevented my trying this plan, but perhaps some of your readers may have an opportunity of experimenting in this direction, and would communicate the result for the benefit of their fellow readers.

I am not suprised that Mr. Davies does not see diffraction rings around stars, for I used my telescope for several months without doing so. I then very carefully adjusted it. Mounting the eye-tube on a movable plate, with a longitudinal motion, in the direction of the telescope tube, and with four levelling screws, enabled me to do this more easily and more accurately, after I had put it nearly as correct as possible with the mirror screws. The result was that in fine air and with any power over 200 I get beautiful circular discs, with one fine diffraction ring around each, and (unless the bright stars) no flares or rays. Close double stars appear far more neat, and are more easily divided, and the better result is worth all the extra trouble.

**W. S. Price.**

Wellington, Somerset, Nov. 8, 1890.

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[31797.]—SOMEONE suggested that the letters on this subject would leave the matter pretty much as they found it; but each contribution seems to throw some fresh light upon the questions at issue, and the tone of the controversy shows simply a disinterested desire to get at the real truth.

"W. S. P." raises a new ghost when he says (letter 31756) "even a well-figured speculum will not define if the film is milky, or covered with fine scratches with the polisher." Now I have looked at a good many films in sunlight, and never saw one quite free from a network of fine scratches, and most surfaces were a bit milky as well, and some of these were deposited and polished by masters of the art.

I have sometimes feared that these imperfections might impair definition, because in the scattered light visible in the field round a bright star, fine, hair-like wisps are traceable amidst a suggestion of milkiness; but I could never be certain that these appearances were due to the causes "W. S. P." suggests. I should like to hear more opinions on this and the no-tube question. I once completely mounted a 6in. speculum in an open frame, and it did pretty well; but an 8½in. (a much finer mirror) that a friend temporarily tried in this way, and which I helped him to test one or two nights, did *not* do well, though, in an iron tube, it now makes a beautiful instrument. I want to buy a bigger telescope one of these days, and should really prefer a reflector, if only these tube currents could be dealt with; but at present they seem to more than counterbalance the theoretical advantages contained in Mr. Nelson's able "summing-up."

*Re* Burnham 648 (?), I wrote "due preceding," not "one preceding." **Tenebris.**

### BRASS MUSICAL INSTRUMENTS.

[31798.]—IN reading down "Answers to Correspondence," I presume one query was for brass instruments. I am a player myself, and consequently have a lot to repair. Now, I have tried all ways, petroleum included, and I find the best and quickest way is as follows:—

Tie a piece of webbing round the bend of slide, and tie the other end of webbing to a staple. Hold the instrument in left hand, and apply the full blast of a blow-lamp for two or three seconds, pulling the instrument as you do so, and out will come the slide. I have never known it to fail if managed properly. I offer this by way of additional advice. If I have made a mistake, no doubt you will find the information useful at another time. I conclude it is the sudden volume of heat that expands the outer slide before the inner can get warm that manages the trick. **E. W. M.**

### ETHER AND ELECTRICITY.—IV.

[31799.]—As "W. C. E." "persists" in an interpretation of my words which I have repudiated, there is no more to be said; but for the benefit of others, I may say that momentum depends upon a property of matter which is expressed in terms of weight or of inertia—that is, of resistance to motion, motion either of itself or other bodies; the ether possesses neither, and therefore can have no momentum, nor be a proper object for the application of dynamics.

I am not prepared to admit specifically that "the ether is necessary to explain the passage of light in a substance like glass." I only admit the necessity of assuming the existence of a something in space which we call ether, but know and can know nothing of with any certainty. It may be convenient for theoretical purposes to assume its presence everywhere, and its action among the particles of matter; but it is not necessary in the case of light, and is unnecessary in the case of electricity and magnetism. I object to any needless hypothesis, and I cannot comprehend the process, to which "W. C. E." is so addicted, of using one imaginary and unproved hypothesis to support a disputed one. There is a lot of nonsense talked about comets' tails; but how can any of this unproved stuff be "an *à posteriori* verification of the electric condition of the sun"? I shall deal with the glass matter by-and-by.

"W. C. E." cannot understand it, he says; yet nothing can well be more plain than my statement that "electric and magnetic lines of force cannot exist in space concomitantly with unchanging gravitation." Well, both these forces involve, of necessity, a directive attraction, a differential attraction, generally called attraction and repulsion. If electric force were present, it would sometimes reinforce and sometimes oppose gravitation, as the various bodies in space alter their relative positions. If magnetic force were present, the bodies in space would be polar, as the earth is; they would sometimes present their similar poles, and sometimes their opposite poles, to each other, and there would be attraction or repulsion to vary the effects of gravitation. If the sun is a magnet, and its lines of magnetic force extend into space, there would be magnetic relations between the earth and the sun. The earth does not revolve round the sun in an orbit which keeps their polar axes parallel and their poles in one plane; therefore the earth's polar axis would sway about under the alternate attractions and repulsions of each pole by the sun's poles. None of these actions occur; the attraction of gravitation is unvaried.

I never objected to "W. C. E." "trying to make me ridiculous," and am in no way thin-skinned. He is welcome to ridicule my arguments as much as he pleases; but it is quite another matter when he tries to ridicule me for using arguments which he has himself invented, and unjustly attributed to me. He repeats this offence against justice and propriety in his reference to my letter, p. 188. It is not true that I "gibbet an extract of Prof. Heaviside's paper, containing a few technical terms, as something supremely ridiculous." I simply quoted it as a sample of intellectual food, a "little of which goes a long way" with me and most readers, because we find it indigestible. I have no other complaint to make of it, nor do I consider it in the least ridiculous; only my mental digestion is too weak for it. What I do consider in some sense ridiculous is for writers to assert positively that certain actions do really occur, and in the next moment to admit that they are talking about what they really know nothing about. But if I laugh at Mr. Heaviside and others for doing this, it is only in fair honour and good friendship, not in the style of "W. C. E.," and I try my best to do them justice, and find out their meaning before I criticise it. Nor would I condescend to strain their expressions, much less twist them round to enable me to condemn something they do not mean. However, like all his predecessors, "W. C. E." is going to retire from the conflict. Is there no one able and willing to explain and defend these new fashionable ether doctrines, except by unjust abuse of me for resisting them, and by using the names of Maxwell and Thomson as rustics do turnips when they want to raise a ghost?

In that charming work, Pascal's "Provincial Letters," the imaginary writer visits a series of acquaintances belonging to the various schools of theology who are attacking the Jansenists, and finds they all agree in using the term "grace"; but on a little examination he discovers that they each of them attach a different meaning to the word, and that they really differ as much from each other as they do from the party they are uniting to condemn. Now, this is exactly what occurs among the etherialists—they all speak of *the* ether and its functions; but there are, in fact, half a dozen or more meanings to the term "ether," entirely different and incompatible. One will call it a jelly; another describes it as consisting of infinite series of geared wheels (of course, meaning only something analogous), with an equally infinite series of idle wheels interposed to enable the others to rotate all in one direction; another describes it as two ethers—alike in some properties, unlike in others—uniting to form one neutral ether. Then *the* ether conveniently varies its nature to suit the nature of the action it is required to accomplish. A jelly serves to transmit light, so Sir W. Thomson says it is like a jelly; but he finds the jelly will not suit when he wants to explain magnetism, and he promptly gives it a structure resembling a honeycomb, and makes it absolutely rigid to direct stresses, but perfectly mobile under diagonal ones, and then incloses in each cell two or three gyroscopes rotating in different directions, and forthwith is produced the vortex theory of atoms. So with each theorist; whatever faculty or structure will serve the present purpose, that faculty or structure is at once bestowed, and then they all unite in one cry of "the ether!" Verily Mr. Heaviside was right when he wrote, "The ether is a wonderful thing." Now let us see what Sir W. Thomson has to say which may give us confidence in his vaticinations. I will take his address to the Institute of Electrical Engineers, on "Ether, Electricity, and Ponderable Matter," in January, 1889. It is very difficult indeed to select a few passages from such a paper without doing injustice to the general line of thought, and therefore I may say that my principal purpose is to show that, on the authority of Sir William himself, his conceptions are nothing but *vague suggestions*, thoughts as to what may possibly not *be*, but aid us in forming ideas as to what may be; they have no claim to authority, no title to demand our assent, and give no one the right to proclaim them as verities of science. My quotations of these thoughts themselves are rather for the purpose of future discussion, or relative to past criticisms.

In seeking ideas as to what the ether really is, Sir William says: "The representative of an insulator in this analogy is a massless fluid; by massless I mean devoid of inertia. Some people attach other ideas to mass, but in the strictest dynamical language 'mass' is taken as the measure of inertia." I quote this chiefly in reference to the earlier parts of this letter. He finds that this analogy is "hopeless" to explain the electrostatic effects. So he goes on, "Let there be an elastic solid body of exceedingly small density, and let there be a portion of it porous, but with the same aggregate rigidity; let the pores be filled with a dense viscous fluid. . . If it were not for the gross ponderable matter that we are forced to consider, I should be perfectly satisfied with the problem of the electro-magnetic induction, by taking the electricity as a viscous fluid, and ether an elastic solid, porous in some places, and continuous and non-porous in others." The gyroscopes or vortex atoms are then worked in to represent the ponderable matter.

Sir William tells us he attacked this subject 42 years before in a paper concluding, "must be reserved for a future paper," and goes on to say that he had been considering the subject night and day for 42 years, the subject constantly on his mind, and the result is, "I have been trying to find an explanation, *but have not found it.*" Then he gives the suggestions I have quoted.

A little later he says, as to a current in a solenoid: "Whatever the current of electricity may be, believe *this* is a reality, *it does pull the ether* [illegible]

:hin the solenoid. [The italics are his own.] I not think this is a dream of electro-magnetic ory; I believe it to be a reality. Somehow or ıer, however it is, the ether is pulled round—aehow or other there is a motion following these y laws we have illustrated by the viscous fluid ılogy."

Speaking of iron in magnetism, he says: "One ng or other the current does: either it drags the ıer round and round, or it drags it round to a tain angle proportionate to the strength of the rrent, and brings it to a static equilibrium so :ned. Now, how on earth can iron differ in the nciple of the interpairal law from copper?" . . . The rotational contribution to rigidity of ether in n must be enormously less than in copper or air." . "These conditions fulfil exactly what we want : the relation of ether and iron inside the helix of electro-magnet. But, alas! we are only led on to crutable difficulties." Note this, students of ence who are led away by "professors" into the cous fluids, &c., which they call ether, and con-er whither their leader himself tells you they ll lead you! What is his hopeful suggestion? The difficulties are so great that we cannot even agine a finger-post pointing us to a way that can d us towards the explanation. I can only say, cannot now even imagine it. But this time next ar—this time ten years—this time one hundred ars, it will be just as easy as we think it is to derstand that glass of water."

Yes, Mr. Heaviside, justly questioned, "is it not ence falsely so-called?" What right has Sir m. Thomson to say, *the ether is pulled round*, ıen all the evidence he can give is, that after 42 ars' constant study, he can only lead us to the mportant conclusion that we really know nothing low the surface." What we do *know* is that linary matter is the acting agent. Why not study properties, instead of going after the red herring ss scent of the ether?

I will next show what Oliver Lodge says, and en examine the parts of electricity bearing on the bject. **Sigma.**

### SUBSTAGES FOR STUDENTS' MICROSCOPES.

[31800.]—When writing previously on this sub- ;t we had no thought of inducing a controversy; t we must, in justice to ourselves, repudiate the ference of your correspondent, "Microscopist," at the substage of the Edinburgh Student's micro- pe is not rigid. One would imagine, from your rrespondent's letter, that it is a useless arrange- ent; but his information is evidently gleaned from e engraving that accompanied our previous letter, ich he has not correctly interpreted, and certainly t from any practical working with one of our struments. We would point out that when the bstage is in the axial position it fits into a special llet, which grips it from beneath, so that there nnot be any shake; it is not merely "roughly cured by a stop-pin," as "Microscopist" assumes. fact, his remarks consist of an expression of perficial opinion, formed from an incorrect concep- n of the build of the instrument.

In proof of our assertion as to the rigidity of the rm of substage, as fitted by us to the Edinburgh udent's Microscope, we may say that the sale of is class of instrument has now run into hundreds, d it is in frequent use by many leading micro- opists, from whom we have received letters pressing great satisfaction with the rigidity of orking parts. Further, a great deal of the demand r the instruments is from the very men that Microscopist" considers are best able to "formu- te the desiderata of a student's microscope"—viz., e teachers in medical schools. From these, roughout the world, we have received orders, not ly for ones and twos, but for "ties," and in arly every instance the instruments have been eferred on account of their rigidity and the con- nience and perfection of substage.

If anyone required a substage on a fixed tail- ece we should supply it; but never, since we have ade the Edinburgh Student's Microscope, have e been asked for such.

**W. Watson and Sons.**

313, High Holborn, London, W.C.

[31801.]—Allow me to supplement my letter 1772, p. 228) by a few observations, which I trust ll forward improvements in the construction of udents' microscopes.

I have suggested that responsible teachers in edical schools should combine and authoritatively rmulate the *desiderata* of a student's microscope, d that the laws of demand and supply would do he rest.

On the question of the need of such combined ction for this purpose, I hardly expect a dissentient oice. But as to the best means of bringing this ction to a focus, that is matter on which I must ly touch with diffidence. The fact that Mr. G. C. arop, secretary of the Quekett Microscopical Club, ows his special interest in the subject (31773, 229) would point clearly in his direction as a ssible centre of action. No great difficulty should be found in forming a committee of men of similar tastes and aims, who would cordially strive to bring out a microscope to meet the modern wants of students, both as to efficiency and economy.

Such a committee would require the co-operation of a skilled mechanician, having considerable manufacturing resources at his command, and who would boldly face the outlay of developing what would be recommended. The prospect of the large business that would naturally follow upon the successful production of a student's microscope, under such favourable auspices, would, no doubt, be quite sufficient to bring forward the right mechanician.

It may be asked why the requirements of students at this moment do not induce an optician to produce exactly what is wanted? On this it may be said that up to the present time the teachers in medical schools have never attempted any concerted action in the matter; they have been content, individually, to make suggestions here and there to the opticians, and these latter have only felt safe in carrying out the suggestions when they emanated from an influential man whose personal authority sufficed to insure a demand for the instrument large enough to recoup the experimental outlay. Thus it has happened that each optician has had to secure for himself one or more of these patrons, each of whom has had his own pet schemes to promote, and there has been no sufficient inducement of probable commercial success to warrant the planning of the manufacture of microscopes on a thoroughly economical basis, by which the most efficient instruments could be produced at a minimum price. The want of concerted action on the part of teachers has thus led to an immense waste of production—a waste amounting in many cases to 50 per cent. or more. It should also be noted that the optician is not, as a rule, catering *directly* for medical students; he has first to secure the good offices of an influential medical patron, who will instruct his pupils to purchase the apparatus he recommends. Unless, therefore, he is willing to forego his own independence of action, and carry out strictly the orders of his patron, the patronage is transferred to a more willing agent. It is wholly beside the mark to urge that the optician is not bound to follow such orders, that he may use his own discretion on the matter. In practice it may happen that Dr. Microtome, professor of Microtomic Biology at half a dozen medical schools, whose patronage is good for the sale of some scores of microscopes per session, knows nothing whatever about the construction of microscopes, or he may have just the smattering of interest in mechanical design that finds outlet in pressing forward novelties *quâ* novelties, regardless of their practical value; but he is keenly alive to the importance of having his name connected with some form of student's microscope, and he knows the value of his patronage; the optician is, therefore, obliged to accept the terms proposed to him, and to produce Students' Microtomic Bacteriological Microscopes according to instructions. To add to the confusion of the circumstances, nearly every medical session is accompanied by changes in the medical staff; new ideas crop up or old ones are revived; the optician is appealed to for this or that petty modification in the design of the microscope, and thus his skill and experience are too often frittered away in carrying out trumpery suggestions, which would not stand a moment's discussion before a jury of experts. To meet this incessant order of change one optician in London has made upwards of twenty different forms of students' microscopes during the past ten years.

My impression is that the present requirements of students do not really necessitate the construction of an entirely new design of microscope, but only the combination or adaptation of a number of useful points which already exist either together or separately in known models. The student wants a stand that will enable him to get the best work out of his optical means. High-class instruments exist which appear to satisfy the demands of the most fastidious microscopists. It would appear, then, that there is no need for the invention of a new model: we want only the application of common sense to the process of selecting and embodying in the most economical way the points of construction, which experience has shown to be the most essential in the high-class microscopes.

It may be, however, that the majority of teachers in medical schools have no particular claim to be regarded as experts in the use of the microscope, and hence that a committee of them would carry no very special weight in their recommendations. A committee of this kind would naturally be guided to a great extent by the more experienced of the members; and these latter would not hesitate to call in the assistance of anyone who was known to be specially qualified to advise on the matter—I think that might well be taken for granted.

With reference to the construction of students' microscopes, where experience informs me that English opticians are very apt to go astray:—If we take a general survey of the various kinds of students' microscopes produced in England, we shall be struck with the fact that they are too light in build, and consequently too liable to become loose and shaky in their bearings throughout. Take an average English stand of this class, as it leaves the maker's hands, put it on a laboratory table to be used by students for a session or two, and it will then show such signs of wear and tear as to need radical renovation. This rapid deterioration of the mechanism of our students' microscopes is, in great measure, due to the inferior quality of the metal employed, which is not selected for its durability, but mainly for its low price and the ease, and consequent cheapness, with which it can be fashioned. Thus instruments are put together with a considerable amount of accuracy in the bearings, and with rack-and-pinion work moving with all desirable smoothness, and, above all, with a most lustrous polish wherever the lathe can be brought to bear on the parts,—the whole so artfully and cleverly finished that we are all deceived into commending the results. We examine critically all the movements, and they pass muster with applause. But the question of the durability cannot be settled by mere inspection. We are apt to suppose that well-fitted metal-work must necessarily be durable, because it *is* metal; whereas, durability depends to a very large extent on the quality of the metal. Many of these modern microscope-stands are made of a quality of brass that is specially chosen of just that degree of hardness to enable the work to be done with the maximum speed, and, consequently, with the minimum outlay on the production of the instruments. The question of durability is wholly ignored. The policy seems to have been to make the utmost haste in the business of manufacturing, and let "the devil take the hindmost."

Judicious concerted action on the part of class-teachers should put an end to this chaotic state of things, by giving the opticians reasonable assurance that those who can succeed in meeting the *desiderata* most efficiently will meet with the desired commercial success.

I have been informed, on reliable authority, that some months ago a project was discussed by sundry amateurs in London for a competition among opticians relative to the production of the most efficient microscope-stands of certain classes, and substantial prizes were to be offered. The matter went so far that the secretary of one of the most prosperous societies in London was ready to inaugurate the competition formally. But wiser counsels prevailed. It was plainly foreseen that the difficulties of settling the conditions of the competition and the selection of the jury would lead to endless bickering and dissatisfaction, and so the matter was dropped.

The scheme we now have at heart is much less ambitious, and, I hope, more practical; and I think it should have the support of Mr. Karop and his fellow-workers. **Microscopist.**

### THE WATCH AN "AMERICAN COMPASS."

[31802.]—A correspondent (31681) appears to question the accuracy of an extract, in which it is stated that a watch may serve as a compass. This should be qualified by the words "when the sun is visible." The explanation of the use is obvious upon a little reflection. If there were 24 hours on the watch dial, then, when the hour hand pointed to the sun, the watch face being horizontal, the zero, or 24-hour mark would point due south. But if the division of the face is into 12 hours, then, since the sun's daily course is divided into 24 hours, the sun has left the noon mark only one half as far behind as the hour hand of the watch has. The sun's apparent daily course is 360°, while the hour hand is 720°, or two revolutions. The halving of the interval must always be along the course already travelled by the hour hand, i.e., the south point will be indicated by IV. on the watch face when the hand points to the sun and VIII.

**R. Brown**, Yale Observatory.

New Haven, Conn., Oct. 27, 1890.

### IMITATION IVORY.

[31803.]—Writing from purely a turner's point of view, I said (letter 31719) that xylonite does *not mould* well, and this is true of such thick shapes as a turner would need for decoration with bold patterns, but as you will see, Mr. Editor, from the samples sent herewith, it is readily moulded in very thin hemispheres, and is capable of receiving excellent impressions of dies. I may add that, whilst a very fair polish is obtained by the same treatment as ivory, the best finish results from the use of pumice-stone No. 80, finishing with rotten-stone or felspar, as the work may be dark or light in colour, for xylonite counterfeits tortoise-shell, malachite, and many other substances to perfection.

**C. C. Ellison.**

It is now recommended as a good method of annealing steel to let it "soak" in the fire until red hot, as it heats more evenly, then take it from the fire and carry it to some dark place, allowing it to cool in the air until the dull red is no longer obvious in the dark, and finally cooling it off in hot water.

# REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[72284.]—**Cement Kiln.**—To "JACK OF ALL TRADES."—If you will refer to page 86, "E. M." (query 72284, line 11), you will find that "covers" was your own expression, and is no mistake of mine. I am quite familiar with the form of kiln, and used nine of them for burning lime for a long time, but could never manage to burn "Portland" cement clinker, though I could readily produce the yellow underburnt material with incipient signs of clinking. Hard Nottinghamshire coal was used. I have also tried to burn cement in ordinary tunnel kilns and in regular cement kilns with coal as fuel, but could never get "clinker," or only a little bit here and there, and should be extremely obliged if "Jack of All Trades" could put me in the way of burning "Portland" cement with coal, otherwise than in a Hoffman kiln. I should also like more information as to the "continuous" burning of cement in a conical kiln, as I find that if drawn at the bottom, the portion at top does not get burnt sufficiently, and I always allow my kilns to burn out before drawing. I have frequently seen grey lime clinkered as described, and quite understand the cause and how it would improve the hydraulic properties of the lime. I think the intensity of the heat has quite as much to do with it as the potash. In the case of pure white lime, where is the silica to come from?—there would not be sufficient in the wood's ashes. Brick and cement clinker are two entirely distinct and separate things, both physically and chemically. CEMENT CLINKER.

[72284.]—**Cement Kiln.**—I know that bars are used in kilns where breeze, culm, slack, or coal are used. Will "Cement Maker" please read wood, which is a very different thing altogether, and if he were to fire under bars he would very soon have them down. I have shaped a little bit at Robinson's at Northfleet as a millwright, and been engaged on the Isle of Sheppey, where there is cement made, so know a little bit about it; as well as in the South of England, in the brickfields, where all classes of bricks have been made, and taken my part in all of it, from getting the muck from bank into pit, tempering, washing, moulding, hacking, slacking, charging, firing, and drawing, and carting and laying material afterwards; so if I am green I shall remain so. Cement—save the mark!—is not what it should be, and was in days gone by. I know of some that was made and work done with it fifty odd years ago, and as good now as it was when done; but what comes into the market now nine-tenths of it comes off faster than it was put on. What is the reason of that? Can you tell me, being a "Cement Maker"?

JACK OF ALL TRADES.

[72428.] — **Bookbinding.** — Cutting books by means of a knife, as recommended by "C. M." and the writer of the excellent articles on bookbinding in "E. M.," should not be lightly undertaken. After 34 hours' patient experiment, I am satisfied that the man who can turn out a job to his own satisfaction by this means is either very easily satisfied or is the most skilful of skilled workers. I find that a rasp and file give much more satisfactory results. I secure book in way suggested in the articles—cut away as much of rough edge as possible with scissors, then rasp till edge is level, but "woolly"; then finish off with a fine file. The effect is charming. Beware of the dust while filing. I find it necessary to muffle nose in silk handkerchief. D. BLACKBURN.

[72457.]—**Petroleum Burners.**—I am afraid "Nun. Dor." has misunderstood me. I never dreamt of getting 41c.p. from a one-inch burner. I have a burner of this capacity running at present; but it is of the "central draught" type and too big for my requirements. What I want is a thoroughly reliable lamp to light a room 12ft. by 9ft., be the burner round or flat, though the former preferred, say, giving 25 candles. Moreover, I think a discussion on Lamp Burners would prove useful to many of "Ours" who have to depend on petroleum for their house-lighting.

PERFECT COMBUSTION.

[72512.]—**Heating Shop.**—It is not easy to answer such a query as this without inspecting the premises in which the hot-water pipes are to be fitted; but there are many illustrations of such work in back numbers which may assist the querist. A saddle-boiler should do, and if the flow-pipe can be taken at a rise all the way along to the highest point, there ought not to be any difficulty in keeping up a circulation even in 2in. pipes, though if the water is heavily charged with lime salts, they will clog more quickly than pipes of 4in. The question, "over or under the door," is the crux. Much depends on how the work can be done.

H. W. E.

[72515.]—**Umbrellas.**—Why not get an old umbrella, unpick the covering, and see how the gores are cut? As to kind of silk, several qualities are used; but why not try first with some cheap fabric, and so learn a great deal more than can be taught in answer to a query? NUN. DOR.

[72528.]—**Benzoline Gas.**—Procure a catalogue from Fletcher, of Warrington, and look through the back numbers. Gasoline is better than benzoline for such work; but it is not easy to get gasoline anywhere. NUN. DOR.

[72536.]—**Willans' High Speed-Engine.**—The Willans' engine was illustated some time ago—when it first came out; but the querist can, I think, get illustrations from the patentees and makers, and certainly in the specification sold by the Patent Office. G.

[72543.]—**Silvering Plate-Glass Mirrors.**—There are two processes—the quicksilver or old method, and the one known as patent silvering, which latter consists in the deposition of a film of silver from a solution. It has been described many times. S. L.

[72555.]—**Loss of Power in Marine Engines.**—The loss of power depends to a large extent on the actual conditions; but as to that due to slide-valve and reversing gear, it depends on the pressure and form of valve in one case and on the friction in the gear. L. D.

[72556.]—**Starting Marine Engine.**—Started by means of the "starting engine." L. D.

[72557.]—**Calculating Increase of Speed of Ships.**—The power required increases as the cube of the speed. L. D.

[72569.] — **Assaying.** — I should like to ask "Tyro" if he has studied chemical analysis? Because if he has, I cannot understand his ignorance concerning the humid method for estimating silver. If he has not, no reply of mine can assist him.

SM.

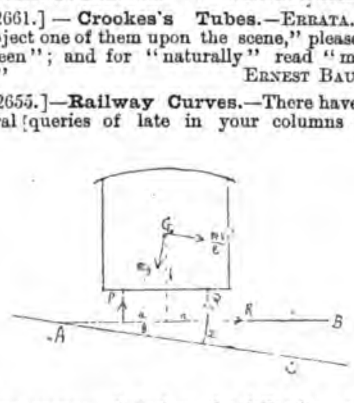
[72584.]—**Fountain.**—Believing it to be understood that a man seeking perpetual motion is most likely to end his labour in a lunatic asylum, I beg to correct an erroneous impression likely to follow B. Brooks' letter (p. 230), who evidently thinks that I was the original querist of the above. I do not blame B. Brooks', as anyone reading my letter (p. 211) might reasonably form the same conclusion as he. Perhaps I am to blame for answering another reply; if so, my excuse must be that, as I have devoted many months to the construction of a fountain that will work a long time without attention, I was naturally interested when "Caldemone" offered a sketch of a "perpetual fountain." Yet, while ridiculing the idea of obtaining perpetual motion, I take this opportunity of saying that I—and I think many other readers—would be interested in a sketch, or perhaps, a series of sketches, showing the nearest approach to perpetual motion that has been applied to mechanical or motive purposes. I thank B. Brooks' for his offer, and, having advertised my address in this issue, shall await the favour of his designs, &c. E. P. J.

[72613.]—**Violin-Making.**—The wood used is of two kinds. Maple is used for the back, ribs, and head; Swiss pine is used for the belly. The arching on the back and belly is formed by carving only; any stamping would prevent the instrument having any power of tone. The inner surface of both back and belly is gouged out to correspond with the curve of the outside; but the thickness in the centre is slightly greater than at the edges. If "W. N. C." would advertise his name in the Address Column, I should be very pleased to give him any assistance by letter. AMATEUR.

[72649.]—**L. and S.W. Tank Engines.**—I do not think that "Locomotive" will find there are any more ten-wheeled tanks by Stephenson, 1885, than those he mentions. NORTH-WESTERN.

[72661.] — **Crookes's Tubes.**—ERRATA.—For "project one of them upon the scene," please read "screen"; and for "naturally" read "materially." ERNEST BAUGH.

[72655.]—**Railway Curves.**—There have been several queries of late in your columns about railway curves. I inclose the following solution for ascertaining the amount of super-elevation required, and hope it may be of use to some of your readers:—Let $2a$ be the width of the gauge; $h$ the height of the centre of gravity of the carriage G, above A B; $\theta$ the angle B A C; $x$ the required super-elevation; P and Q the pressures of the wheels on the rails. Then the forces acting on the carriage,—which is supposed to be receding from the observer to the left,—are $mg$ its weight, $\frac{mv^2}{r}$ the centrifugal force, the pressures P and Q, and the side thrust R of the flanges of the wheels against the rails.



Resolving horizontally, we get $(P + Q) \sin. \theta$

$$= R \cos. \theta + \frac{mv^2}{r} \ldots .1.$$

Resolving vertically, we get $(P + Q) \cos. \theta$

$$+ R. \sin. d = mg \ldots .2.$$

Taking moments about G, $P . a = Q a + R h \ldots .3.$ Now we want R to be zero; then from 3 we get $P = Q$, and substituting these values of R and P in equations 1 and 2, we get $2 Q . \sin. \theta = \frac{m r^2}{r}$ and $2 Q . \cos. \theta = mg$ respectively. Divide one by the other $\therefore \tan. \theta = \frac{v^2}{rg}$ and $\tan. \theta = \frac{x}{2a} \therefore x = 2a . \frac{v^2}{rg}$ where $v$ is the velocity of the carriage in feet per second, $r$ the radius of the curve in feet, and $g = 32 \cdot 2$ is the force of gravity. G. B. M. R.

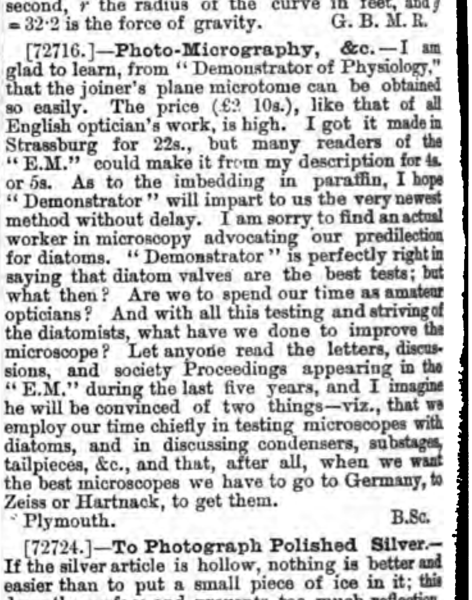
[72716.]—**Photo-Micrography, &c.**—I am glad to learn, from "Demonstrator of Physiology," that the joiner's plane microtome can be obtained so easily. The price (£2 10s.), like that of all English optician's work, is high. I got it made in Strassburg for 22s., but many readers of the "E.M." could make it from my description for 4s. or 5s. As to the imbedding in paraffin, I hope "Demonstrator" will impart to us the very newest method without delay. I am sorry to find an actual worker in microscopy advocating our predilection for diatoms. "Demonstrator" is perfectly right in saying that diatom valves are the best tests; but what then? Are we to spend our time as amateur opticians? And with all this testing and striving of the diatomists, what have we done to improve the microscope? Let anyone read the letters, discussions, and society Proceedings appearing in the "E.M." during the last five years, and I imagine he will be convinced of two things—viz., that we employ our time chiefly in testing microscopes with diatoms, and in discussing condensers, substages, tailpieces, &c., and that, after all, when we want the best microscopes we have to go to Germany, to Zeiss or Hartnack, to get them.

Plymouth. B.Sc.

[72724.]—**To Photograph Polished Silver.**—If the silver article is hollow, nothing is better and easier than to put a small piece of ice in it; this dews the surface and prevents too much reflection. This dodge was told me several years ago by a professional who had a good deal of this work to do, and I have always found it successful.

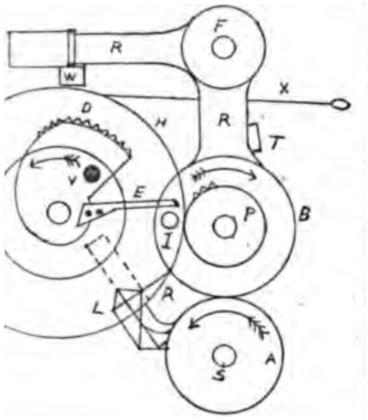
F. R. S. E.

[72725.]—**Mechanical Motion.**—The sketch herewith may enlighten "Australian" as to means for obtaining the motion required. For a slow speed it might, perhaps, work better in a vertical position. R. J. URQUHART.



7, St. Ann-street, Manchester.

[72725.] — **Mechanical Motion.** — A difficult thing to obtain mechanically; but by expenditure of a small amount of power the whole time of running, may be done as follows, unless I overlook an error. A, B, C, are three toothed wheels: A fixed on shaft S, B on a rocking-frame, R, hung at F; C on an independent shaft. I is a pin fixed in B; P is a smaller toothed wheel, friction tight, on the same shaft as B; E is a starting piece riveted on C, D is a snail piece travelling with C, and having its upper end toothed to gear with P; W is an adjustable weight, throwing the rocking-bar against the block T; L is a locking-piece raised on R, having a spring head, which will allow E to pass, but bars its return; W is a grooved pulley carrying the rope X, and is fixed to C, or carried on the same shaft outside the frame (not shown) altogether; V is a pin in C, which meets a stop in the frame and prevents any backward motion of C, D, W, E, farther than as shown, in which position it is held when the machinery is at rest by a spring connected with X. The shaft S being started, I meets E, is r it, thus throwing B into gear with C, ; the pull on X. On E passing L, the ngages with P and throws B out of C, on of P, held by D, keeping the rocking- d L in place. When S stops, the weight mes the friction of L, and R and E fly



arting-point. P might be held friction- n adjustable spiral spring round its shaft; weight W are to be adjusted so as to carry ng-frame with the least loss of power. etch is not to scale: it merely gives an idea.

HORO.

—**Barometer.**—This is not a barometer. ation of volume is caused chiefly by change ature. Place your hand on the flask so as he air, and observe result. SM.

— **Barometer.** — The "flask-in-jar ." was illustrated in the "E. M.," if my serves me, about 18 years ago. As C." (p. 231) apparently refers to my n he says that the instrument is not set in the "help of the thumb," it may be as int out that the flask is filled with water, umb is placed on the top of the neck to ater falling out in the process of inver- thumb is withdrawn when the neck of is sealed by being beneath the water in - just the same operation as with a standard barometer. The water affair is gh and ready sort of thing.

NUN. DOR.

—**Smokeless Firing.**—"Spreading" attering the new coal evenly over the al in the furnace: it is the most economical "Alternate" means firing each furnace r, leaving a space of time, say, three fter firing one furnace before opening the e other. "Coking" means leaving the just inside the door on the dead plate t firing, and pushing back over the fire gases have been driven off. If "Stoker" nately and uses the coking method, e door of furnace just fired slightly open admission of plenty of air for combustion s), for a few minutes, he will find he can emission of smoke. W. E. H.

—**Electric Light.**—If the dynamo be -wound, a little sparking might occur e lamp circuit being switched on; if series- sparking should occur. Should there be, shows short-circuiting somewhere. The t of position of the conductors on arma- l be due to slack winding or the absence wire. When a dynamo is running with on, there is an immense drag on the wire tors on the armature. This drag is usually que, and occurs on all the conductors on twice in every revolution, in most cases. have the centrifugal force, when running, throw the wire out from armature. Of th the two forces acting—one tending to back in the opposite way to which it is he other tending to throw wire off—unless ed, an accident is bound to happen.

H. H. HEADWORTH.

—**Self-polishing Blacking.**—A patent d for Nubian in 1877 (No. 1750). The :—Rectified or methylated spirit, 1gal.; uid, ½gal. Mix and add: camphor, 11oz.; pentine, 16oz.; shellac, 36oz.; benzine, stor-oil, 3¼oz.; boiled linseed oil, 1¼oz. gether. The mother liquid, covered by composed of blue-blue aniline, 20·8dr.; brown aniline, 31·2dr.; rectified spirit,

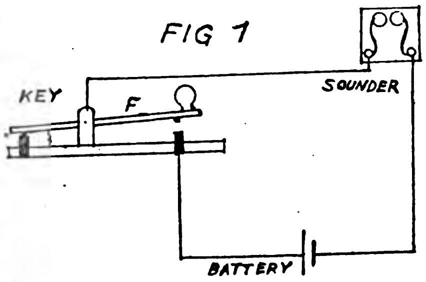
PHARMACIST.

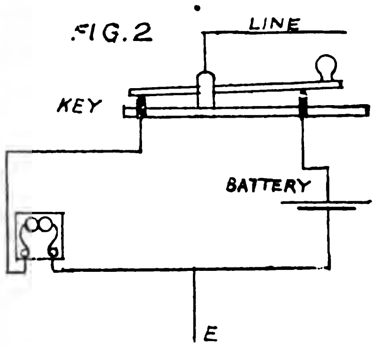
—**Self-Polishing Blacking.**—In reply led," it is supremely difficult to see "what ed to mixture (p. 214) will make the same an," inasmuch as only one of the six named is used in Nubian Blacking. given by D. M. Lodge is a much better one, but still further off genuine "Nubian," as not a single solitary one of all its ingredients is to be found in the article "Muddled" evidently desired to imitate. Would it not be more satisfactory, instead of wasting time, money, and temper on these ancient, not to say antediluvian formulæ, to make the genuine Nubian itself from a formula guaranteed correct. This is one of my unpublished trade recipes or guaranteed trade secrets, a list of which has been advertised in "Sale Column" every week since No. 1057, and which list is sent gratis and post free anywhere. The following is a reliable formula for a waterproof self-polishing blacking. It is, of course, inferior to Nubian, but is also less expensive:—Logwood extract 2oz., bichromate and yellow prussiate of potash 2 drams each, powdered borax 3oz., liquor ammoniæ 2oz., shellac 16oz., water 1 gallon. Dissolve the extract in the water, heating nearly to the boiling point. Dissolve the borax in above, then add the lac, and lastly the ammonia. Keep at a gentle heat, stirring with glass or wooden rod till the lac has dissolved, and the odour of the ammonia has been dissipated.

P. W. STANLEY, Analytical Chemist.
5, Billson-street, London.

[72765.]—**Insomnia.**—I have complained of this for some time, and find taking a cup of dandelion coffee (obtainable at any grocer) the last thing at night, produces excellent results. Be careful to make it according to directions, as, if too strong, it will have a bitter taste. ROMEO.

[72766.]—**Morse Key.**—If intended for a local circuit, join up as shown in Fig. 1 (inclosed); but if intended for communication between two places,





then it should be connected as in Fig. 2 (inclosed). Almost any size of wire will do.

Newcastle-on-Tyne. HY. WILSON.

[72768.]—**Cement for Dry Battery.**—Pitch with a little paraffin-wax added is what I use, and it answers very well. SIEBERT C. HART.

[72773.]—**Watchmaking.**—The following is an expeditious method of putting new hole to "cock" for verge top pivot, when the old hole is not upright with bottom pivot-hole, and if "Anxious" carefully proceeds according to the following hints he will most likely succeed:—With a drill, four or five times the size of the pivot (top pivot), drill through the old pivot-hole in "cock," and with a "broach," passed in from the inside, make the hole in "cock" slightly tapering, so as to insure a good fit with the new plug. Now file down a piece of hard brass wire, tapering to the same degree as the hole in "cock," and, after pressing the wire tightly into the hole, cut it off nearly close to the "cock," leaving the other end long enough to hold it by in pin-vice, or tongs. Now remove the plug, and put it into pin-vice, and, after filing the end flat and burnishing it, it will be ready for "centring." But as the old hole was out of "upright" when the job was commenced, it must not be "centred"; but a dot must be made a little out of the centre. How much out may be easily ascertained by noticing how much the "balance" was out of upright before beginning the work. Now comes the drilling of "pivot hole," which may be done very well with a drill made from a broken "pivot broach," which must have a sharp but chisel-shaped end, so as to leave bottom of hole quite flat. The drilling may be done in the pin-vice. After cleaning out the hole with peg-wood the plug may be put into its place in "cock" again, and pressed in until verge has sufficient end-shake. Now, most likely the balance will be "out of upright"; but it may soon be made "upright" by turning the plug a little way round by the end of plug projecting through top of "cock." The verge and escape-wheel stand in right positions one to the other, when a line, called the "line of centres," can be drawn from the bottom pivot-hole of the verge to the "follower hole"—back pivot-hole of escape pinion—with the "dovetail hole"—back pivot-hole of escape pinion—on the same line. The "dovetail slip" may be moved either way to bring the "dovetail hole" on the "line of centres" if it be wrong. In other words, the verge must stand directly opposite the "dovetail hole," and when this adjustment has been made the escapement will be right, and the "drops" equal—that is, if the escapement be correct in other particulars.

COUNTRY HOROLOGIST.

[72774.]—**Electrical Conductivity of Copper Wire.**—If the conductivity of the copper wire used in connection with telegraphic purposes be increased, the speed of signalling will be greater. For instance, if the conductivity of copper wire of a cable be increased without altering the diameter of it so as to keep the capacity the same, the speed of the cable will be considerably increased. 100 is taken as the standard for pure copper. If it be desired to know the percentage of conductivity of a piece of copper wire, cut off a convenient length, and measure and weigh it carefully, noting the temperature. Suppose the length be, say, 40ft. and the weight 400gr. (that is, 10gr. per foot), and the resistance of this sample is ascertained to be ·900w. by means of Thompson's slide bridge, or other apparatus, and finally the temperature—say, 68° Fahr.—noted. Tables are prepared giving the resistance of a foot-grain of pure soft copper at various temperatures (Jenkin). Ascertain from this table the resistance of a foot-grain of pure soft copper at 68° Fahr. This will be found to be ·2228w. Now, the resistance per foot of our sample will be one-tenth of a foot grain, and the resistance of 40ft. will be 40 times that, or—

$$\frac{\cdot 2228 \times 40}{10} = \cdot 8912$$

would equal the resistance of the sample if it were pure copper. But, as stated previously, its resistance was ascertained to be ·900w.; therefore—

$$\cdot 900 \;.\; 891 :: 100 : 99.$$

Or the sample would be 99 per cent. pure copper.

Newcastle. J. ELLIOTT.

[72776.]—**Metal Wanted.**—Platinum is the only metal which would fulfil the required conditions; but as the market value of that commodity is something enormous (and still rising), I do not know whether the outlay would be paid by the result. I have often seen iron pans coated inside (query: is this a bull?) with some kind of enamel which withstands the action of acids; but it does not appear to expand and contract at the same rate as the iron, because it very soon cracks, and ultimately peels off. If an enamel could be obtained that would contract at the same rate as the iron, I should think it would meet the case. ABERTIFY.

[72776.] — **Metal Wanted—Substitute for Lead Sheets in Vitriol Chambers.**—I quite agree with the replies given last week by Mr. Bottone and "Jack of all Trades," but may perhaps be allowed to mention that a composition has been discovered to replace the lead sheets of vitriol chambers at a quarter the cost of the latter, with, of course, the additional advantage of entirely obviating the metallic contamination of the acid. Mineral-water chemists loudly complain that it is a matter of almost impossibility to secure samples of citric or tartaric acid free from lead, owing to the presence of the latter in the $H_2SO_4$ used in their manufacture. The composition referred to entirely resists the actions of the highest concentrated acid, and hence, setting aside the question of original cost, should receive attention, if only on sanitary grounds alone. I shall be glad to communicate further with any persons interested in the subject.

P. W. STANLEY, Analytical Chemist.
5, Billson-street, London.

[72778.]—**Cancer.**—I have been told on good authority—that is, by a person who knew the person affected—that a cancer of the stomach was cured by eating raw onions. Whether they would be effectual if the cancer was in another part of the body would have to be proved. I do not see that there is anything improbable in it, knowing the strong and powerful juice of that vegetable, and how it penetrates the whole system. If it was external, it might be beneficial to try poultices of them chopped up fine, and constantly renewed as the strength evaporated, as well as taken internally —at least, it is worth trying, as there are no other means of cure at present known. SIGBER.

[72778.]—**Cancer.**—It greatly depends on its cause, position, and extent, and if of recent origin or of long standing; also the age and constitution,

&c., of patient; but in any case it is essential to insure good nursing and the utmost passivity of mind and body that is possible. Some of the following books would be useful to consult—viz., "On Cancer of the Mouth, Tongue, &c.," by Dr. Jessett, of the Cancer Hospital, Brompton; "Clinical Notes on Cancer," by Dr. Snow (of ditto.); "On Cancer," by Dr. Purcell (of ditto); "Cancer of the Rectum," by Dr. Cripps; "The Diagnosis and Treatment of Cancer," by Dr. Collis; "Cancerous and other Intra-Thoracic Growths," by Sir J. Bennett, M.D., F.R.C.P., &c. For further particulars please write to address given in advertisement column.

W. H.

[72781.]—**Pneumatic.**—Why not use one of Körting's blowers? MARIENBERG.

[72786.]—**Model Marine Boiler.**—Boiler is too small for a charcoal furnace, but will steam well with methylated spirits or paraffin oil. J. A.

[72790.]—**Electrolysis of Water.**—The theoretical quantity of electricity required to decompose a compound is measured by the quantity of zinc consumed in the generating battery. Sixty-five parts by weight of zinc are burnt to decompose 18 parts of water (consisting of two parts of hydrogen and 16 of water). Now, as a gallon of pure water weighs 10lb., it follows that, as 18 is to 65, so 10lb. of water (or one gal.) requires 36lb. of zinc to decompose it. This calculation is theoretical. In practice, you would require the expenditure of a much larger quantity of zinc. The quantity of acid required to decompose the zinc cannot be given, as the strength of acids is not uniform.

ABERTIFY.

[72792.] — **Quinine.** — Singular to say, just previous to reading this query, a lady had stated to me that she had to avoid taking quinine owing to the curious effects resulting; amongst others, it caused a rash to break out. I should say that it is a very unusual experience. LEO.

[72797.]—**H.P. of High-Pressure Engine.**—If the mean or average force of the steam acting upon the piston is known (either by the indicator or by calculation), the theoretical H.P. is found as follows: Multiply the area of the piston in square inches by the mean force of the steam in pounds per square inch, or by the velocity of the piston in feet per minute; divide the product by 33,000, and the quotient is the theoretic H.P. The brake H.P. will be about $\frac{1}{5}$ less. If working expansively, the *mean* pressure may be found by multiplying the initial pressure by a coefficient answering to the cut-off, thus:—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Steam cut off at | $\frac{1}{10}$ | $\frac{1}{8}$ | $\frac{1}{7}$ | $\frac{1}{6}$ | $\frac{1}{5}$ | $\frac{1}{4}$ | of stroke. |
| Co-efficient.... | 0·32 | 0·38 | 0·42 | 0·46 | 0·51 | 0·58 | |
| Steam cut off at | $\frac{1}{3}$ | $\frac{1}{2}$ | $\frac{3}{4}$ | 1 | | | |
| Co-efficient.... | 0·68 | 0·82 | 0·94 | 1·00 | | | |

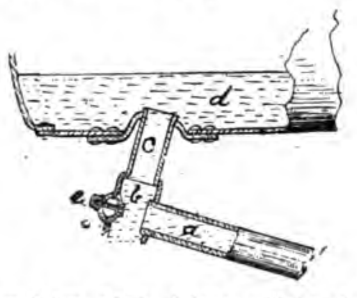
Steam being taken at a pressure as indicated by a gauge fixed on valve chest. MARIENBERG.

[72799.]—**Telephone.**—To MR. F. C. ALLSOP.—I thank him for referring me to his article No. 1. Would he kindly say if I am right in having on each bobbin about 1¼oz. No. 36 wire silk covered? I should have said that the telephones referred to have on the magnet end a screw for fixing a magnet and two other connecting screws. Are side ones any use? SOMERSET LAD.

[72801.]—**Water Motor.**—I, for one, would be interested with an account of "Whoroo's" electric light driven by water motor. In particular, would "Whoroo" please state the height of fall, and if the sizes he has already given of motor, pulley, supply-pipe, and jet in reply to "Rural" are the same as those in his own installation? Also, is the Thirlmere motor on the usual principle of a drum with cams or cups round the circumference?

BOBADIL.

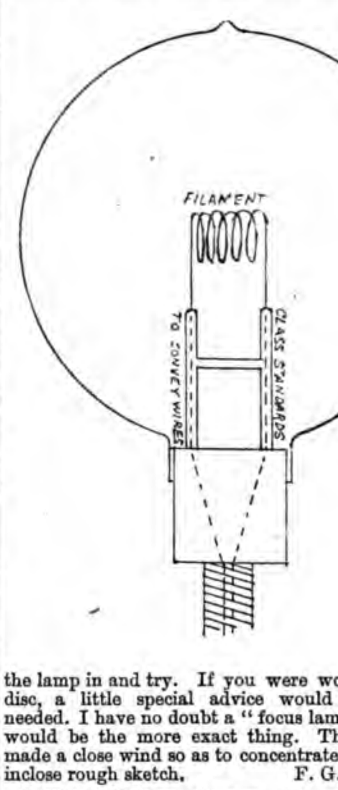
[72805.]—**Water Tube Boilers.**—I send a rough sectional sketch of a part of a Babcock and



Wilcox boiler, which, I hope, will be of some service to "Volcanic." In the sketch, *a* is one of the vertical tiers of water tubes, which are expanded into the zigzag box *b* (called the "header"). The neck *c* joins this "header" to the main shell *d* above, the two necessary joints being also made by an expander. There is a manhole, *e*, opposite every tube.

Brymbo. T. G. L.

[72808.]—**Incandescent Lamp in Magic Lantern.**—If 25 c.p. is sufficient light for you, there is no doubt about you being able to light your magic lantern (optical lantern). Success depends upon the amount of illumination you require. Put



the lamp in and try. If you were working a 40ft. disc, a little special advice would probably be needed. I have no doubt a "focus lamp" (Swan's) would be the more exact thing. The filament is made a close wind so as to concentrate the light. I inclose rough sketch. F. G. WILLATT.

[72811.]—**Boiler Query.**—30 nominal H.P. means, according to Watt, 30c.ft., or 30 × 6·25 = 187·5 gallons of water evaporated per hour, or in ten hours 1875gals. To lift 1000gals. 45ft. represents: $\frac{1000 \times 10 \times 45}{33{\cdot}000} = 13{\cdot}64$ H.P., and may be done in one or in five hours, but would be cheaper if done in the shorter time, as the pump would be larger, and work more economically. Assuming, however, a donkey pump capable, say, of doing the work in five hours, the steam consumed would be about 3cwt. of coal burnt under the boiler for this purpose, and for wear and tear, oil, and attendance, the equivalent of a further ¾cwt. should be added, from which you can easily get at the money cost. A geared pump, driven by the engine, would do the work at less than one-half the cost.

MARIENBERG.

[72816.]—**Analysis.**—According to a book I have, laudanum is a tincture of opium. Now, opium contains 10 per cent. of morphine, and if a neutral solution of ferric chloride is added to a solution containing the drug, it turns blue. Nitric acid will turn it yellow, and a mixture of nitric and sulphuric acids gives a blue coloration. You had better, first of all, buy a small quantity of the drug; dissolve it in a glass of beer, and then add the above reagents, using a fresh lot of beer for each trial. Note the result and the intensity of the coloration; afterwards add the reagents to the suspected liquids, and if similar results are obtained place the remainder of the suspected liquid in a bottle, cork up tightly, and take to an analyst.

ABERTIFY.

[72819.]—**Nitrate of Potash**—I believe is refined by melting the nitre with sulphur.

JACK OF ALL TRADES.

[72822.]—**Bicycle Power.**—The tension on the rope is less than that on the driving-chain. The tension of the chain to the tension of the rope is as the diameter of the driving-wheel to the diameter of chain-wheel thereof. Say, in a safety bicycle, the driving-wheel being 30in., and the chain-wheel thereof or pinion being 3in. diameter (pitch circle), then the tension on the chain is ten times that on the rope. The work done is the same in each case—friction neglected. But, considering the friction of the moving parts when driven, it requires greater power to drive the machine up a hill than to pull it up with a rope.

R. J. URQUHART, Mechanical Engineer.
7, St. Ann-street, Manchester.

[72822.]—**Bicycle Power.**—The man riding uphill has the hardest work, for, supposing him to be mounted on a 60in. machine with a 10in. crank, he must, to balance the weight at the end of his 30in. spoke, apply three times the weight at the end of his 10in. crank. This gives him on the level three steps to a pedestrian's one; but when a hill is encountered his work is increased, perhaps, fourfold, forcing him to decrease his speed to that of the pedestrian, and even then demanding a pressure on the crank often in excess of his own weight, making him glad to dismount and ascend the hill with one-third of the power he has been applying on his short cranks, and leave Herculean glory to cyclists in their novitiate. W. J. G.

[72823.] — **Electric Lighting.** — Say your plates were 1ft. square—two plates in one cell; you would have a capacity of about 120 ampère-hours, which would take days to charge from a two-cell Bunsen. When coupled for intensity you would have 6 ampères at 40 volts, which would maintain one 40-volt lamp for about seven hours. To erect such a plant you would require plenty of patience.

J. R.

[72823.] — **Electric Lighting: Accumulators.**—"Planté" is quite right in his statement; it is perfectly possible to charge 20 cells coupled up in parallel by the current set up by two Bunsen cells, since the E.M.F. of two Bunsen cells is about 3·6 volt; while 2·5 volt is all that is absolutely necessary to enable the current to set up the decomposition in a single accumulator cell (for that is what the 20 cells coupled in parallel virtually amount to). But, and this is a very large "but," supposing you could charge one of your cells of accumulator sufficiently to give six ampère hours by means of your two Bunsen cells in seven hours, it would take 140 hours to charge the 20 cells to the same point since the capacity would be increased twenty-fold. Since no Bunsen cell will run for more than 10 hours at a stretch, you will see that either the cells must be recharged seven times, or that 14 cells must be used; and since the accumulator wastes at least half the energy put into it, it follows that it would be cheaper to employ the 14 cells direct for lighting without the intervention of the accumulators. The duration of light will depend entirely on the size of the plates and the length of time of charging. The accumulators described in my book, "Electrical Instruments," will answer as well as the coiled plates.

S. BOTTONE.

[72824.]—**Dynamo (Manchester Type) for Electric Lighting.**—To MR. BOTTONE OR MR. ALLSOP.—An armature 8¼in. dia. by 8in. long, to give 110 volts, should be wound with 14lb. of No. 14 d.c.c. if of the ring pattern; or with 7lb. of No. 14 d.c.c. if of the drum pattern. This would carry safely 20 ampères. If you wound the machine in shunt, you need about 90lb. of No. 16 on the field-magnets in the case of a ring armature, or 45lb. of the same wire if a drum armature be selected. It would take nearly 3½H.P. to drive this dynamo, if properly constructed. S. BOTTONE.

[72826.]—**New House.**—Beware of new houses, as I have some friends very near wound up through going into a new house. Open all windows, and light some good coke fires all over it. Don't go into it until it is well aired.

JACK OF ALL TRADES.

[72827.]—**Bichromate Solutions.**—No, there is no cheap method by which these can be reconverted into bichromate of potash, and it is no use attempting to renovate them. But if set aside to crystallise, the crystals of chrome alum which form are saleable, and valuable for the potash and chromium they contain. S. BOTTONE.

[72828.]—**Cats with Fits.**—The man who rears an entire Tom cat (except for breeding) ought to be prosecuted as a nuisance to his neighbours, for he is the cause of the midnight concert of caterwauling which so disturbs sleepers. You should have your Tom castrated, as oxen, wether sheep, and horses are. This will cure his fits, and, when grown, he will drive away all others of his species, and be the best of mousers, and most domesticated.

F. GILL.

[72828.]—**Cat with Fits.**—I have a Tom cat which, when about the same age as yours, had fits very bad, which came on in sleep. I found the cause of the fits was eating raw pluck or meat. He started to have the fits when he was three months; he was about seven months when he had the last, which was very bad. We gave him a dose of castor-oil, and since then we have cooked all his meat and given it in small pieces. He is now sixteen months, and a beautiful cat. CHUMMER.

[72830.]—**Electrical.**—A No. 3 "Jones" Manchester type may be either a "lighter," in which case it would give about 10 ampères, or e "plater," giving about 120 ampères at six I presume yours is the former. In this case shunt-wound with rather fine wire, and as the res ance of the shunt circuit is rather high, you will get any indication of current if you coupled up dynamo to an ammeter, presenting probably a f tion of an ohm resistance, since unless a consider resistance is in circuit (say from 5 to 8 oh sufficient current is not driven round the f magnets to magnetise them; hence little or current is produced. But I think you will find that troduce sufficient resistance in circuit, he shape of a number of accumulator cells ır else by inserting a few feet of No. 30 you will get a decided indication on your S. BOTTONE.

—**American Organ.**—In No. 947, May 'Organ" will find the second edition of ıl instructions I gave in Vol. XXVI. for ıllows of American Organs. The ordinary n reeds can be used on American organs, any good purpose. Why anyone should se such reeds puzzles me. ORGANON.

]—**Chromic Acid.**—The crimson-needle the true chromic acid. I do not know other is; perhaps bichromate of potash. ASSOC.N.S.S.

—**Chromic Acid.**—One sample is purer other, and consequently more expensive; e only difference. The acid used to be . in this paper at about 7d. per pound for ırposes. SM.

]—**Chromic Acid.**—The only difference e red powder is the ordinary dry form Sullivan's chromium trioxide), while the he crystallised form. This latter, being pure, is very much more expensive; ttery purposes the former is both better per. It can be bought at about 9d. per S. BOTTONE.

]—**Cubic Contents.**—Cubic contents of is area of end multiplied by depth.

of your shaft opening = $\pi \times 90$sq.ft.
= $\frac{22}{7} \times 90$sq.ft.
ı .................. = 300ft.
Cubic contents = $\frac{22}{7} \times 90 \times 300$
= 84857$\frac{1}{7}$c.ft.

ASSOC.N.S.S.

]—**Cubic Contents.**—The shaft men- obviously a cylinder, the depth of which is d the diameter of each end 90ft. Now, to cubic contents of a cylinder, it is only to multiply the area of the end by the perpendicular height. The diameter of the en; therefore, to find the area of the end 90ft. = 8,100sq.ft., and, according to the Mensuration of Circles, multiply this by hich process will be found to give .ft., which is the area of each end of the l shaft. Multiplying this again by 300, er of feet in the depth of the shaft we 08,522c.ft. as the required content. AUTOLYCUS.

]—**Cubic Contents.**—"P. R.'s" query o cubic contents of a shaft 90ft. in dia- l 300ft. deep is propounded as follows:— diameter of the base, which is 90ft., half of the diameter by half of the circum- find the superficial area. To find the ence, multiply the diameter (90) by 3·1416. one this, the sum may be stated thus:— 90 = 282·740 = circumference—

$$\frac{2·7440}{2} \times \frac{90}{2} = 141·372 \times 45 = 6361·74 \text{ area.}$$

rived at the area, multiply it by the height 0ft., thus 6361·74 × 300 = 1,908,522c.ft. al content). B. BROOKS.

]—**Self-exciting Voss Machine.**—The arge is set up by the sweeping of the long the glass and the bosses. If you get a clear idea of the action of these and machines, read Gray's "Influence Ma- Whittaker and Co. S. BOTTONE.

]—**North-Eastern.**—N.E.R. No. 779, l Works, 1887:—Low-pressure cylinder, meter by 24in. stroke; high-pressure 18in. diameter by 24in. stroke; coupled ft. 8¼in. diameter on tread. No. 1463, n Works, 1885:—Cylinders, 18in. diameter stroke; coupled wheels, 7ft. diameter. 20 engines of this type; ten were built at n and ten at Gateshead works in 1885, designs of Mr. Tennant, which are prac- same as Mr. Fletcher's, his predecessor. sing levers on these engines are worthy of ing set unusually high, the handle coming t of the roof of the cab. I do not know s to which the other numbers you mention

w. METEOR.

]—**Dynamo.**—How can anyone tell you r engine can do when you do not say travel of the piston rod per minute is? for obtaining the H.P. is as follows:— the area of piston in inches by the travel rod in feet per minute, and the result by ssure per inch. Divide the result by When you have performed this operation reckon that with a well-made dynamo ıld get about 200c.p. in incandescent each H.P. your engine gives. S. BOTTONE.

]—**Cleaning Clock-Case.**—What has it been dressed with? If oil, wash it or rub it well with an old, well-darned worsted stocking foot and some turps, or with a brush and strong soda, or pearl-ash and hot water and a fibre brush. JACK OF ALL TRADES.

[72841.]—**Watch-Jobbing.**—The staff is held in a split-chuck if you have a lathe; if not, a screw-ferrule is fixed on the staff, and the back centre in the turns used should have a hole drilled down it to take the pivot easily, so that all pressure from working at the other end may be borne by the shoulder only. Don't take the balance off. HORO.

[72842.]—**Ancient Arithmetic.**—The early Greeks were largely indebted to the Phœnicians for their knowledge of practical arithmetic. As most nations appear to have done at some period in their history, they adopted the plan of indicating numbers by the digits of one or both hands; this enabled them to count up to 10. Proceeding further, they invented a way of representing numbers by groups of pebbles, and this again led to the construction of the "Abacus," a device frequently resorted to at the present day to teach simple notation. For representation in writing, a number was usually indicated by the requisite number of strokes, and, for greater brevity, special signs were introduced for 5, 100, &c. These points are illustrated in the Roman numerals. In the third century (B.C.) the Greeks abandoned their system, and adopted the Alexandrian, in which numbers were represented by the letters of the alphabet, the first nine letters standing for 1 to 9, the second nine letters for 10 to 90, and so on. This system, from its clumsiness, prevented much progress being made in Greek arithmetic, and all results were obtained by some concrete method, multiplication and division being worked by repeated additions and subtractions. The earliest known work which contains a systematic exposition of our decimal system of numeration, is that of a Hindoo mathematician, Blaskava, and this was in use in India during the 7th century. The Arabs, having considerable commercial intercourse with India, obtained a great part of their mathematical knowledge from this source. The works of the Arabian mathematicians became known to the Moors of Spain, who jealously guarded their secret in their universities, and it was not till the 12th century that copies of these books were obtained in Western Europe. The first copy is said to have been obtained by an English monk, who, disguised, obtained entrance to the university at Cordova. DUBITA.

[72843.]—**Electrical Query—Voltmeter.**—To MR. BOTTONE.—I have recently given in the pages of this paper full and detailed descriptions, with illustrations, of the mode of constructing voltmeters to read from 20 up to 50 volts. If you will kindly turn to p. 317, Vol. LI. of the "E. M." for June 6, reply 71482, and again to p. 150 of the present volume, Oct. 10, you will find all you require. I need only add that, by winding the coils with No. 12 copper wire (one coil only) instead of the fine German-silver wire, the instrument becomes an ammeter. It must, of course, be graded, either by comparison with another ammeter, or by the method described by me in my "Electrical Instruments," which you have already perused. S. BOTTONE.

[72844.]—**Voltmeter.**—If you make an instrument precisely on the lines described and figured in my reply (72440, Oct. 10, p. 150), with the exception that the solenoid, instead of being wound with No. 40 German silver, should be wound with 50ft. of No. 36 silk-covered copper, you will have a very handy and trustworthy voltmeter. In order to get the grading to volts, use 10 Daniell cells in good order (10 strips of copper in 10 Liebig's extract of meat pots, in which 10 tobacco-pipe bowls, with the bottom holes plugged with wax, stand, little strips of zinc in the pipe-bowls, will do very well). Each Daniell will give a deflection of the pointer equal to 1 volt. Of course, as you add Daniells on, you must couple up in series. S. BOTTONE.

[72847.]—**Furnace for Scrap Brass.**—You want a reverberating furnace with a well; cost I cannot say, or loss in melting. Birmingham is where you will find men acquainted with this class of work. Advertise. JACK OF ALL TRADES.

[72846.]—**Reversing Electric Motor.**—To cause a motor to reverse the direction of its motion, it is only necessary to carry the brushes through an arc of 180°—or, in other words, to cause the left-hand brush to touch on the right-hand side of the commutator, and vice versâ. This can easily be done by mounting the brush-holders on a movable rocker, as described and figured in my book, "Electro-Motors," p. 90 *et seq.* To measure roughly the power of your motor, attach a pound weight to the spindle by means of a long piece of fine twine, and then note the time it takes to pull the weight of 1lb. through 3ft. Since 1H.P. would pull the weight through 33,000ft. in one minute, a simple rule-of-three will enable you to calculate the horse-power. Say, for instance, that it pulled the weight through the 3ft. in one second, this would be equal to 180ft. per minute. Hence 180 : $x$ as 33,000 : 1H.P., or 180)33,000(183·3, or $\frac{1}{183}$rd of a horse-power nearly. Of course, this is a very rough way. S. BOTTONE.

[72846.]—**Reversing Electric Motor.**—Uncouple wires from the brush holders and couple up to opposite ones. It takes about ¼E.H.P. to drive. Edinburgh. B.SC.

[72848.]—**Old Clock.**—If "Tintom" sends his address to "J. S." in Address Column, he will get the information he requires. J. S.

[72848.]—**Old Clock.**—A brass bob, pear-shaped, about 1¼oz., having hole through the centre lengthwise, tapped to fit the brass wire, which is probably wanted about 6in. in length. HORO.

[72850.]—**Milk.**—Perhaps you refer to the use of condensed sulphurous anhydride instead of condensed air for refrigerating machines. Was the milk cooled by cold brine instead of a cold chamber? You should give details if you want an explanation. Life is too short to be spent in guessing what querists mean. SM.

[72851.]—**Organ.**—One reason why 32ft. tone reeds are rarely seen is, because they take so much wind to blow; in fact, practically require a pressure bellows. Surely the large scale pedal reeds of 16ft. are big enough. Is the querist sure that the organ he refers to has a pedal note of 32ft.?—because it is an easy matter to have the "32ft. tone" in the treble half on the manuals. However, the Americans will make anything required, if ordered, and at their price. ORGANON.

[72852.]—**L. and S.W. Tank Locos.**—No. 131 is not of the same class as Nos. 130 and 132 (it is a six-coupled, six-wheeled saddle tank engine, by Beyer, Peacock, and Co., 1880, and used in the N.E. goods yard); but 133 is. Mr. Adams, in 1886, rebuilt several of the "Fireball" class. Can "Locomotive" give any particulars of the Beattie's patent tank engine that Mr. Adams rebuilt last year, and now is working between Waterloo and Richmond (Kew) viâ Kensington. NORTH-WESTERN.

[72852.]—**L. and S.W. Tank Locos.**—No. 131 is a saddle tank, built by Beyer Peacock, in May, 1882—all wheels 4ft. 2in.; No. 133 is a bogie tank. I give the complete list of South-Western bogie tanks, so far as I have been able to make it. If "Locomotive" and "North-Western" will kindly correct mistakes and make additions where necessary, we shall get them complete and correct at last. First, there is the 318 class, with brass domes, built by Beyer Peacock, 1875. There are six of them, Nos. 318 to 321, Jan.; 322, 323, Feb. Then there are twelve from Beyer Peacock, 1879, as follows: 46, May; 123, 124, June; 130, 132, 133, 374 to 376, July; 377 to 379, August. There are twelve more from Beyer Peacock, 1882, Nos. 415 to 426. There are eighteen from Robert Stephenson and Co., 1883, Nos. 45, 47 to 57, and 427 to 432. So far, so good. Now, I find ten only of Stephenson's in 1885, Nos. 58 to 60, 82, 104, 106, 107, 125, 126, 129. Then there are eleven Neilsons, 1885, Nos. 479 to 489, and sixteen Dübs, 1885, Nos. 490 to 495, and 516 to 525. Then I find Nos. 169, 170, 171, 173 from Dübs in 1884. Will "Locomotive" tell me, if possible, the particulars of Nos. 457, 458, 459, and 134; also the numbers of the 527 class of "front coupled"? As regards Fireball, &c., I believe some have been broken up, and some rebuilt with a modern heavy boiler—the Python, No. 100, which was Mr. Beattie's favourite engine, has been treated so. I can explain the misunderstanding about No. 123 class. It appears that they were originally built with only eight wheels, and that the large coal-bunkers and small trailing wheels were added afterwards. This explains the fact of their having such long side tanks. C. F. DENDY MARSHALL.

[72853.]—**Clock.**—Altering balance would not make so much difference as is required; should think the locking is bad, or the 'scape-wheel and pallets are slightly shallow. The fault might not be easily noticed, as when fully wound the action may be so quick that the lever would be carried over before the tooth of wheel has time to drop. HORO.

[72855.]—**Watchmaking.**—For a four-legged gravity escapement regulator, with seconds pendulum and great wheel turning in twelve hours, the numbers of the wheels must be 144, 96, 90, and 90, with pinions of 12; and 120, 80, 75, and 75 with pinions of 10. If "Jew" can get engine-cut pinions, pinions of 10 will do very well; but if he has to make his pinions from wire, pinions of 12 should be used. Higher numbers are both inconvenient and unnecessary. G. T. C.

[72855.]—**Clock Train for Four-Legged Gravity Escapement.**—Great wheel 144, pinion 12, centre wheel 96, pinion 12, third wheel 75, pinion 10, fourth wheel 75, pinion 10 on 'scape-wheel arbor. 'Scape-wheel turning once in eight seconds, the fourth wheel will turn once in one minute, and the centre wheel once in an hour. To place the 12-hour hand at an equal distance from the centre, use pinion of 16 on centre arbor, into wheel of 56; and pinion of 14 into wheel of 48; if the wheel and the wheels and pinions in motion work to 26 diam. pitch, in going part are cut to 38 diam. pitch, it will place the centres of the 12-hour dial and seconds dial $2\frac{9}{16}$in. from centre of hour circle, which gives a good 12in. dial. Lantern pinions should be used in going part, made from No. 60 steel wire; cut pinions in the motion work. I am at present working on a clock of this description, and have provided most of the details, and should "Jew," or any other subscriber, require further particulars, I shall be glad to give them. BOD.

[72858.]—**Horse.**—Your horse having contracted this habit, it will be somewhat difficult to cure him of it. A remedy may be found in the manner in which it is shod. Have the front shoes made heavy at the toe and light at the heel. Have a thick clip drawn, which should not be let into the hoof but on the outside. This will have the effect of throwing the shoe well forward, the reason for which is this: when trotting, the horse finds an inconvenience arising from the shoe being set forward, and unconsciously tries to throw off the weight by throwing out its feet. In addition to being a preventive against stumbling, it gives the horse a pretty action, known as a "high stepper," and it is a well-known fact that a horse with a high action seldom falls. I have seen some horses, especially trotters, shod with a dove-tailed clip on which a weight is slipped, fixed with a set-screw. These weights run as much as 4 or 6oz. Keep its head well erect by means of a bearing-rein. I know of no remedy to make hair grow where a cut has been, but a good plan is to cut the hair off short about half an inch above the scar, and dress this part every morning with paraffin, rubbed on with the hand with a downward motion. This will cause the hair above the cut to grow longer, and the action of rubbing it downward will cause it to cover the scar. A practical man will, however, soon discover it by passing his hand over the place. B. BROOKS.

[72859.] — **Dented Drawing-Board.** — Try wetting it with some hot weak glue water.

JACK OF ALL TRADES.

[72859.]—**Dented Drawing-Board.**—Damping the "ruts" with water and a camel-hair brush will do a little towards filling them up; then get your board planed down to level.

Plymouth. B.Sc.

[72859.]—**Dented Drawing-Board.**—Put a wet towel, folded, on the dented part of the board, and keep it wet for 24 hours. This will (if the fibre of the wood be not broken) cause the dents to swell to their original place. This wrinkle is good for a dining-table, as I have found. F. GELL.

[72859.]—**Drawing-Board.**—Has it not occurred to you that you might get a carpenter to run his plane over the board—supposing you can spare the 32nd of an inch off its surface? It was certainly a wise thing to trust an unprotected board to the mercy of the railway officials. SM.

[72859.]—**Dented Drawing-Board.**—The best and surest way of getting rid of the ruts will be to plane the board until quite level and smooth. Afterwards, if necessary, rub with fine glass-paper. Before using the paper, make sure the ruts are quite gone by planing.

96, Plough-road, S.W. A. B. T.

[72860.] — **Depositing Copper on Brass Castings.**—Get a 2lb. plum-jar, a porous cell 6in. by 2in., and a zinc rod, with terminal wire, such as is used in the ordinary Leclanché cells. Amalgamate this rod with a little mercury, place it in the porous cell, and place the porous cell in the jam-jar. Now make a saturated solution of blue vitriol in water, with a few drops of oil of vitriol in it. Also make up a dilute acid, by mixing 1oz. of oil of vitriol with one pint of water. Fill up the porous pot with this acid, and nearly fill the jam-jar with the blue-stone solution. Having thoroughly cleaned the brass castings, by dipping them in dilute nitric acid, attach them to the wire leading from the zinc, and let them dip into the blue-stone solution. Keep up the strength of this latter solution by letting a little muslin bag full of blue-stone crystals hang over the side of the jar into the solution, the articles will be well coated in a few minutes. Wash well and dry quickly.

S. BOTTONE.

[72860.]—**Depositing Copper on Brass.**—Get three Daniell cells (size to depend on number of castings), and connect in parallel. Now on to the two end poles of the battery join two wires, and on to the end of the one coming from the copper join a plate of copper, and on to the one coming from the zinc connect your brass casting, which has been previously cleaned of all grease. Now hang copper plate and casting into a trough containing a concentrated solution of copper sulphate, and leave till you have a sufficiently thick coating of copper. The brass casting should be turned round every now and again. If you will advertise your name in Address Column, I will send you full particulars, if the above are not sufficiently explicit. S. C. HART.

[72861.]—**Pulley.**—Friction is the cause of transmission of power by a belt, and is increased by various means, roughened and perforated rims, &c., and by the application of slip preventive compositions. Adhesion in a driving-belt can only be by means of "chemicals," which cause the surfaces of belt and pulley to come into closer contact, and whilst increasing friction is in itself a loss of power.

CHISEL-BORER.

[72862.]—**Boiler Tubes.**—Get some cast-iron borings, and to every cwt. put 1oz. of salammoniac and 1oz. of flowers of brimstone, and well mix up with water, and let it stand a day before using. Caulk your joints with that.

JACK OF ALL TRADES.

[72864.] — **Saccharated Lime.** — See *Brit. Pharmacopœia.* Slaked lime, 1oz.; sugar, 2oz.; water, 1 pint = 7·11gr. lime per fluid ounce. As for the glycerol, I do not know. Why do not you try for yourself? SM.

[72864.] — **Solution of Lime.** — The liquor calcis. sacch. of the British Pharmacopœia is a solution containing seven grains of hydrate of calcium to the ounce. See B.P. for process. Follow instructions closely, or you will make a nice mess, as the sugar and lime form a strong cement. Lime is not so soluble in glycerine as in a solution of sugar.

Aberdeen. CHEMIST.

[72865.]—**Boiler.**—Make a vertical copper boiler 20in. high, 12in. diam.; firebox 12in. by 10in. of $\frac{3}{16}$in. plate, with ends dished $1\frac{1}{2}$in.; put in $\frac{3}{8}$in. rivets, and boiler will work safely at 50lb. pressure; safety-valve $\frac{1}{2}$in. diam. J. A.

[72869.]—**Hanging Electric-Bell Wires.**—To MR. BOTTONE.—1. It would be better to use zinc tubes or wooden casings. 2. If hooks are used instead, be careful not to run more than one wire under each hook, or else you will be nearly sure to get leakage and short circuits. 3. You will certainly advantage by having the battery wires No. 18, as there will be so much less resistance in circuit. S. BOTTONE.

[72872.]—**Dynamo-Winding.**—How is it possible for anyone to tell you how to wind your dynamo, when you give neither the size of the armature nor yet of the fields? If your armature is 5in. diameter by 3in. deep, you can get on it from 3lb. to $3\frac{1}{2}$lb. No. 18, and this will give you 45 to 50 volts pressure, and from 6 to 8 ampères of current at 2,500 revs. per minute. To balance this, you can use about 10lb. to 12lb. No. 18 on fields. But you could not get 6lb. No. 18 on a 5in. by 3in. armature, and if you could, it would give 120 volts.

S. BOTTONE.

[72873.]—**Astro. Telescope.**—The tube is made of slips of brown paper glued together round a 2in. pipe, from which it is afterwards taken off, and when covered with leather it has a very nice appearance. There are three lenses—the object-glass, the field-lens, and the eye-lens—which can be bought for five shillings at Dollond's, the focal length of the object-glass being about 40in. Of course, the arranging of the lenses, &c., in the brass eyepiece is the most difficult part of the undertaking, requiring great exactness and nicety; but with a little care and patience this will soon be overcome. This telescope can be made at a very small cost, and will give a magnifying power of about twenty-five diameters. L. J. BROWN.

[72874.]—**Cyanogen.**—The cheapest form in which you can get this is, I expect, in the shape of prussiate of potash. JACK OF ALL TRADES.

[72874.]—**Cyanogen.**—There are many different compounds containing cyanogen. I cannot say which one is most suitable unless I have an idea of the purpose for which it is required.

ASSOC.N.S.S.

[72878.]—**Model Boiler.**—The fault lies in the tubes being so narrow that they choke the draught. Perhaps the firebox is a little on the small side for burning coal; still, I think if you insert two $1\frac{1}{2}$in. tubes, three if you have room, your boiler will steam all right, if firebars are not arranged too close together in the grate. J. A.

[72879.]—**Microscopy.**—What is your objection to water? You can use alcohol for salicylic acid. One can't answer more without particulars. There is no universal solvent. I never before heard of benzoininic acid. Is it a new discovery? SM.

[72879.]—**Microscopy.**—A very trifling degree of rarefaction is required for this. I generally use a small single-barrelled pump, with barrel 6in. by $\frac{3}{4}$in., one or two strokes of which, when attached to a 6in. bell-glass, are sufficient to fetch away the air-bells. The vacuum certainly does not exceed 10in. of mercury. Your pump would be almost certainly too strong, and tear delicate tissues. To construct a simple ringing machine, get a nice flat lid of a coffee-tin about 3in. diameter, with a rim about $\frac{1}{4}$in. deep. Find the exact centre of the inside, and mark it. Get a small punch nail about $1\frac{1}{2}$in. long; cut off the head, and round the top of the rod left by careful filing. Drive this into a square piece of board about 6in. square and $\frac{1}{2}$in. thick, point downwards, to the depth of $\frac{1}{2}$in. Now make a little tube in tinned iron to fit loosely on this nail (this should not exceed $\frac{3}{8}$in. in length). Solder this upright in the centre of the inside of your tin lid. Now solder two thin steel springs at opposite points of the circumference of the outside of the lid, to serve as clips to hold the glasses. Lastly, fill the inside of the lid with a cream of plaster of Paris, and let it set. S. BOTTONE.

[72882.]—**Bicycle Power.**—The bicycles being alike in every respect, the same power is required in each case to ascend the incline. The tension of the rope is very much less than that of the chain, the rope being parallel to the road. The power exerted is equal to the tension or force multipled by the distance through which it acts. Now the rope moves through a greater distance than the chain, therefore the tension of the rope is not so great as that of the chain.

Edinburgh. B.Sc.

## UNANSWERED QUERIES.

*The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.*

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## QUERIES.

[72882.]—**Re-Spoking Bicycle.**—I want to re-spoke a 54in. bicycle wheel of 64 spokes. The "dishes" of the hub are 3-32in. thick, and flanged at edges with a groove in the inner side of the flange into which the spoke heads (which are flattened on two sides) sink. The spokes are tensioned by pipe-nuts through the hollow rim. At present, the dishes of the hub are out of truth (doubtless through unequal tension), though the rim runs moderately true, and the spoke heads continually break off in the recesses of the hub "dishes." I am thinking of avoiding heading the spokes altogether by running a double spoke length of wire through each pair of holes in the hub, and tensioning the ends at the rim as before (the wheel then being made up of 16 pairs of spokes on each side); also of running these spokes out at a tangent and lacing them, making them of one gauge thicker wire, and re-tapping the pipe-nuts. I should be glad of any opinions on this, and of any information on rebuilding the wheel. —G. W. B.

[72883.]—**Dynamo.**—Will some correspondent kindly give me a little assistance as regards the winding of a dynamo. I want to make one to light thirty 16c.p. [illegible] volt lamps, absorbing about 1 ampère each, and as I do not want to use resistances, I must make a compound one. I can work out the armature, but the sizes and wire for magnets I cannot find in any book or paper. I do [illegible] want to run at more than 1,000 revs. per minute, and the armature, when finished, would be about 12in. diam. and the commutator in 48 divisions. From what I make out, the wire must be safe for 35 ampères, which is No. [illegible] B.W.G. and 240yds. in all. Is this correct? I thought of making it as "Xeros" described in 1886. Is there any better way? The poles would be on the Manchester type. I have about 3H.P. at my disposal. Is this sufficient for the lamps. No doubt a few simple calculations will be useful to many others. Any hints as to winding, &c., to aid me in my venture will be esteemed.—TOLV.

[72884.]—**Voltmeter.**—To MR. BOTTONE.—I have made a voltmeter, same as your sketch at No. 72440, Oct. 10, only that I wound the solenoid with 200yds. No. [illegible] s.c. copper wire. It seems to work very well; but [illegible] having cells enough to grade it, I made several [illegible] accumulators by filling the heads of a number of clay tobacco pipes with red lead in paste, and a strip of lead in each as a connection. I bored them out carefully [illegible] that the clay would be very thin. I put them in [illegible] in little glass cells and filled each cell with the usual acid, and I have them formed and in working order. What [illegible] want to know is: Will they each give off two volts [illegible] current when fully charged? I think not, on account of the greater internal resistance. Also will my voltmeter give good results with above winding on solenoid? J. T. B.

[72885.]—**The Tides at the Society Islands.**—Would "F.R.A.S." kindly favour me with an explanation as to the cause of the unchanging regularity of the [illegible] at these islands, which is mentioned in a "Lady's [illegible] in a French Man-of-War"? She states that day [illegible] day they ebb and flow with unchanging regularity. [illegible] noon-day and at midnight the tide is invariably at [illegible] full, while at sunrise and sunset—in other words, at [illegible] in the morning and evening throughout the year—it is low water.—LEO.

[72886.]—**Manganese Nodules in Red Clay.**—It is stated that these contain a kernel round which [illegible] s accumulated, either a fish's tooth or a bit of some other substance. Is it known how they ated?—Leo.

-**Loco. Design.**—I would be glad if some r would tell the measurements of the engine, , as full as possible, including rail to foot-plate tre of boiler, width of foot-plate, smoke-box, and width of cab, and height of arm-rail of the same of G.E.R. 700.—Inventor.

-**Alabaster.**—Will any reader tell a novice ish alabaster columns (Derby)?—Alabaster.

-**Bruises Removed from Plate, such ots, Coffee-Pots, &c.**—Will some ingenious r give us a few wrinkles to best remove bruises, ring to be done from the inside, so as not to he plated articles, shape of stakes usually c.?—John the Workman.

-**Window Attraction.**—Can anyone assist suggestion for an attractive mechanical or other able for placing in my shop window? I have convex and concave mirrors, and these have vell; but as they are becoming hackneyed I thing else, which must be inexpensive. Would cable to have something contrived to rotate by and thus to exhibit cards or other announce- rotated?—T. Norton.

-**Steam Power.**—I should be glad to know of your practical contributors what would be of a steam-engine (nominal horse-power), to r from a well 90yds. deep with a three-cylinder . diameter and 4in. delivery? Engineering r much in these calculations, and say the horse- 3,000lb. raised 1ft. high, and if raised 2ft. high , and so on. Therefore, when it comes to a they want 100H.P., which is absurd.—B. B.

-**Manchester Dynamo.**—Could any of ders assist me with the proportions of a dynamo nchester type? I should like the armature to diameter. When finished, please state what make the armature of. Also sizes of field- stings, and sizes of wires to wind the armature nagnets with, suitable to light six 16c.p. lamps. .P. water-motor drive it?—Blondon.

-**N.E.R. Bogies.**—Will any reader please e following dimensions, so that I shall be able model, 1in. to the foot, of one of the North gie engines, coupled wheels, under one cover, with Joy's valve gear?—Amateur.

-**Model Traction Engine.**—With refer- model traction engine described by "J. H." a s ago, will he kindly favour me with an actual ig of the link-reversing gear, as I am rather in t it? Also what diameter should the safety I have made my firebox 2½in. by 3in. by 3in. would like to know if I shall be able to get up urning charcoal instead of spirit.—S. J.

-**Spectacle Lenses.**—Are convex meniscus convex lenses easier for the eyes, and which given when convex spherical lenses are ordered? ists say double convex, because there is not so s in these to absorb the light, as in meniscus thers recommend meniscus, because they better from the side to a focus, and are consequently the eyes.—Puzzled.

— **Armature for Motor.** — What size f armature, and what size and amount of wire, equired to give 74½ watts?—B. H.

-**Mercury.**—Will someone please inform me method of testing a bottle of medicine, to see ns mercury?—Lexty.

-**Mannesmann Tubes.**—I cannot under- either of the diagrams shown how it is possible ie tubes closed at both ends, as stated. So far e, one end (the one first formed) is bound to be in order that the mandrel may be kept in against the ingot) by a shaft over which the tube is forced. Will your correspondent kindly rther?—Aberstify.

-**To "F.R.A.S."**—I thank "F.R.A.S." giving me the angular measurement of the hich I find are a trifle larger than those given *utical Almanac* for 1891. When I pointed out pancy between the two measurements given by r, I was right: it was not a misprint. For in- gave 19½″ on the 1st of June, when Mars was ie earth; whereas in the "E. M.," the apparent was 22·8″ for the same date, and Jupiter's ent was 48″ in *Knowledge* when in opposition, being 45½″. I fail to see how it is that Mars ieter being 5·580″, when every new work on gives 4,200 miles linear. If 5·580″ is correct, diameter would be 5,000 miles; but there is a rence between 5·580″ and 4·688″, the latter measure ling to 4,200 miles; so that when the planet was ie earth in 1877, it would have an apparent of 24·5″ or 30·4″. Can "F.R.A.S." inform me ight?—Tom Moore.

— **Bookinding.** — To "Practical Book- -Will the writer who assumes the above *nom-* assist a fellow craft in the country by answering tions respecting cloth case blocking, as, judging cles to amateurs, he is a thoroughly practical Is there any composition other than glue for ss blocks in the blocking press? After being heat for a short time it becomes brittle, and the p off? 2. The perfectly made cases turned out rms show no appearance of glair on their sur- when a solid surface of leaf appears on the title. Is this done with dry albumen dissolved, owder? Some cases appear so clean that the s as if new from the roll. Do they put some- ie glue, and leave the rest to heat and pressure? is the best way of getting up a high gloss with s ink on a case? An early reply will oblige, as rk waiting which I would like to turn out in a y manner.—Provincial.

-**Pump.**—Will any kind reader suggest a few iculars for a vertical boiler force pump of ⅜in. er, as the one I have gives no end of trouble, as explained in my query, No. 72673, which I believe must be in the size of valves (conical)? Is it the speed, or too much play, or that the valves do not have time to allow water to pass? Or it seems to me that valves do not descend quick enough, and allow water to return?—Billy Hooks.

[72902.]—**Coin.**—I have a coin of Charles I. which I wish to copy to make presents to a few friends at Christmas. I have tried in vain to get a sharp impression from silver or German silver. I have also tried some of the alloys taken from W. T. Brannt's "Metallurgy" without success. My cast is in fine plaster which does not stand heat well. I have tried graphite mixed with kaolin, the white of an egg, and fine pounded china compressed. This stands the heat better, but is too tender. Will some practical person kindly give me a good white alloy, or an alloy of silver which will take a sharp impression, or the way to take it in standard silver with material for the mould? If it can be done better in gold, or an alloy of gold, I should be pleased to be instructed how.—Novice.

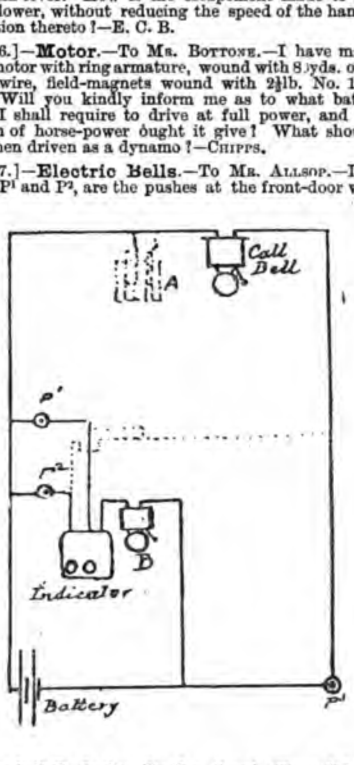
[72903.]—**Copper Boiler.**—I shall be much obliged if some kind contributor would give dimensions of copper boiler for ⅛H.P. engine, 60lb. working pressure. What gauge of sheets, and size and distance of rivets? What would the approximate weight of materials be? If of steel, what thickness would the plates require to be?—Powes.

[72904.]—**To Mr. Bottone.**—I want to light my shop-window up brilliantly with electricity. The window is about 10ft. wide by 9ft. high. Should I be able to light it with a 50c.p. dynamo? If so, please give dimensions of armature (Siemens type), field-magnets, and amount of wire, and size; and also probable cost if home-made.—Amateur Electrician.

[72905.]—**400-day Clock.**—Will any reader kindly explain the conversion of an ordinary English lever clock (eight-day) to the above form with torsion pendulum? I have read a little in back numbers, but found nothing clear enough. I wish to experiment first on a cheap American lever. How is the escapement made to go so much slower, without reducing the speed of the hands in proportion thereto?—E. C. B.

[72906.]—**Motor.**—To Mr. Bottone.—I have made a small motor with ring armature, wound with 80yds. of No. 20 c.c. wire, field-magnets wound with 2½lb. No. 16 c.c. wire. Will you kindly inform me as to what battery-power I shall require to drive at full power, and what fraction of horse-power ought it give? What should it give when driven as a dynamo?—Chipps.

[72907.]—**Electric Bells.**—To Mr. Allsop.—In the sketch $P^1$ and $P^2$, are the pushes at the front-door which ring the bell B, during the day time? The call-bell at top is rung from push $P^3$. I want an arrangement so that the bell at the top can be switched on at night, so as to be able to ring it by pressing either of the pushes $P^1$ or $P^2$. The only way I see to do it is to put a cell or cells in at A, and connect up as shown by the dotted lines; but I want to do without the extra battery. A sketch would oblige.—Ivan.



[72908.]—**Boiler.**—Would anyone oblige me with the size and thickness of iron for a boiler and firebox (to burn coal, if possible) to drive an engine 2½in. stroke, 2½in. in bore?—C. H.

[72909.] — **Model Boiler.** — I intend making an ordinary cylindrical single-flue model boiler, of 1-32 copper, and riveting it up in the usual way, but do not wish either brazing or tinman's solder to enter into its composition. My idea is, after it is finished, to electro-copper it to, say, 1-64 thicker. Would this process effectually block up, and unite every crevice and seam (making the boiler as it were, a solid ingot of copper)? Would it stand steam-pressure as well as if brazed? How long would it take to deposit 1-64?—Esca.

[72910.]—**Sectors for Wimshurst.**—I have 16 sectors on each plate of the following dimensions:—3½in. long, taper ¾in. to ⅜in., rounded ends. Is this correct proportion, because I don't get more than a 3in. spark, though it is very thick, brilliant, and very loud reports? Would smaller and more numerous sectors increase length of spark? Without Leyden jars, there is a good stream of sparks 1in. long. Plates 16in. diameter.—Puzzled One.

[72911.]—**Brighton Engines.**—Will some reader kindly give the dates (months, if possible) of the following:—Nos. 19, 42, 76, 97, 103 to 106, 112 to 114, 115, 130, 142 to 144, 155, 183, 268, 269, 296, 358, 402, 404, 407, 410 to 413, 419, 420, 422 to 432, and 481, and the size of cylinders of No. 157? Also the original numbers of Nos. 401 to 408, and the original dates of Nos. 201 to 207?—C. F. D. Marshall.

[72912.]—**To Mr. Bottone.**—Would you kindly say what size dynamo (Manchester type) an engine with 6in. cylinder, 8in. stroke, and 7 lb. pressure, would drive? Would you give sketch and dimensions for the patterns of same?—An Irish Reader.

[72913.]—**Photographing the Moon.**—Shall be glad of hints as to adapting a camera to a telescope with 2½in. object-glass.—Negative.

[72914.]—**To Mr. Allsop.**—Will you please give directions for making Callow's continuous bell attachment, as shown on page 98 of your book? Dimension of core and quantity of wire required for coils, &c.—A. T. J.

[72915.]—**Canal Boat.**—A canal boat, A, is passing another boat, B, each travelling at the rate of three miles an hour. I want to jump from A to B. The bargee tells me that I must jump in the direction in which A is going to prevent a fall. Can any of your mathematical readers give me the theoretical explanation?—Inspector.

[72916.]—**Telescope Lenses: Increasing the Density of the Glass.**—Some time ago Whitworth found out the advantage of subjecting steel ingots while still in a fluid state from the melting furnace to enormous pressure, whereby it was rendered denser and more homogeneous. If a similar process of compression were applied to the melted glass, would it not be rendered denser, and thus more suitable for use in telescope lenses by probably considerably increasing its power of refraction? May I ask the opinion of "F.R.A.S." and other optical correspondents?—A. S. L.

[72917.]—**Cardboard Plates for Wimshurst Machine.**—To Mr. Bottone.—In an old number of the "E. M." of about three years ago there is an article headed "Cardboard Plates for the Wimshurst Machine." The writer of that article said he made some very successful 18in. diameter plates from cardboard, thoroughly soaking the cardboard in paraffin and then varnishing them with shellac varnish. He does not say whether paraffin oil or wax was used. I tried paraffin wax, knowing that to be much used by electricians, but I could not get the wax to soak into the cardboard beyond the first layer. Will you kindly say how I ought to set about it? Is it possible that paraffin oil, not paraffin wax, was used by that subscriber? I know that glass is the usual substance to use for Wimshurst plates, but I should very much like to try cardboard by way of experiment, especially as our subscriber found it so successful.—E. H. Tomlin.

[72918.]—**Fluoride of Ammonium.**—Can this be made without special apparatus? If so, how? Can any reader oblige with the chemical properties of above if treated with acids, or suggest a possible substitute, as I am unable to procure this chemical in London?—George Williams.

[72919.]—**Ammeter, Voltmeter, &c.**—To Mr. Bottone.—I want a reliable and accurate voltmeter to read up to 75 volts, and ammeter to read up to 20 ampères. Please describe best form for these. You describe a voltmeter page 150, Oct. 10, 1890. Is this a better instrument than that described page 317, June 6, 1890? I notice in a back number you say back E.M.F. of an arc light is 39 volts. This I cannot understand, as I have run a small arc with not more than 30 volts.—J. Chasseur.

[72920.]—**Sound Copper Castings.**—How can I get sound copper castings without being porous?—A. B.

[72921.] — **Spherical Valves.** — Could any kind reader oblige me with any information or the description of a tool to make a true sphere for a small force pump —diameter of sphere 5-16—as the circular disc I have in the pump for a valve will not work, and I cannot turn one truly spherical with the tools I have?—Perplexed One.

[72922.]—**Removal of Rust.**—Will some of our readers kindly advise the best mode of effectually removing rust from cast iron and steel caused by coming in contact with salt? Its removal must be entire, and the articles, although badly eaten into by the rust, are to be covered with tin with a view to further use?—Rustic.

[72923.]—**Ball Bearings.**—Can any of "ours" tell me how the small steel balls used in the above are made? Are they ground round like toy marbles, or turned?—B. H.

[72924.]—**Model Gun.**—I purpose making a model artillery gun of steel to the following particulars:—Diam. of bore of gun, ·3in., length of bore, 8·0in., diameter of breech 1·0in., weight of projectile 96·25gr., weight of charge to give a maximum pressure of 16 tons per square inch, 16·2 gr., angle of elevation 25°, rifling R.H., three V-grooves, pitch 1 in 15in. Now I want to draw the trajectory at the named elevation that I may graduate the back sight, and to do this I require the following particulars: Probable range, time for ditto in seconds, muzzle velocity, mean velocity during flight. Also supposing I do not rifle the gun and use a 40gr. shot, what would then be the probable range, &c.?—Amateur Artillerist.

[72925.]—**Substitute for Stereotype Metal.**—I want a substitute for type metal for casting stereotype plates of a small-pica job I am privately printing. Two or three years ago I saw such plates, but not being specially interested in the subject only noticed that they were very like guttapercha. They bent, and could be jumped upon without damage. They were introduced by the inventor of a composing machine of which I have heard nothing since. Could I cast guttapercha plates in the old-fashioned plaster matrix?—Blackburn.

[72926.]—**Enamel for Brass.**—Could any reader let me know how I could make an enamel (clear) to go on polished brass tablets which I make designs on with ink, leaving a good hard and glossy surface?—Perplexed.

[72927.]—**Resistance.**—Will any electrician kindly give me answers to the following queries? 1. How is it that when you commence charging accumulators at the rate of 30 ampères, speed being 650 revolutions, you have, as you continue to charge, to increase your speed to get the 30 ampères? Is this owing to decrease of resistance in cells, or to E.M.F. of same rising? 2. The engine going at its highest speed—viz., 750 revolutions—after running two and a half hours, only makes 10 ampères. I want to make 30 ampères instead of 10 at this point. Can it be done, or must engine speed be increased?—Wireman.

[72928.]—**Pump.**—Would "T. C., Bristol," kindly give his opinion on the following? I have a pair of engines coupled to run dynamo. On each engine there is water pump for feeding portable boiler. If I allow the water in gauge glass to show 1in. and then put one pump on, the water immediately sinks out of sight. Suppose pump on for five minutes and then stop, the water gradually rises in glass. Query—Why does water go out of sight when pump is put on?—Wireman.

[72929.]—**Binding Screw Clamps.**—I read in the "E. M." a few weeks ago of the employment of platinum wire for connecting carbon battery plates, and have thought that platinised clamps would be more convenient and offer less resistance if the thin coating is sufficient to resist corrosion. Would Mr. Bottone or other electrician state their opinion, as I should think they would be less expensive than platinum wire?—Pharmacist.

[72930]—**Portable Engine.**—Will any kind reader let me know how to lengthen tubes, because I have got a portable engine to draw the tubes out and clean, and I have got to use all of them I can, and they will come short, so I want to lengthen them about ½in.?—One in a Fix.

[72931.]—**Organette.**—Will some kind reader give me the necessary instruction how to make an organette?—Music.

[72932.]—**Delezenne's Circle.**—Can some fellow-reader tell me the best size wire to wind this with? Also describe the arrangement of commutator?—Jacques.

[72933.]—**Water-Motor.**—To "Whoroo."—Should be glad to see description from you with as many particulars as possible.—Rural.

[72934.]—**Rubber.**—I wish to attach to a cramp sheet rubber to prevent marking the furniture, and have failed to find anything that holds the rubber firmly to the malleable iron cramps. Can anyone assist me?—J. J. C.

[72935.]—**Uni-Direction Machine.**—To Mr. Bottone.—I have got your book on this subject, but it only gives one size. I want to know if one of these machines could be made and used with success to give ½H.P. at 20 volts and 8 ampères. If so, will you kindly state size of magnets, armature, and quantity of wire for same?—Subscriber.

[72936.]—**Boiler for a 4ft. Yacht.**—I am making a new boiler which I want to stow a working-pressure of 40lb., and wish to know if, instead of riveting seams, braze them instead. If not, I purpose only riveting the outer seams, and brazing the inner and other parts that are not so much under the strain. A word as to the reliability of brazing will much oblige.—Billy Hooks.

[72937.]—**Birkenhead Gold.**—A paragraph went the round of some local Lancashire papers asserting a discovery under Birkenhead of an auriferous gravel down a well now being sunk. Is anyone possessed of information?—Chisel-borer.

[72938.]—**Salt Glaze.**—Would "Potter" or "Jack of All Trades" inform me how to get a salt glaze, and what salt is used for it, for down-draught kiln? Clay to stand fire well.—T. P.

[72939.]—**Star-Finder.**—I have an astronomical telescope which when drawn out is 36in. long, 2in. object-glass. Will some reader please tell me how to make a star-finder, and how to fix it and use it, and oblige?—Amateur.

[72940.]—**Motor.**—A great want would be met if someone would construct a motor of ½H.P., at a low figure and fairly efficient. Much has been written in the "E. M." on model-engines, but I believe in a motor that will do some useful work—such as driving a 5in. back-geared bench lathe, or driving a boat or dynamo. Which is best and cheapest—a steam, electric, Thirlmere (or Pelton), water, gas, or oil-motor? Will someone give details of cost, efficiency, and cost per hour of these? Has any reader any experience of the Butler-Petrol domestic motor, which is advertised as 1-6H.P., about 16in. high, 7in. wide, and about 14in. long, and uses benzoline? If someone would write an article on this topic, I am sure many would be interested.—J. Johnson.

[72941.]—**Zincography.**—In "Ours" of last week there is a paragraph from a Berlin paper announcing another old new discovery—the etching of a zinc plate by means of the electric current. This has been known for years as theroretically feasible; but I should like to know if it has been, or is now, worked practically. I shall also feel obliged for a hint or two as to how the transfers for process (say, Meisenbach) blocks are produced.—D'Evlyn.

[72942.]—**Throttling Governor.**—Will "T. C., Bristol" kindly give me the sizes (length of arms, diam., and weight of balls, &c.) of a throttling governor, suitable for an engine I am fitting up? Cylinder (vertical inverted) 2in. bore, 4in. stroke, flywheel 13in. diameter, rim about 2in. thick, steam ports ⅜in. by 3-16in., exhaust ⅜in. by ¼in; running at about 30lb. pressure.—J. A.

[72943.]—**Dynamo Designing.**—Where does the difference between a Gramme and Paccinotti armature lie? In calculating the magnetic resistance of the circuit, do the teeth add to the cross-section, or only diminish the air space? What is the rule? Again, how does the loss, due to hysteresis with a given armature, speed affect the winding? I work to Kapp's formula.—J.

[72944.]—**Telescope for Box Sextant.**—I have a small box sextant which is not provided with a telescope, as I believe is usual. It has only a small sight-hole through which to make the observation. I should like to fit it with a telescope, and should be very glad if any of your readers would kindly send me details of diameter and length of telescope, and diameter and focus of lenses. With so small an aperture, I presume non-achromatic lenses will answer the purpose. I may say that I have a lathe, and can easily fit up the brasswork.—W. S. P.

[72945.]—**Compond Engine.**—What would be the horse-power of small compound engine, high-pressure cylinder 6in. diameter, low-pressure 11in., stroke 12in.? Are the proportions between the two cylinders correct? Have any readers of "Ours" had any experience with small vertical boilers of the Field type?—if so, what is their opinion in point of economy? I should have said the boiler-pressure is 60lb., and the revolutions of engines 150 per minute; also non-condenser.—Jack Straw.

[72946.]—**Feeble Hand.**—I have a friend who met with a serious accident about 12 months ago, by cutting his wrist with a chimney glass of a paraffin lamp. The cut was very deep, and he lost a large quantity of blood. He was unable to do any work for several months, and during this period he suffered great pain. Owing to the nature of his work, he was able to resume his duties after being idle four months, although he could not then lift a half-pound weight with it. But it has steadily gained a little in strength, but it is far from what it should be, and he feels a pricking pain in it now sometimes. Does any friend know of a remedy for it, and will give the benefit of his advice? He is 46 years of age.—Alltfab.

[72947.]—**Indiarubber.**—Will any reader be kind enough to inform me the size of a sheet of rubber 3-16in. thick, which will weigh a pound—in other words a sheet of rubber 3-16in. thick, weighing a pound: how many square inches will it contain?—F. S.

[72948.]—**Curious Musical Instrument.**—Passing down Holborn the other day, I saw near Holborn Circus several people looking at and listening to a curious kind of American organ which a man in the shop was exhibiting. It had an ordinary keyboard on which the man occasionally played himself; but there was a kind of recess above the keyboard in which a perforated paper was running over rollers, and evidently sounding the notes automatically, irrespective of the playing on the keys. The curious thing was that so narrow a band (probably not above 8 or 9in. wide) could act on so large an instrument, more especially as I could detect no pins or projections working through the holes in the paper, so the connection must be pneumatic and not mechanical. Another odd thing was that the performer, though working the ordinary bellows with his feet, did not turn a handle, or seem to in way keep up the movement of the rollers that worked the band with the holes in it. Can any correspondent tell me how the thing is worked, and how the small band can affect such a large and complete instrument with (I noticed) several stops.—Puzzled.

[72949.]—**Faulty Dynamo.**—I have made a series dynamo, open cast-iron field, winding space 6in. by 3in., wound with 10lb. No. 16, armature laminated, + shaped, open coils 2¾in. diameter, 5½in. long, wound with 2lb. No. 20. When driven at 2,500 revolutions, I obtain about 2 ampères at 15 volts pressure. What better result would I get by putting in wrought-iron field shunt wound?—2nd, to use 4 poles; 3rd, closed coils. A little good advice would greatly oblige.—Menkara.

[72950.]—**Strata under Sahara.**—Can anybody give a M.S. section of the strata bored through by the French borers on the Great Desert, or any geological data; or description of method employed, whether diamond bored, hand percussive, or machine percussive?—Chisel-borer.

[72951.]—**Pidgeon English.**—What is the origin of this combination, sometimes also spelt pidgin English? Is the word pidgin a corruption of some Chinese idiom? What is the Chinese for business, rendered phonetically?—A. C. G.

[72952.]—**Depositing Vat.**—I have made a small depositing vat for sulphate of copper. I got a wood box, about 1ft. by 8in. by 5in. deep, made a layer of ¼in. of Portland cement all over inside, and then put marine glue over that; but the latter blisters, and the $CuSO_4$ eats away the cement and destroys the liquid. I have tried to buy an earthenware one, but can find nothing suitable. I want to try another way—instead of putting marine glue, fixing tightly pieces glass on sides and bottom. Will this do, please? Also will cyanide of silver and potassium act on the cement?—F. H. Wise.

[72953.]—**Boring Taper Holes.**—Which is the best way to get them dead true, and what is the best tool for steel work? -X. Y. Z.

[72954.]—**Brazing by Electricity.**—Could Mr. Bottone or other reader kindly inform me what quantity of current (I presume the pressure would have to be about one volt) would be required to braze by electricity steel tubes together (with ordinary brazing spelter), averaging ⅝ to ¾in. in diameter and 1-16 to ⅛in. thick? The ends of the tubes have to be inserted about 1in. in each other (thus a ½in. tube 1in. in a tube of, say, ¾in.). My object is chiefly to avoid the large amount of work caused in finishing the tubes after brazing in the ordinary manner, the joints being very difficult to get at after brazing.—C. H. Bingham.

[72955.]—**Telephones and Microphones, Connecting.**—When a pair of telephones are used with microphone transmitters and batteries for short distances without using induction coils, should not the microphone be so connected to the telephone terminals that the battery currents passing through the telephone coils would help to strengthen the magnetism of the bar magnets? If this is important, will Mr. Allsop or Mr. Bottone please say how it is to be done? Must the commencing winding end of one telephone coil be connected to the finishing winding end of the other one by line-wire at distant station? I have an idea, if this is not done, the battery currents passing would have a decided tendency to weaken or reverse the telephone magnets.—F.R.Met.Soc.

[72956.]—**Turning True Cylinder in Steel.**—Why does this kind of work, when changed end for end in the lathe, run out of truth? After centring and squaring up both ends and turning up one end (using Clements' driver), and then replacing carrier on turned end and reversing work on lathe centres, the second portion of the cylinder does not turn up dead true with the first part. Is it the carrier? Kindly say what is the best kind and oblige.—X. Y. Z.

[72957.]—**Electric Clocks.**—I possess two electric clocks, patent, labelled "Dixon and Cassey." One is a driving clock passing the current on to the second one. I wish to utilise the second one to give time to our village, which possesses no regular timekeeper. I shall esteem it a favour if any of your correspondents would be good enough to enable me to start the former, if the action of the clock is known to them. I have two Leclanché cells to drive it with, but cannot get the current to drive the pendulum. How must I couple the batteries, and how arrange to break the contact? At present the armature clings to the coil, and the swing of the pendulum is not strong enough to lift it from the coil. No doubt the points of contact have been strained in transit, so that they do not act either at the proper moment or at all. An arm, tipped with platinum, on the pendulum should lift the armature by acting on a wire, which wire has another arm tipped with platinum moving in a brass cup. Should this cup be filled with water?—Guardian and Overseer.

[72958.]—**Microscopic—Celloidin Section.**—Will any reader kindly give me directions for imbedding, cutting, staining, and mounting objects in celloidin? I have seen nothing relating to the same in any of your previous numbers, and I'm told most of the finest sections are prepared by that process, as they can be cut, stained, and mounted without removing the celloidin, which is, of [illegible], necessary with paraffin wax.—A. G. E.

[72959.]—**Sound.**—What produces the sound in the cracking of a whip?—Q.

[72960.]—**Equation.**—Will some one kindly show how to obtain the values of $x$ and $y$ from—

$$A = \frac{74{\cdot}41}{39{\cdot}04}x + \frac{58{\cdot}36}{22{\cdot}99}y$$

$$B = \frac{173{\cdot}9}{78{\cdot}08}x + \frac{141{\cdot}8}{45{\cdot}98}y$$

—Q.

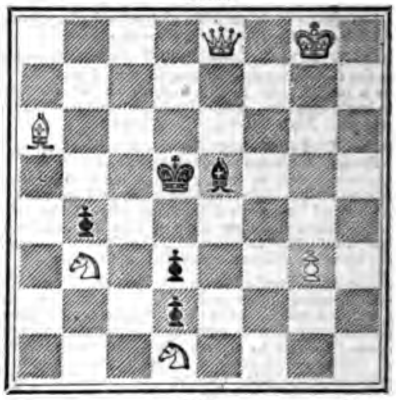
[72961.]—**Rapid Determination of S.G.**—Will Mr. Brown (letter 31769) kindly explain how he makes the difference between 7·301 and 7 330, 4·468 and 4·48 to be ·0031 and ·004?—Sm.

## CHESS.

All communications for this department must be addressed to "J. Pierce, Knollside, Yawl, Lyme Regis, Dorset."

### PROBLEM MCCXXVIII.

*Black.*



*White.* [6 + 5

**White to play and mate in two moves.**

Solution to 1226.

| *White.* | *Black.* |
|---|---|
| 1. B-K Kt 3. | 1. Any. |
| 2. B or Q mates. | |

### NOTICES TO CORRESPONDENTS.

Correct solutions to 1226 by J. Kistruck (a very difficult problem), W. A. Clark, Biene, D. Mackay, W. L. Martin, G. W. Middleton, J. B. (clever and difficult), W. Gleave (peculiar, but not pleasing, and very uneconomical), C. P. P., Fr. Fernando (the other four attempts are incorrect), Lieut. Col. Ryan (ditto), and W. Sangster; to 1225 by A. A. (but K R 5 put for K Kt 5, second solution), J. A. Rogers (second solution; if 1. $\frac{}{\text{P takes P (e p.)}}$, 2. Kt-Q B 3 *is* mate), J. B. (author's), G. W. Middleton (2), D. Mackay (2), and W. Sangster (author's).

E. Perrin, W. J. Greenstreet, A. G. Fellows, A. A., and Fr. Fernando:—If in 1226, 1. $\frac{\text{B-Q 6 or K 5}}{\text{Q-K B 2 (ch)}}$, and there is no mate next move.

"Chess Exemplified" by W. J. Greenwell (I. M. Brown, Leeds). We have not yet had time to peruse the whole of this work, but from the little acquaintance we have already made with it, we feel sure it will prove a useful addition to the chess player's library. It consists of 132 games of the best players from the days of Staunton to the present time. They appear to be very well selected, and most of them are entitled to be ranked as classical chess, and should be well known by all students. The principle, which is excellent, of selecting them, not so much for brilliancy as for sterling good play on each side, has in the main been carried out. There are, however, exceptions; for instance, Game No. 14 between Cochrane and the Brahmin appears to us to be very weakly played by the latter. There are plenty of diagrams at critical points in the games. The notes are quite up to date, and present the old masterpieces under the new light of modern research. The work has been well edited. We notice no list of errata, and, as far as we have read, we have met with no typographical error. Should there really be none, the book in this respect will be an editorial *tour de force* unexampled in chess literature. The book is intended more to illustrate the style of the great masters than the various openings; but, of course, indirectly, it serves both objects. A work somewhat on the lines of the one before us, but with the object of illustrating the several openings *historically*, by giving the best games by the best masters during the last 200 years, would be a great boon. Will some zealous and competent player take this up? If well done, it would prove a valuable and useful adjunct to the somewhat dry-as-dust theoretical treatises.

## RS TO CORRESPONDENTS.

*munications should be addressed to the* EDITOR
H MECHANIC, 332, *Strand, W.C.*

### INTS TO CORRESPONDENTS.

one side of the paper only, and put drawings
ms on separate pieces of paper. 2. Put titles
d when answering queries put the numbers
e titles of the queries to which the replies
charge is made for inserting letters, queries,
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rs or correspondents, or where tools or other
be purchased, or replies giving such informa-
be inserted except as advertisements. 5. No
ng for educational or scientific information
through the post. 6. Letters sent to corre-
nder cover to the Editor, are not forwarded,
nes of correspondents are not given to in-

ion is especially drawn to Hint No. 4. The
l to letters, queries, and replies is meant for
ood, and it is not fair to occupy it with ques-
are indicated above, which are only of indi-
st, and which, if not advertisements in them-
to replies which are. The "Sixpenny Sale
ers a cheap means of obtaining such informa-
trust our readers will avail themselves of it.

g are the initials, &c., of letters to hand up
day evening, Nov. 12, and unacknowledged
—

rson.—J. and H. Grace.—A. R. P.—Bichro-
st.—Element.—Magnet.—Ulsterman.—W. H.
g Beginner.—H. G. Leitner.—A. Caplatzi.—
t.—G. Poston.—Meteor.—Jack of All Trades.
. B. T.—Junior.—F. H.—Sm.

(We have on several occasions explained in
in that when a planet is spoken of as
" in our Astronomical Notes, it is meant
for the purpose of the ordinary observer with
pe. Turn your own instrument, if you have
Mars in his present position, presenting, as
merely the appearance of a largish red star
een 20° and 30° of South Declination, and
ly close to the horizon), and make a drawing
rficial detail. We will willingly engrave it!)
We have frequently explained the process of
t a patent. The forms can be obtained at
offices for a few pence, and the stamp on the
costs £1. It is not "necessary" to search
s; but it is advisable to do so, and it is not
for the applicant to come to London. The
s are supposed to give information to intend-
ees only when they are aware that similar
ns are pending, the subject matter of which
seen by the public, and that information is in
f a warning. The intending patentee must
published specifications for himself, or employ
-the wisest plan—if the invention is worth
)—AMATEUR, Gateshead. (Is not your question
answered on p. 461, last volume, July 25 last?
must refer to a textbook on the subject.)
HEAD. (Please refer to the many instances of
arrangements given in back numbers, for we
grave so large a sketch on so small a matter,
as the arrangement seems completely un-
There are three illustrations on p. 537 of
er for August 15, 1890; another on p. 322,
89; p. 222, Nov. 9, 1888, and many others in
nes. Why not consult one of the manuals on
ct, such as Eldridge's, Murray-street,
—SEPTIMUS. (We do not know; but the con-
of accumulators has been frequently described
lumes, though, so far as we remember, none
so high a voltage as you require, if you mean
cell. Please see the index to the last
-X., Liverpool. (Methods of drilling china
many times. See p. 163, Oct. 18, 1889, and
but you do not say what sized holes you want
See indices.)—AN OLD CONTRIBUTOR. (Do
mber anything over the signature mentioned;
al coils have been frequently described, and
ester you can surely see the volumes, and
e able to find what you mean.)—INTHLING-
(For incubators, see Nos. 935, 1007, 1009,
)—PHOTO-DEALER. (No license that we have
but they are supposed to be registered; but
f the known dealers.)—WM. A. C. GOSTLING.
t remember it, and as it was probably men-
identally, we do not see how we can find the
SAFETY. (You can burn it off as painters do,
e it by means of caustic potash. 2. Equal
otton-seed (flask) oil and paraffin oil are gener-
Sperm is the best for lubricating, where a
f blacklead and washed lard cannot be applied.)
GRIFFITH. (The usual way with patentees
ot manufacture their inventions is to make
ents with some firm—either selling outright,
a license to manufacture and sell under a
-DAZZLED. (The best way to relieve eyes
y brilliant lights is to look for a few minutes
darkness: a hat will do if the eyes are closed.)
(If the query was received, you were, no
swered at the time. There are such things as
achines; but if you mean fishing-nets, they
elieve, invariably made by hand.)—GILBERT
(Such a request can only appear in the
Wanted Column.)—A. A. A. (How can any-
medical man answer such a question?—and he
without personal examination. You might,
state the symptoms and circumstances to Dr.
Medical Editor of the *Weekly Times and Echo.*)
If you mean the actual putting together of
and the actual tending, we do not know of such
Such duties should be attended to by com-
n who have had experience.)—H. T. CLARKE.
anks; but too full just now.)—T. E. N. (We
y no space to spare for queries two columns
illustrations and full of unnecessary verbiage.
l state your difficulty briefly and succinctly,
have your share of the patience we extend to
able readers.)—H. B., Six Years' Subscriber.
better get another copy of the number you have
lost. It is much more reasonable to ask you to spend 2d. than to expect a correspondent like Mr. Bottone to waste his time and our space in repeating information so recently given and so easily accessible.)—INKO. (Given repeatedly; see indices to recent back vols.)—NOLDON. (You had better seek the aid of a capitalist by advertising. Possibly Mr. F. Wetherfield, 2, Gresham-buildings, Guildhall, might help you, if the invention is really worth anything. He has negotiated some good patent sales for people we know of.)—ASCALON. (Described many times. The figures are suspended by a piece of cord, which twists and untwists as the air is dry or moist, and so moves the figures.)—R. B. S. (Thanks: but we are too crowded just now to care about giving sketches of sunspots.)—J. FOGGIE, NORFOLK HOROLOGIST, BIJLI, CHISEL BORER, A. MARSON. (In type.)

**One of a Thousand.**—"I procured one of your Electropathic Belts when I was suffering so severely from general debility and chronic indigestion. It effected a decided improvement after a week's wear, and I am now infinitely better. My digestive powers are much stronger, and I have less lassitude." The above is an extract from a letter recently received from Mr. Charles Sibery, 1, Queen-street Lane, Dover. All who are interested in the cure of disease by Electricity should call or write at once for descriptive pamphlet and book of testimonials, which may be had free on application to the Medical Battery Company, Limited, 52, Oxford-street, London, W. No charge is made for consultation either personally or by letter.

**Oil of Wintergreen.**—By James D. Staple, M.R.C.S., L.S.A.—This oil consists of 10 per cent. of a peculiar volatile hydrocarbon called gaultheriden, and the remaining 90 per cent. of salicylate of menthol. I have used the oil of wintergreen as a local application in subacute and chronic cases of rheumatism for nearly four years, and am highly satisfied with the results. During my two years' house-surgeoncy at the Stockport Infirmary I used a liniment composed of equal parts of oil of wintergreen and olive-oil in forty cases of subacute rheumatism. After this was applied the joint was wrapped in cotton wool and lightly bandaged, and the patients stated that the pain generally ceased in from five to six hours after its application. It is in the more chronic cases of rheumatism, however, that the oil of wintergreen is the most useful; and although I have used it in over one hundred of these cases, I have notes of only two patients who did not experience any relief from the liniment. I should add that in these chronic cases it is most essential that the liniment should be thoroughly rubbed into the affected parts. I first read of the oil of gaultheria as a local application in an American journal, and tried it in a few cases, which I reported, and I see in Martindale's and Westcott's extra Pharmacopœia for 1890 that my short note in the *British Medical Journal* on the oil of wintergreen as a local application is the only one mentioned under that heading.—*Lancet.*

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**Astro. Telescope**, 6½in O.G., Cooke, six eyepieces, finder, equatorial mounted, no circles. Exchange. 4in. wanted.—BASSETT, 82, High-street, Stoke Newington.

**The Chenies-street Exchange** offers greatest choice. Entire stocks and single instruments purchased. Best market. Particulars first.—CAPLATZI, Chenies-street.

**Telescope Equatorial**, 12½in. With reflector, slow motion R.A., 2in. finder, 6 eyepieces, Barlow's lens, diagonal set of stops. Photo 12 stamps.—Below.

**Transit Instrument**, 2¾ o.g., silver circles, striding level, collimating eyepieces; photo 6 stamps. Photometer by Hilger, micrometer by Grubb, astronomical books and instruments.—Below.

**Barometers**, 2 aneroid, Patterns for Equatorial stands, dynamos, tricycle, Cromartie lamp, new ebonite Wimshurst machine, 9in. spark; lantern photos. List stamp.—Box 20, Liversedge.

**Boiler**, 2ft. by 13in., over 1cwt. weight, no fittings. Want Treadle Lathe, about 3½in. or 4in. centres, with slide and backgear rest, about 3ft. iron bed.—JOHN HARRIS, Ventonleague, Hayle, Cornwall.

**American Organ** wanted, with several rows reeds, would do out of repair. Good exchange given.—SCHOFIELD 292, Stubbins, near Manchester.

**Wanted, Autograph Letters of Celebrities**, or picture books, or anything relating to coaching. Exchange MAGIC LANTERN, &c.—COLLECTOR, 18, Lowbaxter, Bury, Suffolk.

**Oil**, one cask American cylinder, 1s. 2d., delivered free, cost 2s. 6d. Sample sent. Wanted, Photo Lens or small Lathe.—30, Worsley-road, Patricroft.

Allen's Portable Steam and Medicated **Vapour** BATH, Zither, Magnetic and Electrical Experimental Apparatus. Exchange for Photographic Apparatus or Lantern Slides. List.—ELECTRICAL, 72, Price-street, Birkenhead.

**Tricycle**, genuine Humber, first-class condition. Exchange for "Engineering Dictionary," "Gas Manufacture," and other scientific books.—URQUHART, Chorlton-cum-Hardy.

**"Loomis' Practical Astronomy,"** half bound, good condition; "Noble's Hours with 3in. Telescope," new; "Chambers's Encyclopædia," Vols. I. to IV., new.—Rev. SAUL, Millom.

**Planing Machine**, planes 3ft., good condition; bench drilling machine, new, with parallel vice. Steam gauges from 1in. diameter; several boiler fittings. Exchange.—Below.

Compound **Launch Engine**, cylinders 2½in. and 4in. by 4in. stroke, new; two 3ft. flywheels. Exchange Gas-engine &c. Stamp reply.—FREDK. COOKE, King-street, Southsea.

Splendid **Horizontal Copper Boiler**, 9in. long by 4½in. diam.; chimney smoke-box, safety valve, etc. Take Cock Canary or Goldfinch.—A. MOODY, Queen-street, Louth.

Rogers' **Fretsaw Treadle Machine**, quite new, cost 28s. Will exchange for two good pairs of Roller Skates.—LEMEL, 61, Highbury Park, London, N.

Two **Electric Telephones** complete, two magnets and bobbin, four large Bunsen cells (heavy zincs), quantity of silk and cotton-covered wire, ½-pt. bichromate cell and coil with four vacuum tubes, first-class ether saturator, pair of first-class ox-hy. lime jets, quite new pair of spirit jets, complete. Will exchange above for pair of Oil Lanterns, complete.—E. BAKER, Leaf House, Eastbourne.

1H.P. **Launch Engine** horizontal type, lagged cylinder, feed-pump, link motion, well finished, nearly new with propeller. Want Safety or offers.—Below.

Small **Printing Outfit**, 8vo. size, 2 fonts type, practical press by Morton, London (Albion pattern), everything necessary for circulars, cards, &c. Offers wanted.—Below.

Set of **Twin Cylinder Horizontal Engine** PATTERNS, splendid design, 2½in by 4in cylinder. Engine off these brought high price. Offers wanted.—SNOWDON, Novel's Bank, Sunderland.

6in. **Foot Lathe**, back-geared, compound slide-rests chucks, &c., good useful machine. Wanted 3½ or 4in. Screw-cutting Lathe.—CRAVEN, Pontefract.

Kangaroo pattern **Safety Bicycle**, balls to wheels and cranks, part plated, &c. Exchange for Musical Instruments, value £4 10s.—S., 14, Store-street, W.C.

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**Village Cart**, 12 hands, light running, sound. What offers in exchange?—FORD, 72, Queen's-road, Bowes-park London, N.

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**Wheels**, Racks, Pinions, Worms, Screws, all sizes, all numbers; all complicated Clocks to order.—Every.

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Horizontal S ..., 2in. bore, stroke. Castings, Manchester.

**The Abov** the English Mecha

**For Price Li** Testimonials, inc chester.

English Mechanic
ORLD OF SCIENCE AND ART.
*IDAY, NOVEMBER* 21, 1890.

## TO CONSTRUCT A QUARTER CHIMING CLOCK.—IV.

### 6.—The Escapement.

is the most important part of the k as regards timekeeping, and will the skill and care that can be upon it. The form recommended lock is that known as the "Recoil," in the 17th century by Dr. Hooke. an old form, it is the best all-round nt for the ordinary run of clocks, ey are provided with seconds pen- when the "dead-beat" is to be ., though it requires far greater care nstruction.

alled the "recoil" from the fact e is no position of rest for the 'scape- th as in the dead beat and some As soon as one tooth "escapes" her drops upon the pallet, the wheel " until the pendulum reaches the of its vibration. Until then the fers a *resistance* to the motion of the n. When the pendulum comes to commences its return vibration it *assistance* of the wheel until the capes, and so on. The wheel, of advances more than it recoils; the e constitutes the impulse.

7 is a drawing of the escapement.

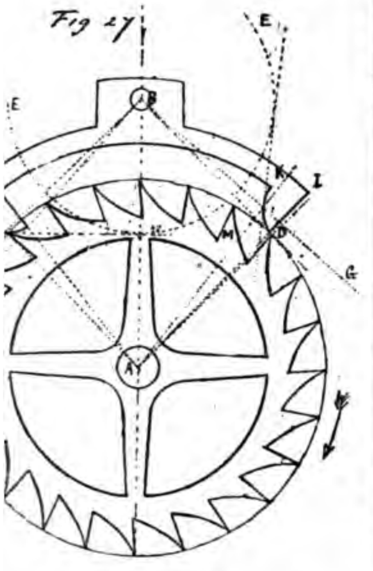


Fig 27

out, proceed as follows:—Draw a presenting the 'scape-wheel. Through re draw the vertical line A B. Mark le off into twenty-four equal di- beginning at the point where it is ed by A B. These represent the the teeth. From the fourth tooth r side, that is, three whole spaces centre, draw the tangents C B and itting A at B. B represents the the pallets. From B draw B F and n angle of 4° to the tangents C B and his 4° is the impulse required, that istance through which the pallets are iven by the wheel at each vibration. escape-wheel having 24 teeth, the between each tooth will be 15°, and el advances half this distance, $7\frac{1}{2}$° at bration of the pendulum. This is into 6° of impulse and $1\frac{1}{2}$° of "drop" end of the pallet-face. A radial line, refore drawn at an angle of 6° to . Where A H cuts B F is the "engaging" pallet. A curve this point and the point C, as shown in the figure, forms the impulse-face of the pallet.

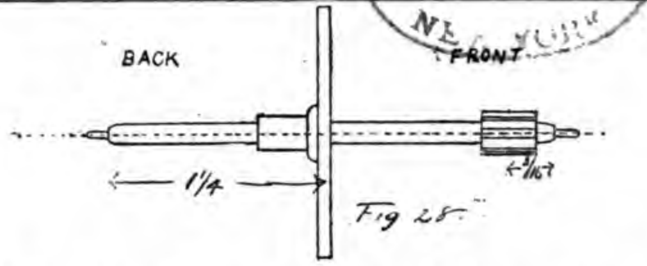


Fig 28

For the "disengaging" pallet, draw the line A I $1\frac{1}{2}$° from A C (the tooth having "dropped"), from this again draw A K 6° from A I. Where A K intersects B G is the point where the next tooth will fall upon this pallet. The point where A I intersects B D marks the point of pallet. A curve drawn through these points forms the impulse-face of the "disengaging" pallet. To form these curves, from the pallet-centre B, draw the circle E E with half-distance between A and B as radius. Then draw tangents to this circle through the points where the wheel-teeth fall upon the impulse-faces—viz., where A C and A K intersect B C and B G, as shown in the figure. Let the curves start from these tangents as shown. The backs of the pallets are formed by radial lines from the 'scape wheel. The backs of the 'scape-wheel teeth are inclined at a slight angle. The fore sides are curved as shown.

The action is as follows: The wheel has a tendency to advance in the direction of the arrow, but is forced to recoil through the tooth C having just "dropped" upon the impulse-face of the engaging pallet, which, containing its forward motion, drives back the tooth till it comes to rest, and commences its return vibration. Then the tooth assists it. The assistance up to the point C just balances the recoil it has received. Therefore, until the tooth again reaches the point C, the true impulse is not given. At C, the true impulse begins, and continues till the tooth finally drops off the edge of pallet, having given the latter its 4° of impulse. The tooth M then drops on the disengaging pallet, recoils, gives its impulse, and drops off again in the same manner, and so on.

The escapement had better be drawn out exactly to size. The best way to do this is to lay the 'scape-wheel flat upon a sheet of paper on a soft blotting-pad, and press it in sufficiently to mark points of teeth; at the same time mark centre carefully. This will insure the pallets being set out exactly to size. A pattern of them can then be cut out in writing-paper, and used as a guide for filing them up to. In planting the escapement also, it can be measured exactly from drawing to obtain the correct distance between 'scape-wheel and pallet-holes in plates.

### 7.—The 'Scape-Wheel.

Fig. 28 shows the mounting of the 'scape-wheel, &c. This is $1\frac{5}{8}$in. in diameter and $\frac{3}{32}$in. thick, and, as before stated, has 24 teeth. Its pinion has seven leaves. It is mounted on a brass collet, as shown, like the third wheel (No. 5). The pivots are small. Both wheel and arbor are made very light. The teeth should be carefully polished with a boxwood polisher and rottenstone and oil. After being mounted it should be centred in the lathe, and tested for truth. All the teeth should be *exactly* the same length. If not, hold a piece of fine emery lightly against the tips, and revolve the wheel rapidly; this will top them all down evenly.

### 8.—The Pallets.

The pallets should be screwed by a couple of screws to a brass collet on the arbor. The centre of faces must come exactly opposite the 'scape-wheel teeth. They should be filed to shape to a paper pattern, as before stated, carefully smoothed, and the holes drilled. They must be hardened, but *not* tempered. They are then polished with oil-stone dust and oil, and red-stuff and oil, on a boxwood polisher, care being taken to keep all surfaces quite square. The centre hole must be opened to fit the pallet-staff, and they must be knocked on tightly up to face of brass collet to which they are screwed. The staff itself is hardened and tempered in same way as a pinion. The back pivot should be a trifle larger than the front, as it bears weight of crutch. Both pallets and crutch are shown in Fig. 29.

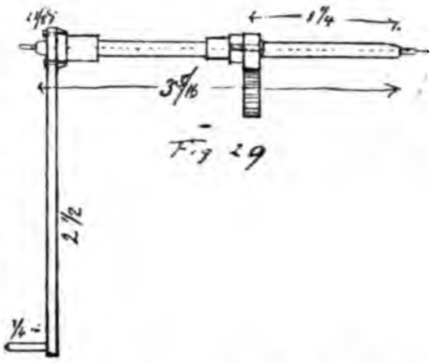


Fig 29

### 9.—The Crutch.

The crutch shown in Fig. 29 is of brass, $2\frac{1}{2}$in. long, and fixed to a brass collet on pallet-staff by two screws in same manner as the pallets. A steel pin, nicely polished, $\frac{3}{4}$in. long and $\frac{1}{8}$in. thick, is screwed into lower end. This pin passes through a slot in the pendulum-rod and transmits the impulses received by the pallets to the pendulum. It will be noticed that the pallet-staff to which the crutch is fixed is longer than the pinions, and the point where the crutch is screwed on comes through the back plate, the entire crutch being behind the clock-frame.

### 10.—"Pitching" the Going Train.

Having now completed the going train, the next thing to do is to "pitch" the wheels—that is, to drill the holes, &c., in the plates and run the wheels in position.

Take the back plate with the pillars riveted into it. On the inside draw a line straight down the centre from top to bottom, with a fine point. Measure $4\frac{1}{8}$in. from the top, and drill hole for back pivot of centre wheel. In drilling pivot-holes, first mark the exact spot with a pointed chamfering tool held in the fingers. Fig. 30 shows such a tool. Then drill with a small drill, afterwards opening the hole to the correct size by means of a fine tapered broach revolved lightly between the finger and thumb, taking care at the same time to keep the holes upright. When the back pivot-hole is drilled, take the front plate, lay it carefully on the back of back plate, see that its edges coincide

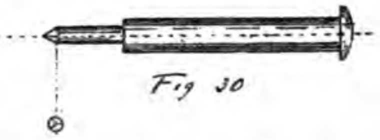
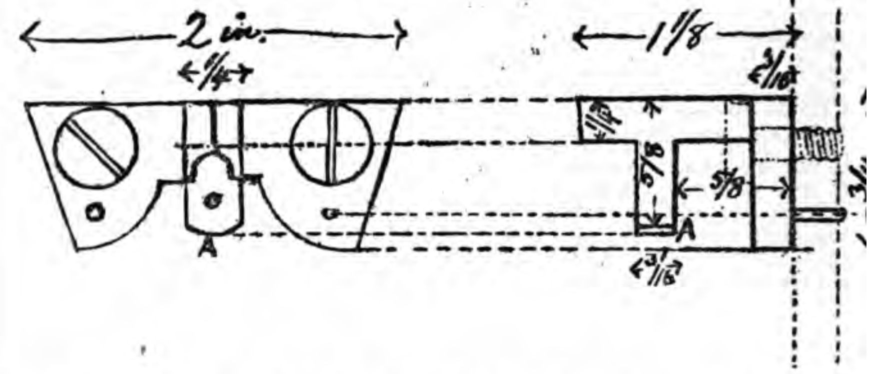


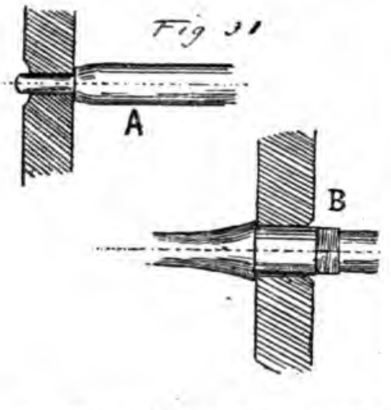
Fig 30

Fig 34

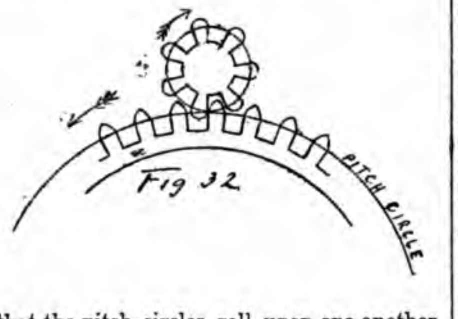


perfectly, and mark centre of front pivot-hole with the chamfering tool through the hole already drilled. This will insure the wheel being upright. Drill this hole as before, and open out to correct size. Pivots should have no perceptible side-shake in their holes, but at same time must be easy enough to drop in and out of them when the frame is reversed. The section of a pivot and hole is shown in Fig. 31. The inside, it will be seen, is left square, but the outside is cupped out to retain the oil around the end of pivot, and prevent it spreading over the plate. This cupping out should be about ⅛in. in diameter; if larger, it will not retain the oil. The front pivot, being larger, merely has the edge bevelled off the outside of the hole, as shown at B (Fig. 31). The centre wheel should now run quite true and freely in the frame without any side-play, but the end-shake must be distinctly heard when the frame is reversed. These few remarks about end-shake and side-play refer to *all* the wheels and arbors throughout the clock.

Fig 31



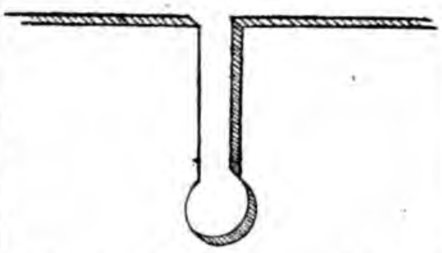
The third wheel will now be taken. For pitching these depths clockmakers have a special "depth-tool." This amateurs, of course, will not possess, so I shall describe a way of pitching depths with ordinary compasses. The depth in question is that of the centre wheel with the third-wheel pinion. As has been lately explained in the excellent articles on "Odontics," wheel-teeth (ordinary form) are formed up to a certain point of radial lines; from that they are curved to a point. A circle drawn where the radial lines end and the curves begin is called the "pitch-circle." Similarly with a pinion, the leaves are formed by radial lines up to the "pitch-circle," beyond which they are semicircular. There is this difference, however: the acting portions of the wheel-teeth *are the curves*, while the acting parts of the pinion-leaves are the *radial portions*. To run properly, the wheels must be so placed that the pitch-circles roll upon one another, as it were (see Fig. 32). Therefore, in pitching a depth, it is only necessary to measure the diameters of the pitch-circles, leaving the points of the teeth to themselves. With a pair of fine dividers measure the diameter of the pitch-circle of the centre-wheel, and transfer it accurately to a piece of paper; then do the same with the pinion; add that to the other measurement on the paper, halve the sum of these, and that is the correct distance at which the wheels must be placed. Measure this distance along the centre line on plate, mark point for pivot-hole, drill, and open out as with the centre wheel, and mark position of front pivot-hole through the back plate as before. Run this wheel in first by itself, to see that all is right; then with the centre wheel, to try the depth. If not quite correct, open the hole next to the pinion (called the "depth" hole) out larger, plug it with good hard brass, and re-drill.



Repeat the same operation with the 'scape-wheel; but in this case measure the distance upon the front plate, that being the depth-hole this time.

The pallet depth can be measured from the drawing previously made of the escapement. Measure this along the centre line on both plates, and drill front pivot-hole. In the back plate, where the pallet-staff is to pass through, drill a ¼in. hole, and make a slot from top of plate wide enough to admit the staff. (See Fig. 33.)

Fig 33



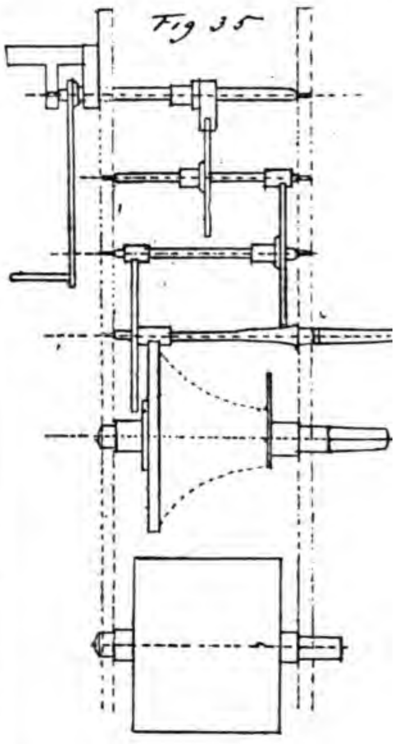
To hold the back pivot, a brass bridge is required, as shown in Fig. 34. This had better be a casting. Dimensions are given in the figure. This is screwed on to the back plate by two large screws, and further held by two steady-pins. The pallet-staff is passed under the arched centre, and the back pivot hole is made in a projecting piece A. To fix this bridge in position, first drill the two steady-pin holes through it, arrange it on plate, so that the piece A covers the hole in plate through which the staff passes, and mark steady-pin holes. The pins can then be fixed in bridge, and holes in plate opened to receive them. The screws can now be easily fitted. They must be hardened and tempered (as must be *all* the screws in the clock) and either polished bright or blued.

The part B which projects ⅜in. beyond A has a fine vertical slit throughout its length, through which the pendulum suspension-spring passes.

Sight point for back pivot-hole through the front one already drilled and hole in back plate. Try the depth, and if alteration is required, effect it as much as possible by means of the front pivot-hole, which can be manipulated easier than the back. The depth can be easily observed by pressing centre or third wheels forward with finger when the pallets are in position. teeth should have as little "drop" as sible, but must clear the backs of the pal safely. Should the pallets require alterat they can be reduced by an emery-stic required, and re-polished.

Next take the fusee and score off depth as before. As will be seen from 1, the fusee, centre, third, 'scape, and pa holes are all on the centre line.

The barrel-holes are drilled 2⅝in., be the fusee-holes, but not on the centre li Mark them ¼in. to the left, as shown Fig. 1. Fig. 35 shows the arrangement the going train.



The square on barrel-arbor comes throu the front plate. On to this square ratchet will be fitted. The click or pawl screwed to the plate, as shown in Fig. The ratchet measures 1⅜in. diameter, about eighteen teeth; and is 5/16in. thi It must fit the square without play, but be too tight. The click is a casting thick and 1½in. long, of shape shown Fig. 1. Both ratchet and click are of bra This ratchet and click are both stations when the clock is being wound, and when is going they only serve to hold the ma spring. When the spring is set up, click is tightly screwed to the plate so t it cannot move.

ıe chains or lines, together with the stop-, will be considered later on, when all rain-wheels have been planted.

ɔedless to say, the method of uprighting ɔls here described is not that resorted to lockmakers. A special "uprighting" is used. It consists of a flat table a small hole in the centre, through h a fine-pointed steel runner passes ion-tight, and is adjustable vertically, point just coming through the plate. ctly over this runner is another, held in ion by a firm standard, something after nanner of a drilling machine. This is adjustable, and should meet the lower ıer exactly. The bottom pivot-hole g drilled in plate, the frame is placed on table in such a position that the point of r runner just enters the hole. The top ıer is then pressed down on to the top ), and marks position of top pivot-hole. ıis tool is troublesome to make, and nsive to buy. With care, very good ts can be obtained by means of the h-and-ready method described. There-unless any readers contemplate a run lockwork or similar apparatus, it will be worth their while to make or buy al tools.

ıe same can be said of the depth-tool e referred to. This consists of a pair ames jointed together. Each frame is ided with a pair of runners on the side site to that at which it is jointed. A l is placed between one pair of runners, a pinion in the other. By means of an sting screw, they can be made to ɔach each other until the depth is cor-

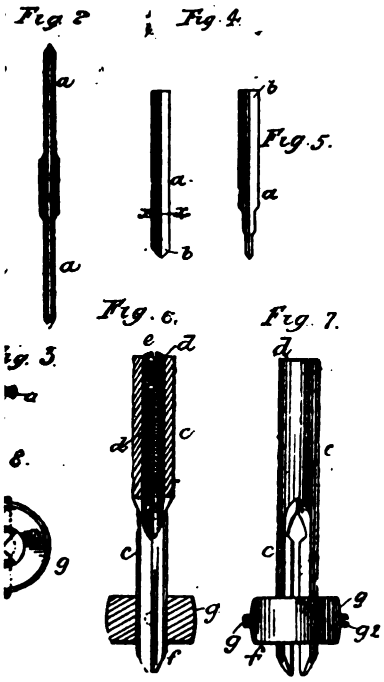
The outside points of runners, which ɔct from the ends of frames, are then as a pair of compasses to score off the ı on the plates.

e striking train will now be proceeded

avoid delay and consequent annoyance, will correspondents who write either for materials formation on points they deem insufficiently ined, kindly address as per advertisement on page of this issue ?]

## ꝚTIN'S IMPROVED DRILLS AND CHUCKS.

E improved drills and chucks for holding them shown in the annexed illustrations the subject of a patent obtained by Mr. A.



ı, of Greenwich, the object being to make ng and efficient drill, with a chuck for g it, that will grip centrally and instantly, rovide for the application of lubricants without withdrawing the drill from its work. Fig. 1 is a front elevation of a drill; Fig. 2 a side view of the same; Fig. 3 is a section through line *x x*, Fig. 4; Figs. 4 and 5 are side views of other examples of drills; Fig. 6 is a vertical section of the chuck; Fig. 7 is a side elevation; and Fig. 8 is a plan of the underside thereof. It will be seen on referring to the drawings that the drills *a* are formed with a V-shaped groove *b* on either side thereof, extending the whole length of the drill. A drill constructed of this form is not only much stronger than those at present in use, but the V-shaped grove *b* is so arranged that oil may be supplied to the point thereof without withdrawing it from its work, which in some work would be a great saving of time, and is a great consideration. In some cases the drills *a* are made double, as shown in Figs. 1 and 2; thus a great saving would result in transport. Another modification of the improved drill would be forming its point end with two or more different-sized drills, as shown in Fig. 5, thus saving time in changing drills.

The chuck shank or plug *c* is constructed of suitable metal of a circular form, and is drilled or bored out and screwed or tapped at one end, *d*, to allow the drill *a* to pass through; a suitable screw-nut, *e*, is fitted in this opening in the shank *c* to regulate the length of the drill *a*. The lower end *f* is slightly tapered, and is grooved out V-shaped, as shown more fully in the plan, and is cut through to a point at or near its centre; this V-shaped groove will take any sized drill constructed according to the invention, and the lower end *f* may be formed tapered with a screw-thread thereon having a suitable nut which would screw on over the spindle, and thus spring and tighten the V-shaped sides of spindle C into the V-shaped groove in the side of the drill. The end of this form of shank may be used as a countersink. In some cases the shank is nearly straight, and a collar, *g*, passes over the end *f* of the shank *c*, having set-screws, $g^1$ $g^2$, on either side thereof to force or spring the V-shaped inner sides of the shank into the V-shaped grooves in the drill. The patentee does not confine himself to the use of the V-shaped groove in drills alone, as it may be used with good results for rimers and other similar tools without departing from the nature of the invention.

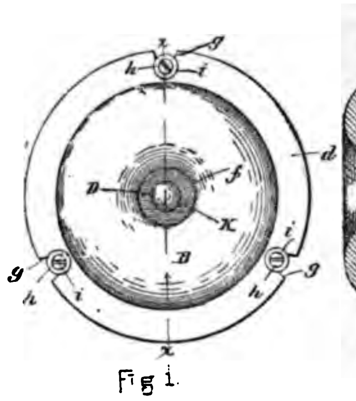


Fig 1.

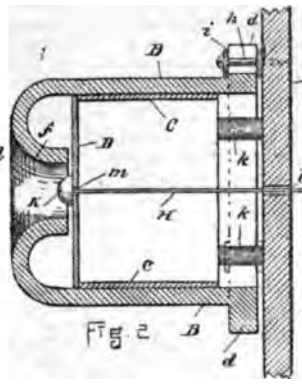


Fig. 2

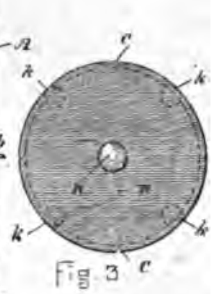


Fig 3

## KNIGHT'S MECHANICAL TELEPHONE.

THE mechanical telephone shown in the above diagrams has been patented in this country by Mr. Henry H. Lake, on behalf of Dr. M. W. Knight, of Milford, Mass. The invention relates especially to transmitters for mechanical telephones, and it consists in certain novel features, the object being to produce a, simpler, cheaper, and more effective device of this character than is now in ordinary use. Fig. 1 is a front elevation, Fig. 2 a vertical section taken on line *x x* in Fig. 1, and Fig. 3 an elevation of the diaphragm, the body or mouth-piece being removed. Like letters and figures of reference indicate corresponding parts in the different figures of the drawing. The nature and operation of the improvement will be readily understood by all conversant with such matters from the following explanation. In the drawings A represents the back plate, and B the case or body. The back plate is constructed of wood, and is provided with a wire opening *b*. The case B is cylindrical in cross-section and is constructed of glass. An annular flange, *d*, is formed round one end of the said case or body. The opposite end is bent or curved inward, forming a circular mouth-piece, *f*. Slots *g* are formed in the edge of the flange *d*. Screw bolts *h*, passing through the slots into the back plate A, secure the case thereto. Washers, *i* formed of rubber or similar material, are disposed around the bolts of both sides of the flange *d*. Four glass lugs, *k*, are secured to the face of the plate A equidistant from the wire opening *b*, and project within the case B. A cylinder, C, of copper or similar metal fits closely within the case, one edge thereof engaging the lugs *k*. A diaphragm, D, composed preferably of thin sheet metal, closes the outer end of the cylinder C, and is provided centrally with a wire opening, *m*, in alignment with the opening *b* in the plate A. The conducting-wire H passes through the openings, and a button, K, is secured to the outer end thereof, the button projecting into the mouth of the case. The high tension of the wire H upon the button draws it against the diaphragm, and holds the cylinder C firmly against the lugs *k*, the sound vibrations entering the mouth *f*, and, transmitted by the diaphragm to the wire, are intensified by this construction. The glass forming the case, being in contact with the metallic cylinder to which the diaphragm is secured, is found to greatly augment the sound-waves, and render them much sharper and more distinct. The lugs *k* may be formed on the inner face of the body B, and integral therewith, instead of on the back plate, if desired.

## THE ELECTRO-MAGNET.—VI.*

HERE let me go to a matter which has been one of the paradoxes of the past. In spite of Joule, and of the laws of traction, showing that the pull is proportional to the area, you have this anomaly—that if you take a bar-magnet having flat-ended poles, and measure the pull which its pole can exert on a perfectly flat armature, and then deliberately spoil the truth of the contact surface, rounding it off, so making the surface gently convex, the convex pole, which only touches at a portion of its area instead of over the whole, will be found to exert a bigger pull than the perfectly flat one. It has been shown by various experimenters, particularly by Nicklès, that if you want to increase the pull of a magnet with armatures, you may reduce the polar surface. Old steel magnets were frequently purposely made with a rounded contact surface. There are plenty of examples. Suppose you take a straight round core, or one leg of a horseshoe would do equally well, and take a flat-ended rod of iron of same diameter as an armature; stick it on endwise, and measure the pull when a given amount of ampère-turns of current is circulating round. Then having measured the pull, remove it and file it a little, so as to reduce it at the edges, or actually take a slightly smaller piece of iron, or a narrower piece, so that it will actually be exerting its power over a smaller area, you will get a greater pull. What is the explanation of this extraordinary fact? A fact it is, and I will show it to you. Here, Fig. 17, is a small electro-magnet which we can place with its poles upwards. This was very carefully made, the iron poles very nicely faced, and on coming to try them it was found they were nearly equal; but one pole, A, was a little stronger than the other. We have, therefore, rounded the other pole, B, a little, and here I will take a piece of iron, C, which has itself been slightly rounded at one end, though it is flat at the other. I now turn on the current to the electro-magnet, and I take a spring-balance, so that we can measure the pull at either of the two poles. When I put the flat end of

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* Extracted from the Cantor Lectures delivered by Prof. SILVANUS P. THOMPSON, B.Sc., before the Society of Arts.

[illegible] the flat pole A, so that there is an excellent contact, I find the pull about [illegible]. Now try the round end of C on the flat pole A: the pull is about [illegible]. The flat end of C on the round pole B is also about [illegible]. But if now I put together two surfaces that are both rounded, I get almost exactly the same pull as at first with the two flat surfaces. I have made many experiments on this, and so have others. Take the following case.—There is hung up a horseshoe magnet, one pole being slightly convex and the other absolutely flattened, and there is put at the bottom, on a square bar armature, over which is slipped a hook to which weights can be hung. Which end of the armature do you think will be detached first?

If you were going simply by the square inches, you would say this square end will stick on tighter: it has more gripping surface. But, as a matter of fact, the other sticks tighter. Why? We are dealing here with a magnetic circuit. There is a certain total magnetic resistance all round it, and the whole number of magnetic lines generated in the circuit depends on two things—on the magnetising force, and on the reluctance all round; and, saving a little leakage, it is the same number of magnetic lines which come through at B as go through at A. But here, owing to the fact that there is at B a better contact at the middle than at the edges of the pole, the lines are crowded into a smaller space, and therefore at that particular place B, the number of lines per square inch runs up higher, and when you square the larger number, its square becomes still larger in proportion. In comparing the square of smaller B with the square of greater B, the square of the smaller B over the larger area turns out to be less than the square of the larger B integrated over the smaller area. It is the law of the square coming in.

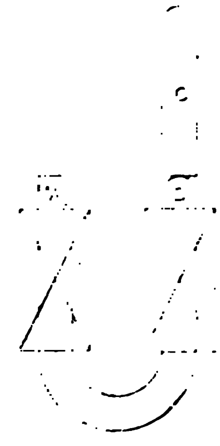


FIG. 17.—Experiment on Rounding Ends.

Let me show you yet another experiment. This is the same electro-magnet (Fig. 17) which has one flat pole and one rounded pole. Here is an armature, also bent, having one flat and one rounded pole. If I put flat to flat, and round to round, and pull at the middle, the flat to flat detaches first; but if we take round to flat, and flat to round, we shall probably find they are about equally good—it is hard to say which holds the stronger.

I now pass to the consideration of the attraction of a magnet on a piece of iron at a distance. And here I come to a very delicate and complicated question. What is the law of force of a magnet—or electro-magnet—acting at a point some distance away from it? I have a very great controversy to wage against the common way of regarding this. The usual thing that is proper to say is that it all depends on the law of inverse squares. Now, the law of inverse squares is one of those detestable things needing to be abolished, which, although it may be true in abstract mathematics, is absolutely inapplicable with respect to electro-magnets. The only use, in fact, of the law of inverse squares, with respect to electro-magnetism, is to enable you to write an answer when you want to pass an academical examination, set by some fossil examiner, who learned it years ago at the University, and never tried an experiment in his life to see if it was applicable to an electro-magnet. In academical examinations they always expect you to give the law of inverse squares. What is the law of inverse squares? We had better understand what it is before we condemn it. It is a statement to the following effect—that the action of the magnet (or of the pole some people say), at a point at a distance away from it, varies inversely as the square of the distance from the pole. There is a certain action at one inch away. Double the distance; the square of that will be four, and, inversely, the action will be $\frac{1}{4}$: at double the distance the action is $\frac{1}{4}$; at three times the distance the action is $\frac{1}{9}$, and so on. You just try it with any electro-magnet: nay, take any magnet you like, and unless you hit upon the particular case, I believe you will find it to be universally untrue. Experiment does not prove it. Coulomb, who was supposed to establish the law of inverse squares by means of the torsion balance, was working with long thin needles of specially hard steel, carefully magnetised so that the only leakage of magnetism from the magnet might be as nearly as possible leakage in radiating tufts at the very ends. He practically had point-poles. When the only surface magnetism is at the end faces, the magnetic lines leak out like rays from a centre, in radial lines. Now the law of inverse squares is never true except for the action of points: it is a "point" law. If you could get an electro-magnet or a magnet with poles so small in proportion to its length that you can consider the end face of it as the only place through which magnetic lines leak up into the air, and the ends themselves so small as to be relatively mere points: if, also, you can regard those end faces as something so far away from whatever they are going to act upon that the distance between them shall be large compared with their size, and the end itself so small as to be a point, then, and then only, is the law of inverse squares true. It is a law of the action of points. What do we find with electromagnets? We are dealing with pieces of iron which are not infinitely long with respect to their cross-section, and generally possessing round or square end-faces of definite magnitude, which are quite close to the armature; and which are not so infinitely far away that you can consider the polar face a point as compared with its distance away from the object upon which it is to act. Moreover, with real electromagnets there is always lateral leakage; the magnetic lines do not all emerge from the iron through the end face. Therefore, the law of inverse squares is not applicable to that case. What do we mean by a pole, in the first place? We must settle that before we can even begin to apply any law of inverse squares. When leakage occurs all over a great region, every portion of the region is polar; the word polar simply means that you have a place somewhere on the surface of the magnet where filings will stick on; and if filings will stick on to a considerable way down towards the middle all that region must be considered polar, though more strongly at some parts than at others. There are some cases where you can say that the polar distribution is such that the magnetism leaking through the surface acts as if there were a magnetic centre of gravity a little way down, not actually at the end; but cases where you can say there is such a distribution as to have a magnetic centre of gravity are strictly few. When Gauss had to make up his magnetic measurements of the earth, to describe the earth's magnetism, he found it absolutely impossible to assign any definite centre of gravity to the observed distribution of magnetism over the northern regions of the earth: that, indeed, there was not in this sense any definite magnetic pole to the earth at all. Nor is there to our magnets. There is a polar region, but not a pole; and if there is no centre of gravity of the surface magnetism that you can call a pole from which to measure distance, how about the law of inverse squares?

Try to interpret this in the old way by the old notion of poles. The electro-magnet has two poles, and these excite induced poles in the opposite surface of the armature, resulting in attraction. If you double the distance from the pole to the iron, the magnetic force (always supposing the poles are mere points) will be one quarter, hence the induced pole on the armature will only be one quarter as strong. But the pole of the electro-magnet is itself weaker. How much weaker? The law of inverse squares does not give you the slightest clue to this all-important fact. If you cannot say how much weaker the primary pole is, neither can you say how much weaker the induced pole will be, for the latter depends upon the former. The law of inverse squares in a case like this is absolutely misleading.

Moreover, a third effect comes in. Not only do you cut down the magnetism by making an air-gap, but you have a new consideration to take into account. Because the magnetic lines, as they pass up through one of the air-gaps along the armature, down the air-gap at the other end, encounter a considerable reluctance, the whole of the magnetic lines will not go that way; a lot of them will take some shorter cut, although it may be all through air, and you will have some leakage across from limb to limb. I do not say you never have leakage under other circumstances; even with an armature in apparent contact there is always a certain amount of sideway leakage. It depends on the goodness of the contact. And if you widen the air-gaps still further, you will have still more reluctance in the path, and still less magnetism, and still more leakage.

Leakage across from limb to limb is always a waste of the magnetic lines, so far as useful purposes are concerned. Therefore, it is clear that, in order to study the effect of introducing the distance between the armature and the magnet, we have to take into account the leakage; and to calculate the leakage is no easy matter. There are so many considerations that occur as to that, which one has to take into account, that it is not easy to choose the right ones and leave the wrong ones. Calculations we must make by-and-by, but for th moment experiment seems to be the best guide.

I will therefore refer, by way of illustrating thi question of leakage, to some experiments made b Sturgeon. Sturgeon had a long tubular electr magnet made of a piece of old musket-barrel iron wound with a coil; he put a compass needl about a foot away, and observed the effect. H found the compass needle deflected about 23°; the he got a rod of iron of equal length and put it in the end, and found that putting it in so that onl the end was introduced—in the manner I am no illustrating to you on the table—the deflectio increased from 23° to 37°; but when he pushed th iron right home into the gun-barrel it went bac to nearly 23°. How do you account for that? H had unconsciously increased its facility for leakag when he lengthened out the iron core. And whe he pushed the rod right home into the barrel, th extra leakage which was due to the added surfac could not and did not occur. There was addition cross-section, but what of that? The addition cross-section is practically of no account. Yo want to force the magnetism across some 20in. air, which resists from 300 to 1,000 times as much iron. What is the use of doubling the sectio the iron? You want to reduce the air reluctance and you have not reduced the air by putting a cor into the tube.

Here is another paradoxical experiment. I hav here a bar electro-magnet, which we will connec to the wires that bring the exciting current. I front of it, and at a distance from one end of th iron core, is a small compass-needle with a feathe attached to it as a visible indicator, so that whe we turn on the current the electromagnet will a on the needle, and you will see the feather tur round. It is acting there at a certain distance. Th magnetising force is mainly spent not to drive mag netism round a circuit of iron, but to force i through the air, flowing from one end of the iro core out into the air, passing by the compass needle, and streaming round again, invisible, into the other end of the iron core. It ought to increase the flow if we can in any way aid the magnetic lines to flow through the air. How can I aid this flow? By putting on something at the other end to help the magnetic lines to get back home. Here is a fla piece of iron. Putting it on here at the hinder en of the core ought to help the flow of magnetic lines. You see that the feather makes a rathe larger excursion. Taking away the piece of iro diminishes the effect. So also in experiments tractive power, it can be proved that the adding of mass of iron at the far end of a straight electro magnet greatly increases the pulling power at the end that you are working with; while, on the other hand, putting the same piece of iron on the front end as a pole-piece greatly diminishes th pull. Here, clamped to the table, is a bar electro magnet excited by the current; and here is a sm piece of iron attached to a spring balance, by me of which I can measure the pull required to det it. With the current which I am employing, pull is about 2¼lb. I now place upon the front of the core this block of wrought iron; it is strongly held on; but the pull which it itself on the small piece of iron is small. Less than suffices to detach it. I now remove the iron b from the front end of the core, and place it the hinder end. And now I find that the required to detach the small piece of iron from front end is about 3¼lb., instead of 2¼lb. The end exerts a bigger pull when there is a ma iron attached to the hinder end. Why? whole iron core, including its front end, beco more highly magnetised, because there is now better way for the magnetic lines to emerge at other end and come round to this. In short, we diminished the magnetic reluctance of the air of the magnetic circuit, and the flow of mag lines in the whole magnetic circuit is thereby proved. So it was also when the mass of i was placed across the front end of the core; the magnetic lines streamed away backwards f its edges; and few were left in front to act u the small bit of iron. So the law of mag circuit action explains this anomalous behavio Facts like these have been well known for a time to those who have studied electro-mag In Sturgeon's book there is a remark that magnets pull better if they are armed with a of iron at the distant end, though Sturgeon did see what we now know to be the explanation of The device of fastening a mass of iron to one of an electro-magnet in order to increase the ma netic power of the other end was patented Siemens in 1862.

M. PLANTE's new process of engraving on g and crystal by electricity is found capable of p ducing results of marvellous delicacy. The p to be engraved is covered with a concentrated so tion of nitrate of potash and put in connection one of the poles of the battery, the design be traced out with a fine platinum point connected the other pole.

## ENTIFIC EXPERIMENTS.[*]

### n Experiment in Conductivity.

onductivity of metals may be easily observed 1 demonstrated as follows:—Take a piece ire, or a knitting needle, and a piece of ire of the same length and of nearly the tion, Fig. 1. Heat these in the flame of a

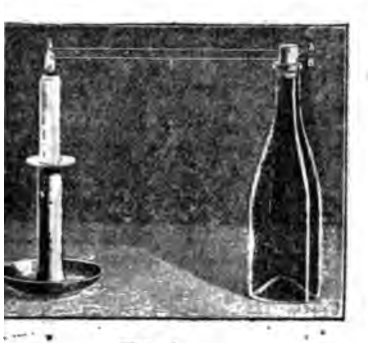


FIG. 1.

and then pass them through the latter. lding them vertically, allow them to cool. ill remain covered with a thin layer of stearic acid. Next, insert the extremities supported by a bottle. Then heat the free es, and, in measure as the heat is propa- e stearic acid will melt and form a globule, run along each wire, thus very clearly the spread of the heat (see figure). The will run more quickly and to a greater upon the copper than upon the iron, and ates that the former is a better conductor han the latter.

### A Centrifugal Experiment.

sert, when a wine-bottle is empty, drain it ly, and ask those who are present how ne they suppose can still be made to fall in m the bottle. Some will say ten drops, enty drops, &c. You can bet on several

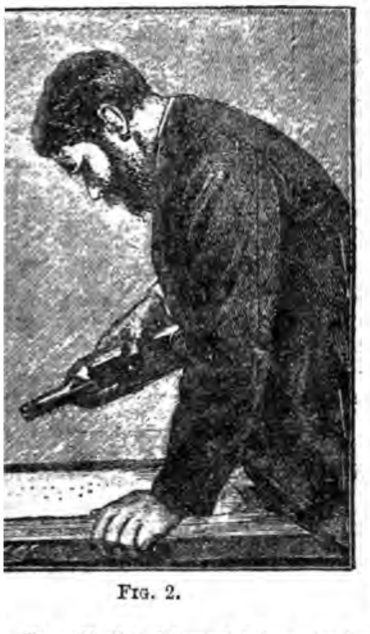
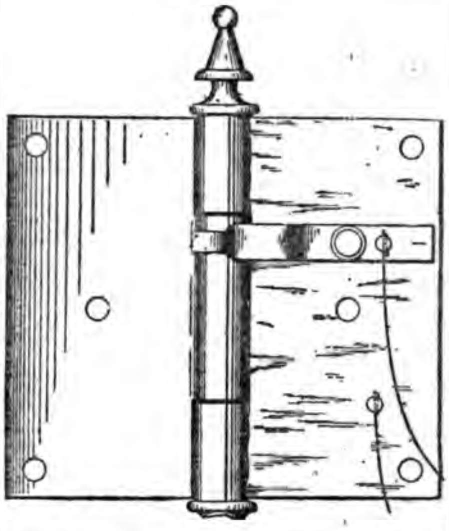


FIG. 2.

To verify this statement, take a sheet of paper, and incline the bottle in order to t it is empty and that not a single drop es from it. Then, raising your arm, make swiftly describe an arc of a circle. The al force will project a number of small which will appear innumerable on the paper. This experiment may be repeated imes, and drops will appear every time, This experiment is more successful when n the floor. Place the paper upon the , leaning over, with the legs wide apart, bottle in both hands, neck downward. bottle swiftly describe an arc of a circle a s above the paper.

## KLEY'S BURGLAR ALARM.

proved form of circuit-closer for burglar- rms has been patented by Mr. W. M. of Verplanck, New York State, which has for its distinguishing feature its extreme simplicity. It is intended for use on the class of burglar alarms which operate on open circuit. The contact device is applied directly to the hinge of the door, and consists of a spring provided with an electric contact placed on the inner side of one leaf of the hinge, and insulated from it by any suitable means. The point of this spring, as will be seen from the illustration, projects beyond the leaf, so as to bear upon the cylindrical shank and the opposite leaf. Into this a small plug of hard rubber is inserted in such a position that when the door is fully closed and the leaves folded back upon each other, the edge of the plug will just raise the spring



out of contact with either leaf. On opening the door even a very small amount the spring drops down upon the shank of the hinge and makes contact, sliding over its surface as the door opens. The circuit is then from the contact on the spring through the spring and the body of the hinge to a second contact placed at any convenient point upon it. The result of this arrangement is a very certain closure of the circuit on the least opening of the door. The rubbing contact of the spring insures good electrical connection.

## A NEW FORM OF SPRENGEL PUMP.

By SIDNEY G. RAWSON, D.Sc., F.I.C.,

Demonstrator of Chemistry, University College, Liverpool.[*]

ANYONE who has used an ordinary Sprengel pump will know that the gas from the vessel which is to be exhausted is removed by small pistons of mercury. These rapidly succeed one another in the barometric fall tubes, and portions of the gas are trapped, and carried away between each two of these pistons. When the exhaustion is approaching completion, the volumes of gas so removed become exceedingly small, and the last portion of the process is then one of increasing slowness. The newer forms of pumps work on another principle. The mercury in them is caused to issue in the form of a fine jet or spray, and the molecules of the gas are, as it were, driven forward and caught by the mercurial bombardment to which they are subjected. They are then trapped by the pistons of mercury which form in the ordinary way lower down in the fall tubes.

This form of pump is divisible into two main kinds—viz., the one in which the jets of mercury issue in a horizontal plane as figured in Gimingham's paper (this *Journal*, III., 83), and the other in which the mercury flows from the commencement in a vertical direction, as in Fig. 1.

Of these two modifications, I prefer the latter, and for these reasons: If mercury issues horizontally, it is somewhat difficult to so place the jets that the streams of mercury shall exactly impinge on the mouths of the tubes. Unless the pump is well made, they will either strike too high or too low, and further, unless there is a considerable pressure of mercury, the jets may not carry even so far as the bounding walls of the exhaust chamber. Then the lowest tube receives an excess of mercury and becomes choked.

In the second form of pump, if the fall tube is slightly opened at its origin, the mercury can only run down that fall tube opposite to its own supply jet. This latter form is also more readily made, and especially is this the case as the number of fall tubes increases. The peculiar mercury distributor of this pump we owe to Nicol, though it had been used by myself some time before the publication of his paper in the British Association Reports for 1887.

My own form of this pump differs somewhat from Nicol's in the following respects. I seal the fall tubes to the pump head, and use no indiarubber as a connection (see Fig. 1, A), thus doing away with all chance of leakage. The mercurial supply tube, within the exhaust chamber in his pump, ends freely, and in the same horizontal plane with it is the exhaust tube. This, to my mind, would impose rather a strain on the tube from the leverage of the mercury, and I have therefore always sealed the tube to the wall (Fig. 2, A), and so placed my exhaust tube, B, that it opens in from above. The fall tubes are also sufficiently long to enable me to collect the gases which are exhausted. All these are, however, minor differences.

It will be found that if a pump has been working for some time, the fall tubes always become coated inside with a thin film, possibly of oxides of foreign metals. The mercury which I use I have had distilled two or three times, and one would feel inclined, therefore, to say that it was quite pure. But even with this pure mercury the deposit, though it formed very slowly, always made its appearance in the end. Small air bells or bubbles cling most obstinately to this film, and hence it becomes a matter of some importance to be able to remove it easily, and without stopping the pump. For this purpose the small funnel C is attached to the pump. Usually this is kept filled with mercury, but, when necessary, a little sulphuric acid is poured on the mercury, and the plug D, which is ground in, is gently raised, and the mercury, together with a portion of the acid, is allowed to run into the distributor, and thence into the fall tubes. The plug is replaced, and a little more mercury poured in. I have found sulphuric acid very good for this purpose. Prof. Ramsay recommends the use of the vapour of glacial acetic acid as a cleansing agent.

This pump is a very excellent one, and of great power. If only three fall tubes are required their free ends can be easily bent up so that they shall all deliver their gas together; this becomes more difficult as the number increases, but if more exhaustion be required other tubes can be added with ease.

While experimenting with this pump I devised the very simple form which is shown in Fig. 3. A piece of ordinary pump tubing some 50in. in length is taken, and about 10in. from the one end a small bulb is blown. There is then sealed in this and projecting into the cavity a small glass jet, about ¼in. in length, and of exceedingly fine bore, with the nozzle pointing inward. It will be noticed that while in the other forms the feed jets of mercury are detached from the fall tubes, here each fall tube carries its own jet, the arrangement being very compact.

The rate at which the feeding jet will supply mercury entirely depends on the depth of the mercury in the exhaust chamber, and therefore on the length of the tube lying above the bulb. By regulating this depth the pump can be caused to work more or less rapidly as may be required, and this without any contrivances in the shape of taps, &c. There is further a very thorough division of the mercury in the little trapping bulb, for the fine jet of mercury, which is under considerable pressure, impinges strongly on the opposite wall, and is there broken up, filling the bulb with a shower of mercury drops. Possibly this effect might be increased if two feed jets were sealed into the bulb. I have found it more advantageous to replace the piece of pump tubing above the bulb by some of considerably wider bore and thinner walls; the difficulties of exhaustion are increased if the molecules of gas have to travel along capillary tubes.

Though two or three fall tubes of this description can be sealed into a glass exhaust chamber, it is a somewhat difficult task. Unless an extreme amount of accuracy in the volume of gas to be collected is required, it is quite sufficient to take a piece of wide glass tubing which is strangulated at either end so as to firmly hold the rubber corks with which it is to be closed. Through the lower cork passes the pump and fall tube combined, and through the upper the mercury feed supply and the exhaust tube. From some experiments which I have made I agree with Gimingham (*loc. cit.*) that the diameter of the bore of the fall tubes should be about 1·6mm., and the length about 1 metre, reckoning from the level of the mercury in the lower reservoir to the mercury feeding jet. In longer tubes than this the mercury falls with much force, and the incessant hammering which goes on is apt to cause the tubes to crack; several have been thus rendered useless in my hands.

In working with exhaust pumps there is usually some difficulty in making an air-tight joint between the pump and the apparatus which is to be exhausted. Of course, the most effectual and certain way is to unite the two ends by an actual glass seal, but in many cases this is by no means easy, and when made successfully it has the disadvantage of converting all the different portions into one solid, rigid whole. Prof. Crookes uses very thin spiral glass tubes to unite the various pieces, and these, from their elasticity, do allow of there being a

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[*] From *La Nature*.

[*] In the *Journal of Chemical Industry*.

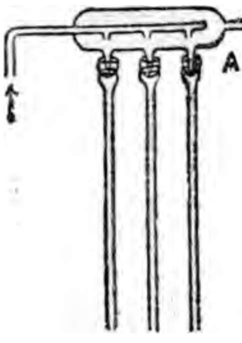

FIG. 1

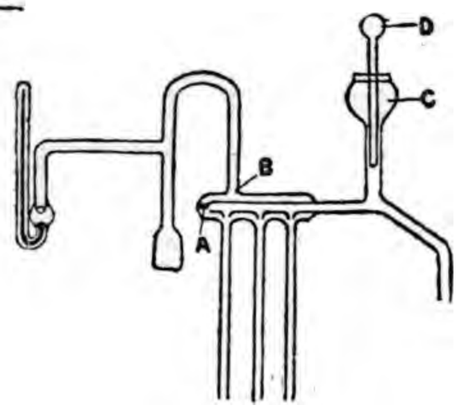

FIG. 2.

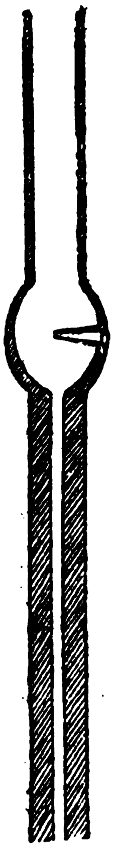

FIG. 3

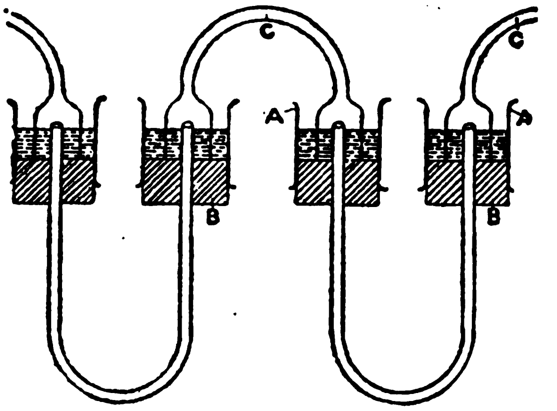

FIG. 4

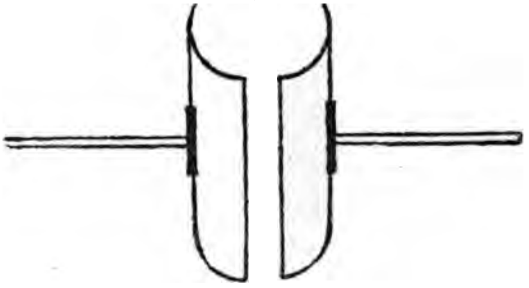

FIG. 5.

certain amount of play, but the glass seal, and with it considerable experimental skill, is still required.

Indiarubber tubing is of very little or no use. All sorts of cements have been tried for this purpose. Prof. S. Thomson* mentions a mixture of Burgundy pitch, 96 parts, with 4 parts of guttapercha or one part of vaseline with 3 parts of paraffin wax. Others are equal parts of beeswax and resin, indiarubber, and many more. I have myself used beeswax and resin, containing a little vaseline, but I cannot recommend it highly, though it is as good as any of the others. Paraffin wax, pure and simple, I have also tried and found to work well, but it contracts on solidification, and attaches itself more especially to the glass walls, leaving a fissure between when these are close together, and hence there is always the chance that air may get in. No organic compound can be said to be good, as at high vacua they all evolve vapour. As suggested by Prof. Thomson in his paper, some experiments were made by me on fused chloride of lead. This only melts, however, at a high temperature, somewhat below a red heat, and at the same time emits fumes. On cooling it contracts considerably, and cracks in all directions.

After trying many materials, the following is the cement I now employ, and which is of very easy application. It is nothing but fusible metal containing a considerable amount of mercury. Its percentage composition is as follows :—

| | Per cent. |
|---|---|
| Bi | 40 |
| Pb | 25 |
| Sn | 10 |
| Cd | 10 |
| Hg | 15 |

If ordinary fusible metal be taken it will crack the glass, from the large amount of expansion which it undergoes on solidifying. The addition of a little mercury reduces its expansibility, and at the same time lowers the melting point. As it still, however, expands considerably on cooling, it forces itself into every minute crevice, acting as a most efficient cement. It should be applied in a molten condition, and the glass should also be hot, and, before exhausting, the joint should stand for an hour to allow the alloy to become thoroughly set. Tubes cemented to the pump by this compound I have had exhausted for weeks without any sign of leakage. I wish here to express my thanks to Mr. H. S. Marsh for the trouble which he has taken in experimenting with me on these alloys.

I also employ a special form of joint. It is shown in Fig. 4 as in use between two U-tubes which have been taken for drying the gases which are to be collected. Each limb bears a small glass cup, A, carried on a cork, B, through which passes one end of the U-tube. A curved tube, C, bell-mouthed at either end, fits in each case outside the free end of the tube, but within the glass cup. The molten alloy is poured in almost to the level of the mouth of the U-tube, and on cooling grips the whole firmly together. Until the alloy is poured in there is any amount of play, as can easily be seen, between the different parts of the apparatus, for the bell tubes need not be placed in position until everything else has been finally adjusted.

Moreover, instead of there being a long stretch of U-tubes or other apparatus, these can be ranged in rows of twos or threes, &c., one behind the other, by placing the proper bell tubes at right angles to the others in that row, and thus making connection with those coming both before and after.

The apparatus can readily be disconnected by placing round each of the glass cups in turn a brass cup riveted to a rod of the same metal. When the
rod is warmed the brass cup rapidly become
and the alloy, as it melts at such a low tem
is easily liquefied, and the bell tube can
lifted out. It will be found more conv
have the brass cup in two halves attache
brass rods as in Fig. 5; it is then mor
remove it. Otherwise, as it must fit clo
glass cup, it will be necessary to wait until
cup is cool before it can be bent open.

In some experiments on which I am e
have found it necessary to use a particularl
flask for the preparation of certain gases.
description of this may prove interesting.

It holds about 200c.c., and fitting to the
ground to it with the *greatest care* is a gla
stopper, A, perforated in two places. Fo
I use a mixture of beeswax, resin, an
vaseline. Through one perforation, B

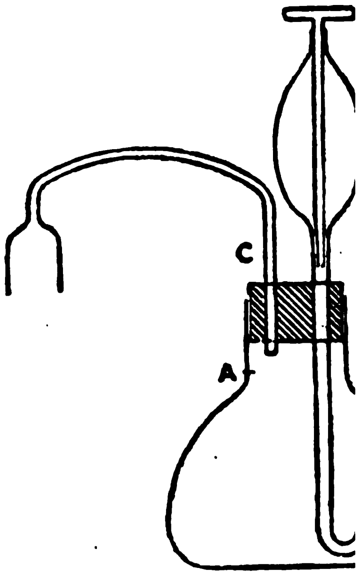

FIG 6.

stopper passes an inlet tube for acid, te
within the flask in a tube bent up slightly
Outside the flask it bears a glass bulb i
the acid can be poured; the bulb is ch
ground glass rod, cut into which is a s
sponding to one in the bulb. When
coincide the acid passes down, but by tu
glass rod through 180° the connection i
A little acid should always be left in
Through the other perforation, C, passe
tube, terminating in a bell mouth.

The whole apparatus, from pump to g
flask, it will be observed, is without a sin
any kind, is air-tight, and yet is re
together and disconnected, and require
in the case of the glass flask, no special
manufacture.

**Pure Zinc.**—It is stated that M. Ca
Paris, has succeeded in bringing the p
refining zinc by distillation within the
commercial requirements, and can deliv
cally pure metal—at a price higher tha
ordinary zinc, but, nevertheless, not exce
This zinc is more malleable than the ordin
and is easily split into plates of great tou
raising its temperature to 60° C. It m
drawn with the greatest ease, and m
useful battery rods. According to the t
by M. L'Hôte, chemical expert, M. C
zinc is not attacked in acid diluted to $\frac{1}{10}$
free (at all events in proportions th
analysed) from the metals and metal
with in commercial zinc, such as lead, tin,
copper, antimony, iron, silicium, sulp
arsenic. MM. Pouchard, Mathioux,
electric clock-makers, have tried this zi
batteries which work their apparatus,
results obtained are as follow: Cells c
carbon, zinc, and salammoniac were wo
circuit of electric clocks, the time during
current was furnished being about 90 ho
consumption of pure zinc (not amalgam
28 grammes per cell, whilst that of ordi
perfectly amalgamated, was 36 to 38
Moreover, the consumption of the forme
regular throughout its length, while ord
was consumed very irregularly, being
almost wholly eaten through at the bot
liquid. With bichromate of potash batt
porous jars) using commercial sulphuric a
to $\frac{1}{10}$th, a much more constant dischar
tained than with ordinary zinc, and the
be left an open circuit in the porous jar
being appreciably worn.

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* "The Development of the Mercurial Air-Pump." *Journal of the Society of Arts*, 1888. From this paper Fig. 1 is copied.

# SCIENTIFIC NEWS.

OM Edinburgh Circular, No. 10, we learn that a telegram by way of Kiel announces iscovery of a rather bright comet by Prof. , at Palermo, on November 15th, at 10h. ı. local time. Its position then was R.A. 5m. 54·8s., Decl. N. 33° 23′. Daily move- – 5m. 32s. and + 17′.

other Edinburgh Circular, No. 11, says Zona's comet has been observed at Kiel, 16, 9h. 1·1m., R.A. 5h. 30m. 46·3s., N. 33° 37′ 6″.

faint comet, not identical with the above, iscovered by Dr. R. Spitaler on the 16th inst., lace at 16h. 32m., local time, then being 5h. 27m. 16·93s., Decl. N. 33° 37′ 16″. It noving slowly towards the north-west.

e session of the Royal Society opened rday; but although the medals will not be nted until the anniversary meeting, the ion of the council and committees is n. Prof. Simon Newcomb, superintendent he Naval Observatory, Washington, is ve the Copley medal for his contributions ravitational astronomy; Prof. Heinrich ;, as might perhaps have been expected, is have a medal—the Rumford—for his in connection with electro-magnetic ion, and Germany also carries off another l—the Davy—which has been awarded to Emil Fischer for his discoveries in organic istry. The Royal medals are awarded to David Ferrier and Dr. John Hopkinson, the newly-founded Darwin medal, awarded e first time this year, is appropriately given r. Alfred Russel Wallace, for his inde- nt origination of the theory of the origin cies by natural selection. The anniversary ng (St. Andrew's day) this year falls on a ıy, so the meeting will be held on Dec. 1st.

accomplished balloonist, Eugéne Godard, ast week at Brussels at the age of 64. He orn in Paris, and is credited with having about 2,000 ascents during forty years. as superintendent of the balloon service and n post during the siege of Paris.

arrangements made for the session of the ty of Arts, which opened last Wednesday, le a series of Cantor Lectures by Prof. V. B. s, on "Gaseous Illuminants," on Mondays, 24, Dec. 1 to 22; a series by Mr. A. J. ins, on "The Construction and Capabilities usical Instruments," Jan. 23, Feb. 2, 9; es by Mr. Gisbert Kapp, on "The Electric smission of Power," Feb. 16, 23, March 2; es by Prof. R. Meldola, on "Photographic istry," March 9, 16, 23; and a series by I. Stannus, on "The Decorative Treatment tural Foliage," April 13, 20, 27, May 4. uvenile lectures during the Christmas holi- will be delivered by Mr. E. B. Poulton, on nicry in Plants and Animals." Among apers to be read during the session there is n "Steam Lifeboats," by Mr. J. F. Green, ı will no doubt attract much attention; and er on "The Use of Petroleum in Prime rs," by Mr. W. Robinson, which will st many.

Sunday Lectures at St. George's Hall, ham-place, on the 23rd inst., will be "The ition of our Globe: from a Nebula to a and finally to a Habitable World," by Mr. cols.

ose who expected to learn all about Dr. 's remedy for tuberculosis must have been pointed when they read his recent paper, t at the commencement of which he says e did not intend to publish anything further it until he had verified his conclusions; wing to the dissemination of exaggerated istorted statements about the "discovery," ought it better "to prevent all false im- ons" to give at once a review of the present on of the subject. Then he goes on to say, regards the origin and preparation of the ly I am unable to make any statement, as search is not yet concluded." Doctors can, rer, obtain small quantities for the purpose king investigations.

ntime a number of medical men have d from all parts of Europe to study the ı on the spot, and many hundreds of con- ives have sought for the remedy, which ; at present be applied. Already there are so many applicants that hospital accommodation is wanting.

Mr. Heinemann will, it is said, shortly publish in London Dr. Koch's work on "Consumption."

The Lord Mayor has promised to convene and preside over a public meeting at the Mansion House to discuss the best means of promoting the culture of fruit in this country. The Fruiterers' Company are the prime movers, and the idea is to have shows (something like the Royal Agricultural Society) in different parts of the country, acting in co-operation with the local horticultural societies. The Company have already arranged that the committee of experts who assisted them at the recent Guildhall Exhibition, should meet once a month and receive and answer questions on the subject of fruit culture.

In excavating for building purposes at Plumstead, near the King's-highway, a hollow cave has been found. The cave, which is about 15ft. wide, had been dug out of the chalk, and within were found a number of bones of animals which had apparently, through succeeding ages, fallen into the cave. Dr. F. C. Spurrell, an archæologist, has visited the cave and prenonuced it to be a dene hole, one of the many found in North Kent.

The Farriers' Company are taking up the subject of technical education for farriers, and applications for registration have already been received from thirty-three counties in the conjoint scheme of the Farriers, the Royal Agricultural Society, and the Royal Veterinary College. A "registered" farrier will have advantages over his rivals in business.

The outbreak of cholera in Spain is attributed to the exhumation of bodies of the victims of the epidemic of 1885. In the *New York Medical Record*, Dr. Coleman gives some rather cogent reasons for thinking that cats may be the source of infection in cases of diphtheria.

The Austrian Government intends to insist on a uniform musical pitch in all military and municipal bands and in all subsidised opera-houses and theatres. The decree was really made in 1885, but has not hitherto been enforced. The pitch adopted is the French diapason normal, A 435.

The manufacturers at Pittsburg, Pennsylvania, are beginning to be alarmed at the prospect of a falling-off in the supply of natural gas, as the company which has the practical monopoly has determined to stop the supply to the puddling furnaces. The company supplies 750 different manufacturing establishments and 35,000 houses, the daily consumption being 800 million cubic feet. The company do not admit any fear of exhaustion of the supply; but some manufacturers have already got to work again with coal.

It is proposed to construct a ship railway from Georgian Bay, Lake Huron, to Lake Ontario, which would shorten the distance between Chicago and Liverpool by at least 400 miles.

**Lagging for Steam-Pipes.**—According to the *Revue Industrielle*, some of the waste products resulting from the manufacture of paper furnish excellent material for cheap and efficient lagging for steam-pipes. The waste products in question are chiefly those coming from the different cleaning and sorting machines, and which are of a fibrous nature. These, when dry, are to be mixed with potter's earth in the proportion of 4 to 1, enough water being afterwards added to form a plastic compound. This is spread by hand over the surfaces to be protected in thin successive layers. When dry, the coating is said to adhere firmly, and is not easily broken. Its cost is practically no more than the cost of mixing and applying it.

**Smoke Annihilator.**—A proposition to free our cities and towns from smoke by a process of absorbing it in water has been made by a Mr. Elliott, who has devised an apparatus for carrying out the desired object. The contrivance consists of a small fan, which draws the smoke from the chimney and forces it into a tank of water at a point near the bottom. The water is agitated by revolving stirrers driven by an engine. The heat of the smoke and other products of combustion in time heats the water, and provision is made for allowing the resulting steam to pass away into the atmosphere. All the solid particles present in the smoke, as well as the sulphurous vapours and noxious gases, are arrested by the water. When fully charged with the condensed smoke, the water is withdrawn and the tank refilled with fresh water.

# LETTERS TO THE EDITOR.

*[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]*

*All communications should be addressed to the* Editor *of the* English Mechanic, *332, Strand, W.C.*

*All Cheques and Post-office Orders to be made payable to* J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

### BURNHAM 648.

[31804.]—If "Tenebris" has followed the directions given in my letter 31502 to find β 648, he cannot have mistaken it for β 641, which is on the S. of γ Lyræ, and further on the W. Anyhow, the position "Tenebris" gives of the *comes* in your last issue shows that he has not seen it. The mean of all my estimated positions is 255° It is a pity Mr. Tarrant did not favour your readers with his measures, as asked. I may say that I split neatly this object with 4in. some weeks ago, out of my 8½in. mirror by With. The silver of this mirror has never been good, through a mistake I made in silvering it, and it is now in a wretched state; but I find it very useful for very bright objects, and I do not find this affects its defining power.

Nov. 15. **C. M. Gaudibert.**

### CALCULATION OF SOLAR ECLIPSE—THE PLANET MARS—CELESTIAL PHOTOGRAPHY.

[31805.]—As a colonial subscriber to your valuable journal, I wish to convey my thanks to Mr. Slade for contributing a fully worked-out example of the calculations for the local circumstances of a solar eclipse, the preliminary drawing and the "final calculations" being particularly valuable in enabling one to grasp the theory of the two methods. I have worked out the particulars for the Eclipse of Dec. 11 visible here—1st, by projection; 2nd, by the rigorous method, employing 16 hours and 17 hours as data; and 3rd, by the same method using 15½ and 17½ hours. Finding the three results slightly different, I reworked the whole for five successive half-hours, interpolating differences at each step as a check on clerical errors, the result being that on plotting the co-ordinates of the several apparent positions of the moon with reference to the sun, the curved path of our satellite (referred to in Loomis 263) was evident, and explained the slight difference between calculations 2 and 3. It would therefore appear that the method of projection offers a ready means of finding the most suitable data for working out the more exact method of determining the times of beginning and end, also that an additional computation is necessary when an exact determination of the central phase is required.

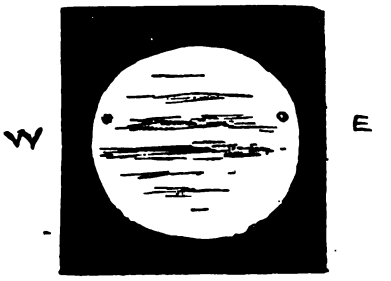
In working out Parallax in Declination (on page 336, Vol. LI.), Mr. Slade finishes with "Correction, see Loomis, Art. 228, $\tan.\ \delta' = \frac{\tan.\ \delta'}{\cos.\ \pi}$."

I have diligently studied Loomis' formula for obtaining δ′, and cannot see the necessity for this further correction. On referring to Loomis, Art. 228, I find the correction $\tan.\ \delta' = \frac{\tan.\ \delta}{\cos.\ a}$ explained, and in articles 262 and 266 I find its application where the factor "a" represents "difference in R.A. of sun and moon." This I understand to be necessary, because in setting out the co-ordinates of the moon's apparent distance from the sun at the approximate times of beginning and ending, parallel lines are used instead of convergent meridians. I should be glad if Mr. Slade would explain why he prefers "Prlx. in R.A." as the factor "a."

The planet Mars has been a conspicuous object here during the recent opposition, culminating between 10° and 15° from our zenith. I have examined it frequently with my 3½ Wray equatoreal, but have always been disappointed, as I could find little or no detail corresponding with descriptions found in books. Previous to opposition it exhibited an ill-defined dark central portion, surrounded with a bright zone. I thought my instrument, or vision, inadequate, and was not a little relieved when I received my "E. M." of June 6 to find a drawing by Mr. Kempthorne of its appearance in a much larger instrument, just as I had observed it. I did not get good views again for some weeks, and then its appearance was quite changed; a segment whose versed sine was equal to about one-fifth of the planet's diameter was distinctly of a different colour from the rest, being a kind of grey with a greenish tinge (probably complementary). Could this possibly be an enormous glaciation? I hope some correspondent having a large instrument in this hemisphere will follow Mr. Kempthorne's example, and furnish a drawing or two.

Five days ago a large group of spots appeared on the sun, occupying six seconds in crossing a wire; they have since increased in number, and now occupy fourteen seconds in transit. I have made many attempts to photograph such spots, and also the moon, but have never succeeded in obtaining a *sharp* image. Attaching an exposing box to the telescope, I have tried the image at principal focus and through the eyepiece, with variations both in and out of the visual adjustment, and with pneumatic shutter near plate and independent cover to o.g. As I dare say others have made similar experiments, an account of same, with results, would be interesting.

I inclose sketch of Jupiter, as seen here on the



evening of August 14th, the fourth satellite and its shadow being simultaneously visible in transit, the latter being the darker object.

Several years ago I fitted up a battery and lamps for illuminating the field of equatoreal, and for reading the circles. It is a great convenience, for even a very faint object can be easily and quickly centred; the cost was very small, and if you think a description would interest your readers, I shall be happy to send one. **John Grigg.**

Thames, New Zealand, Sept. 30.

[Please send.—Ed.]

## LUNAR SNOW MOUNTAINS: TO "F.R.A.S."

[31806.]—With reference to the remarks of "F.R.A.S." in regard to the lunar Apennines, in letter 31530, and the probability of their subsiding bodily if formed wholly of snow and ice, I would like to say a few words. In the first place, it is only at occasional peaks where the elevation would be "nearly 20,000ft." The Western Apennines, according to Neison, average "about 6,500ft.," and the eastern rise to "not much under 10,000."

But, assuming that we have to deal with ranges of 20,000 and over, it must be borne in mind that the difference in gravitation on our earth and the moon is so great as to profoundly modify most phenomena, and render any strict comparisons exceedingly difficult, or even misleading. For instance, terrestrial snow would weigh on the moon only $\frac{1}{6}$ (one sixth) what it does here, and terrestrial ice would be actually lighter than cork. But this is not all, for lunar snow in falling, or piling up, would be so much less compressed vertically by the several layers that the resulting "mass" per cubic mètre would probably not exceed a fourth of ours. Hence the weight would be about 1-24th that of terrestrial snow.

It is difficult to realise the extreme lightness of such material. It would more nearly resemble very lightly piled feathers than our snow; and in the "E.M." for August 8, p. 512, I said: "If an inhabitant of our earth could step from the car of a balloon on to a lunar mountain, he would probably, I take it, shoot down through it for over half a mile ere his two stone, say, of weight could be arrested. But though of so light and flocculent a nature, the lunar snow mountains, rising into an intensely cold vacuum, would to us appear, and practically be, as permanent as our mountains."

I presume that the main difficulty experienced in realising a snow range 20,000ft. high is in regard to its weight and the assumed tendency to subside into ice, which would glide off, like our terrestrial glaciers, or ice rivers. But under the assumed temperature, lunar ice is probably as rigid as so much glass, and not viscous, like ours. The experiments of Mr. Thos. Andrews, F.R.S., reported to the Royal Society (see *Nature*, June 26, p. 214), regarding the non-plasticity of ice at low temperatures, clearly demonstrate that viscosity becomes *rapidly* less as temperature declines, and at last entirely ceases, ice becoming quite rigid. Thus, the arguments based on the viscosity of ice, which have been, and still are, urged against this theory, are vitiated, and, indeed, no longer tenable. The three leading objections against the lunar ranges being formed of snow—i.e., the weight, viscosity, and evaporation—are pretty well disposed of, and thus the *possibilities* are balanced in my favour. Now, with regard to the *probabilities* of the case, I would first draw attention to the fact that, as a rule, the lunar mountains are essentially littoral ranges. Whether named, as the Carpathian, Apennines, Caucasus, Alps, Hæmus, Pyrenees, &c., or unnamed, as the Sinus Iridium Highlands, the borders of M. Crisium, &c., they generally border *maria*. It is not a casual, but, on the contrary, a well-known and persistent feature.

Secondly, the axis of the chain is generally a crescent, with the concave side facing the sea, and for this very peculiar feature no explanation—as far as I am aware—has ever been offered.

Thirdly, these littoral mountain ranges almost always present the precipitous face to the *mare*, as though due to marine denudation (see M. Crisium). We can hardly suppose that these several peculiarities, so persistently associated, can be the result of pure accident, and we are driven to the conclusion that there must be some structural cause for it all. Some structural relation between the *maria* and their peculiar littoral ranges. When we view the moon with low powers, it is evident that these ranges are practically marial ramparts, and repeat on a larger scale the whole or fragmentary rings of craters and walled plains. The salient features common to both are so notorious that it is really waste of space to detail them here. We can understand how marine denudation might have caused the steep and cliff-like profile; but not how the sea (as a sea) can have caused the axis of the range to be in all cases crescent-shaped in plan, which is carried to the extreme in M. Crisium. This last is a feature of the case which we may not ignore. How could marine denudation have raised the huge border to the Sinus Iridium, causing it to have a deep curve, and, at the same time, cause the whole surface, east, west, and north, to culminate in these "stupendous cliffs"? Why is this question of greatest elevation of the crests of these littoral ranges so closely associated with the crescent form or curved line in the plain?

It is precisely what we see in the craters and walled plains. My explanation is that these "littoral ranges" have been formed from, and by, the adjoining *maria*, in the same way exactly as the snow rings around craters. It is here that Mr. Denning's observations in regard to the brilliant (snow) borders to the more regular seas on Mars come in as valuable evidence in favour of my views. I referred to this in letter 31413, page 512. If the water has been raised from M. Crisium (as aqueous vapour) and deposited as snow around the margin, we have the reason—1, why the floor of this *mare* is so depressed; 2, why the ranges so closely circumscribe this sea; 3, why the margin is highest and cliff-like and colourless.

We could understand why the general surface trends up to, and culminates in, a semicircle of "stupendous cliffs" around Sinus Iridium—their growth has been *sea-wards*. The bay is a small "mare crisium," arrested in its growth by the refrigeration of M. Imbrium. This view, that the "littoral ranges" are formed of snow, derived from the adjoining *mare*, would link them (structurally) with the ramparts around the walled plains and craters, and, indeed, all the smaller formations, such as ridges, and even crater cones.

I can see no reason why, during the later stages of the moon's development, in the absence of atmosphere, and under conditions of low temperature, vast snow deposits should *not* accumulate around the last liquid areas. It seems to me only reasonable to suppose they should do so, and that the brilliant borders to the seas on Mars are the incipient stages in this process, seen on a larger and less developed globe.

Thus, as far as I can see, both the *possibilities* and the *probabilities* of the great "littoral ranges" being formed of snow deposit are fairly well made out.

Oct. 10. **S. E. Peal.**

## ANGULAR MEASUREMENT OF THE PLANETS.

[31807.]—The explanation of the apparent discrepancies in the angular diameters of Mars and Jupiter which puzzles Mr. Moore (queries 72643 and 72899) arises from the fact, which perhaps I ought to have stated in *Knowledge*, that from May onwards I have given Marth's values, which he will find in "Monthly Notices," Vol. L., Nos. 2 and 5. I did not receive No. 5 until my article for May was written. In the same way I have given Marth's values for the diameter of Saturn throughout the year. The diameter of Jupiter, when that planet is in opposition in Pisces, may exceed 50″ (using Bessel's value for the equatorial diameter). He will also find that the magnitudes of stars occulted by the moon differ from those given in the N.A., because I have, when it has been possible, taken the magnitudes for northern stars from the Harvard Photometric results, or for southern stars not in H.P. from the Uranometria Argentina; e.g. the magnitude of $\zeta^1$ Libræ on June 1st is given in the N.A. as 4 from the B.A.C., in *Knowledge* as 6, as the H.P. value is 6·2, and the U.A. 5·9. I have also been careful to point out, for obvious reasons, when occultations given in the N.A. occur in bright sunlight; e.g., in the case of the 7th (N.A. 6th) magnitude star δ Geminorum on the morning of the 1st of the present month. I may remark that in the articles in *Knowledge* I use a solar parallax of 8·80″. **H. S.**

## SOME CURIOSITIES IN ASTRONOMICAL LITERATURE.

[31808.]—The recent exquisitely ludicrous specimen of the astronomical article of the period furnished to us by "A Fellow of the Royal Astronomical Society" in letter 31705, p. 166, leads one to recall other instances somewhat similar in character which have occurred to the writer from time to time, some of which are collected in this letter.

Many astronomical solecisms occur in letters written to daily newspapers, by irregular correspondents, who are probably not versed in the technicalities of astronomy, and on that account are more or less pardonable to the mind of one who sees that the faults are not those of carelessness. These cases differ from the one alluded to above, where the aim of the author is clearly to instruct. On this account the nonsense poured forth, as if *ex cathedrâ*, is doubly noxious. It clearly reveals that the author has a number of technical phrases at command of which he does not know the meaning.

The comet of 1880 which was visible at the Cape, and in South Africa generally, was a most mysterious object on account of the enormous length of its tail, its comparative dimness or want of definite outline, and the short period during which it was visible. No doubt many an intelligent person, fairly well acquainted with the appearance of the starry heavens, must have been puzzled what to think of the long faint brush of light he might have caught sight of in the western sky after sunset, stretching to a great elevation above the horizon. One correspondent wrote:—"It seemed like a lunar rainbow, but colourless; it was only one third of an elliptic arch in the south-west. Can any of your readers explain the phenomenon? Was it the polarisation of electric light or a mirage, when the moon had not risen?" What the writer of this had in his mind when he referred to "the polarisation of electric light" is hard to say, and probably he would have been unable to define his meaning of the expression if questioned. The "mirage" idea is more reasonable, although it is not probable any form of atmospheric phenomenon would resemble in any way this comet's tail. Another paper (the *Natal Witness*) after fairly accurately describing its appearance, went on to observe:—"Some have asserted that the light was Zodiacal; but against this is the fact that its base was not in the ecliptic or path of the earth, as such would appear to an observer in the sun. We have seen similar lights in the dry country bordering on the Kalahari desert. It is to our mind a matter of certainty that the 'brush of light' in question was not the tail of a comet, or it would not have been obscured by the earth's shadow as it finally was. It faded slowly, beginning from the point of its horn, gradually shortening till it vanished, leaving only a lingering splendour to mark its path; even this waned away, and totally faded out by 9 p.m." The editor of a contemporary journal alluded in a somewhat sarcastic way to the preceding account in the following remark:—"We wish the *Witness* had explained what it means by the comet [illegible] obscured by the earth's shadow? He is evidently wrong in supposing it not to be a comet"—[illegible] which show that Number 2 editor had some ideas in his cranium about celestial matters [illegible] Number 1.

In connection with this same comet (*a*), 1880, [illegible] following extract from a somewhat [illegible] effusion addressed to a Cape paper reads in [illegible] amusing light. After asking the Astronomer [illegible] (of the Cape) for details as to the position of [illegible] comet, and pointing out that the comets of 1880 [illegible] 1845 are identical, the writer proceeds:—"In [illegible] part of the world I claim to be the first; [illegible] there are other observers in South [illegible] Australia, &c., is yet to be seen. I understand [illegible] it is customary to recognise the services of [illegible] astronomers or amateurs who re-discover a [illegible] by which its orbit or period can be clearly [illegible] If this be the case, then I now claim all the [illegible] privileges, or emoluments that it is usual to [illegible] unless that honour is claimed by another [illegible] the 7th inst., in another part of the [illegible] Hemisphere.

"A question may arise for writing in the place under a *non de plume*, and vitiate my [illegible]

"I now, with your permission, subscribe my[illegible]

(Signed) "J. C. Graham,
"*Alias* 'A Colonist,' and Re-discove[illegible]
Wilmot's Comet of 1845, on th[illegible]
February, 1880.

"Port Elizabeth, 12th February, 1880."

Unfortunately for this gentleman's claim, comet was seen by several persons in Natal as early as the 1st February, and by numbers on the 2nd. One paper stated "the nebulous train, figuratively speaking, was about a yard in length." (!)

The following passage from a Cape paper, referring to the transit of Venus in 1882, is genuinely humorous:—"A well-known Custom House official, being otherwise unprovided with an instrument for his own especial benefit, had utilised a piece of brown-coloured glass, which much resembled the side of a 'square-face' flask; the view through this primitive optical instrument was decidedly unsatisfactory, and it would be difficult to say after inspection if the shape of the sun was oval, irregular, or round." It should be explained, for the benefit of those unacquainted with the allusion, that "square-face" is the local and popular name of the spirit known elsewhere as Hollands, and so largely drunk in the colony of Natal, that it is also known as "the wine of the country." It is contained in a square-shaped flask of dark-brown glass.

The following cutting from a small news sheet, which was published in the town of Pretoria during its investment by the Boers in 1880-81, is from the pen of the late Charles Du Val, a writer who possessed a real vein of humour, which often helped to amuse and relieve the tedium of those who were shut off from some months from communication with the outer world. It is headed "Up in a Balloon":—

"Last night the attention of some four or five important officials of the garrison appeared to be riveted upon the heavens, and with night-glasses, telescopes, sextants, &c., they seemed upon a voyage of discovery upon the air. 'It is,' said one; 'It can't be,' said another; 'Look at the car,' echoed a third; whilst number four could plainly see the men emptying sandbags out, and pulling the valve-string to allow the gas to escape. Inquiry as to the excitement proved that the adjutant, with the aid of an orderly officer, a civil engineer, and the instruments previously alluded [to], were examining a balloon which had been discovered and reported upon. It was darkly hinted that the thing of gas and silk was the one engaged for the postal service, and coming in with the latest mails from England and despatches from Sir Geo. Colley. The balloon, however, after further examination, turned out to be one of those diamonds of the firmament which go to the making up of the constellations, and we understand that the four gentlemen who made the astronomical discovery, and dispelled into thin air the idea of conveyance of mails by steam-power, retired, singing in quartette the pleasing melody, 'Beautiful star, in heaven so bright.'"

From inquiries made at the time, I have reason to believe the star in question was the ruddy and brilliant Antares. Those who have only seen it at its low altitude in England can form no idea what a bright and beautiful star it is when seen high in the sky, through the cloudless atmosphere of South Africa; and hence there is more reason than might appear at first sight in the apparently absurd idea described. Probably, however, it was comparatively near the horizon when first "observed." I am not certain whether the anecdote has appeared before in the columns of this journal; should it have done so, I must ask pardon of your readers, as I have not the whole file of the ENGLISH MECHANIC to refer to.

The following refers to Pons' Comet during its apparition in 1884, and is a curious specimen of the ideas which may be prevalent about a comet. A certain Cape paper stated "that the 'celestial visitant' was first seen in Bloemfontein on Tuesday week, and amateur star-gazers in the neighbourhood fondly believe that, because the tail points to the rainy quarter, the N.E., the present drought will soon be broken up by an abundant opening of the fountains of the firmament.' Let us hope the prediction will be fulfilled, and then we shall have reason to bless the comet of 1884. The name—Brooks's comet—is rather suggestive." This editor certainly was "down" on the star-gazers, and not without reason, too.

The humour of the Emerald Isle is well known, and a burst of it appeared concentrated in the following letter, which appeared in a journal published within a hundred miles of the chief town in the South of Ireland. It should be premised that a local professor had announced the probability of unusual high tides in connection with the total eclipse of the sun of 1st January, 1889, and invited attention to his forecast. A few days afterwards following appeared:—

"DEAR MR. EDITOR,—I am much pained to see the way that clever man, Dr. K., has been ridiculed by the local Press, and, with your permission, will say a few words in his favour.

"For over a quarter of a century I have been sailing between the Coal-quay and Sand-quay, and should know something of 'tidal waves' by this time. Now, sir, no tidal wave could with safety venture up Cork Harbour in such a fog as yesterday's, and surely that is not the doctor's fault?

"Again, they laugh at his knowledge of 'invisible astronomy.' Now, sir, to show you he is capable of foretelling things, mark well my forecast. First, for a 'certainty' we will have two tidal waves on the 29th of next February, and steps should be taken to send them up the north and south channels, as if they both go to the one way the floods may do damage.

"Second, the moon may 'possibly' collide with the sun. It 'grazed it' last time, and a piece of the moon will fall in Cork City at thirteen minutes past ten that night.

"The 'probability' is it will fall on the Barrack-street band-room—timing by Shandon clock; but if Scott's clock is right, which it seldom is, the bit of the moon will fall into one of the Mayor's tan-holes.

"As I stake my reputation as a seaman, and have confidence in "invisible astronomy," please let the public judge.—Yours faithfully,

"PATCHA (Ferryman)."

America, of course, is the home of exaggeration, whether in science or literature, and doubtless a very large number of "yarns" may be in existence in periodical literature relative to astronomy. The following extracts are from an article which appeared some years ago in an American paper, and which appeared to me to be particularly humorous. The effusion in question, entitled "The Spots on the Sun," starts by a reference to the distance of that luminary, and then proceeds: "Several years ago it was discovered that a slight error had been made in the calculation of the sun's distance from the earth, and owing to a misplaced logarithm or something of that kind, a mistake of 3,000,000 miles was made in the result. People cannot be too careful in such matters. Supposing that, on the strength of the information contained in the old time-table, a man should start out with only provisions sufficient to take him 89,000,000 miles, and should then find that 3,000,000 miles still stretched out ahead of him. He would then have to buy fresh figs of the train boy in order to sustain life. Think of buying nice fresh figs on a train that had been *en route* 250 years! Imagine a train boy starting out at ten years of age and perishing at the age of sixty years with only one-fifth of his journey accomplished! Think of five train boys, one after the other, dying with old age on the way, and the train at last pulling slowly into the depôt with not a living thing on board except the worms in the 'nice eating apples!' The sun cannot be examined through an ordinary telescope with impunity. Only one man ever tried that, and he is now wearing a glass eye that cost him 9 dols.," &c. It is to be observed that the author of this jocular piece of work had not read his textbook with the care he ought to, as he implies that the sun's distance was originally underestimated, whereas the fact is it was overestimated, until the rediscussion by Mr. Stone of the observations of the transit of Venus of 1769, and other modern observations reduced it by some three million miles and more.

Some years ago an amusing article in the *World* gave an account in popular language of the duties of the Astronomer Royal, and of the extraordinary epistles which were occasionally addressed to him, asking for information of a decidedly astrological nature.

But, apart from written records, I suppose every amateur in astronomy can recall some instances of comical, curious, or absurd remarks which have been heard to fall from visitors to an observatory, or others who were temporarily interested in the science, like the reverend gentleman who was requested by Admiral Smyth to give his idea of the colours of the star Cor Caroli, and, after a very momentary glimpse, flatly declared that he "could make out nothing particular."

I was once engaged in showing a small party of ladies some "celestial objects" through a "commom," yet very good, refractor. When it came to the turn of one young lady, she evinced a decided disinclination to peer through the optic tube. On inquiring the reason for her objection, it transpired, after a little nervous hesitation on her part, that she was afraid she would not see the right thing. By this was meant, not that she would see anything that was improper, but that she might possibly or probably give a description of her impression not in accordance with the cut-and-dried textbook article! She was, of course, immediately reassured, and requested to have no fear whatever in describing the telescopic picture, whether that description was astronomically orthodox or otherwise. And, truth to say, there was a lesson to be learned by a more practised observer from this incident, for the practice of cooking observations is one not unknown in recording observations, and generally results from the very same feeling evinced by the young lady—viz., a fear that because our observations are different from others, therefore they must be wrong. The old proverb here comes in—"Speak the truth and shame the ——."

Those who frequented the meetings of the R.A.S. some few years ago will probably remember a discussion as to the existence of oxygen in the sun. The atmosphere of the room at the time was somewhat hot, partly due, perhaps, to the gas. One gentleman rose, and looking up at the brilliant star of gas jets which illuminated the room, observed that, however it might be about oxygen in the sun, there was a decided absence of it around him at the time.

No doubt the readers of "Ours" could recall many varied instances of humour, whether spontaneous or intentional, which they have met with in the course of their experience as star-gazers; but enough has been given above to illustrate the subject. It is quite evident that as meat is nothing without salt, so life would be a very dreary affair without an occasional joke, and even astronomy may have its occasional spice of humour, for "Nemo mortalium omnibus horis sapit."

**E. E. Markwick.**

## THE TAIL OF A COMET.

[31809.]—"DUBITO" (31784) is on the same track as "J. S. L. L." Is it not a "magnificent idea"? Donati's comet had a tail 50 millions of miles long. If this was only the radius of the imagined sphere, the sphere was 100 million miles diameter! It would have enveloped all the orbits of the inferior planets. As to the second part, the candle flame is not eclipsed by the sunshine; it shines as brightly as ever, perhaps more so, as would be seen against a perfectly dark background and surroundings. Let "Dubito" carry the lighted candle into a dark room, and allow a ray of sunshine to fall on the flame through a hole in the shutter. **Hammer.**

[31810.]—MANY years ago a theory to account for these was suggested, if I remember rightly, by Prof. Tyndall. It assumes (1) that the space through which a comet moves is filled (this will please the etherialists) with a very rare gas kept in a state of transparency by the sun's heat-rays, but capable of becoming condensed into a visible vapour when these are withdrawn, and (2) that the head of the comet, while allowing the sun's light to pass freely through it, obstructs the heat-rays. These two assumptions being granted, it follows that the appearance of the tail of the comet is caused by the condensation of the transparent gas within the *cold shadow* of the head into the vaporous form in which it reflects the sun's light. Thus the tail is not really a part of the comet moving with it, but only a transient effect produced upon the medium through which it moves. This theory also accounts for the curvature of the tail as well as its direction pointing away from the sun; for the condensation may be supposed to require a certain time for its production, as well as for its cessation; consequently the tail will lag behind the shadow producing it, and it will do this to the greatest extent at the part most remote from the head, where the shadow makes the widest and swiftest sweep through space. **Walter M. Hardie.**

## A STRIKING METEOR.

[31811.]—ON the evening of Sunday last, the 16th inst., at about 10m. past 11, I witnessed from the neighbourhood of London the fall of a very fine meteor or bolide, in an almost plumb line, from a point near the zenith. Commencing with a track of fire, it expanded into an orb of blue light, many times exceeding a star of the first magnitude in apparent size. This suddenly disappeared, when within about 15 or 20 degrees of the horizon, and a residuum of red-hot fragments fell towards the earth. The whole strikingly recalled an effect of ordinary pyrotechny, its almost perpendicular course aiding the illusion. The day had been dull and hazy, but the night was unusually clear and starlight, and it is months since I have seen the Galaxy so beautifully defined as on that evening.

Nov. 18. **A. E. Spencer.**

## THE WATCH AS A COMPASS.

[31812.]—I SHOULD like, if you will allow me, to revert for a few lines to the question as to the employment of the watch as a compass, for the sake of pointing out what seems to me an easy way to discover the "truth."

To employ the watch so amounts to an attempt to find the sun's azimuth from the hour-angle alone, which cannot be done with any approach to accuracy. To begin with, there is error, due to the watch showing Mean Time, which may amount to 3° or 4°. There is also error due to the difference of longitude (as it cannot show local Mean Time everywhere); but the largest error will be due to the neglect of lat. and decl. Let us take an instance: Suppose our lat. to be 52° N. and the time 3 o'clock on a day near *midwinter* (say Dec. 11, 1890), when the declination is about 23° S. Half-way between III. and XII. is ⅛th of the circle, or 45°, so that, according to the watch, the south point would be that much to the east of the sun. Azimuth being counted from the north in north lat., to compare this with the tables we must take the supplement of that, or 135°, which would be the sun's azimuth as shown by the watch everywhere and at every date at 3 o'clock. But by Burdwood's "Sun's True

Bearings on Azimuth Tables," or by computation, we find the *true* azimuth to be 139° 10′, making the error 4° 10′ to the right. Now, suppose it is a day near *midsummer*, and the dec. 23° N., while the sun's bearings by the watch remain the same, the *true* bearings found from the tables, or by computation, would be 112° 42′, showing an error of 22° 18′ to the left. Sometimes the watch would give the south point (or in southern latitudes, the north) point pretty accurately; but usually there would be a large error, which would vary with every change of time or place, and which might amount to as 2½ points of the compass, as the above examples show. In latitude 30° the error would be in the one case (lat. and dec. 23°, same name) 46° 8′, and in the other (lat. and dec., contrary names) 43′. Is this enough to show how misleading the watch as a compass might be? (fancy an error of 46° 8′, more than *four points!*) Or am I making some blunder? Will "F.R.A.S." say? May I ask Mr. R. Brown, Yale Observatory: Suppose the time to be 8 a.m., would not the south point be indicated by X and not by IV.? How can the halving of the interval be along the course already travelled by the hour hand, when the sun is still to the east of the meridian? Surely the south point will be to the right of the sun, and IV. will point to the north?

Nov. 14th, 1890. **A. J. S.**

## THE REFLECTING TELESCOPE.

[31813.]—Allow me to thank Mr. Price and your other correspondents for their valuable hints with regard to the prevention of the dewing of the plane, and concerning the question of adjustment. By these, and two or three very kind and interesting letters which have reached me privately, I hope to profit very materially. In answer to the query of "F.R.A.S." (letter 31778 p. 247) I may say that I tried δ Cygni in the morning twilight last spring, but without success. This year I have removed the instrument to a better position, and intend to try again before long. My telescope not being equatorially mounted, the evening twilight is not well suited for the purpose, as I cannot usually find the star till the sky is too dark.

Ringmer, Lewes. **Charles D. P. Davies.**

## DRY BATTERIES.

[31814.]—About six months ago I made up a dry battery, which has been in use ever since for bell ringing; and although of small size and very simple, it is equal to two Leclanché cells. Perhaps Mr. Bottone will say if several of them would be efficient for electric lighting, as I should like his opinion as to their suitability for a continuous current before making them up. I cast a slab of plaster of Paris with a little oxide of zinc mixed with it, mixing it with water as thin as I could for it to set well, and when thoroughly set I dried it in an oven; when dry I soaked it in a strong solution of chloride of zinc; and mixing a spoonful more plaster with the same solution, I spread it over one side of the slab, and pressed a zinc plate on it before it was set. Then I did the same on the other side, and put on a plate of lithanode, of course leaving one end of each projecting for binding screws. Afterwards I rolled parafinned paper round the whole, and tied it up tight with string.

Its simplicity, cheapness, and portability leave nothing to be desired as far as bell work goes, and I think it would be useful for continuous-current work. **A. L.**

[31815.]—I have not stated, as Mr. Ball implies in letter 31768, that there is absolutely no circulation in a so-called "dry" battery, and Mr. Ball's theory on that point is the opinion of everyone who has given the subject a moment's thought. The point surely evident is, that of two batteries otherwise identical, the one with the greater circulation of liquid is the more efficient; for obvious reasons there is very little circulation in dry cells, but they have, all the same, their uses, notably for purposes of advertisement and sale. A "dry" cell will undoubtedly ring a bell, and if large enough and moist enough it may do so for a century; it will also plate, but no one, except perhaps the "dry battery" manufacturer, has found an advantage in having plating cells *dry*. The current of a dry cell is, moreover, very inconstant, and the internal resistance is high. Are these *desiderata* for plating?

The most glaring misrepresentation of which, according to Mr. Ball, I am guilty, exists in connection with my comment on his cell that was stated to have had a voltage of 3½ volts for "a week or so." Mr. Ball distinguishes between true and acquired voltage, and he reminds us that the 3½ volts were measured *after* regeneration. There is nothing in my letter implying that the measurement was made before, and no one doubts that a newly-charged or regenerated battery would be likely to have a higher voltage than one that had not recently undergone that process. In my last letter I have mentioned the kind of cell that might possibly give 3½ volts; I need hardly add that the cell is of no use for practical purposes, and consequently there is the more interest to know the composition of Mr. Ball's cell. The last few lines of Mr. Ball's letter are beside the question. Were we to argue on the lines there laid down we might, for instance, get the following charming result:—If zinc in chromic and sulphuric acids against carbon gives an E.M.F. of 2 volts, and iron under the same circumstances gives, say, 1·5 volt, then, according to Mr. Ball, a cell consisting of zinc and iron against carbon in chromic and sulphuric acids would have an E.M.F. of 2 + 1·5 = 3½ volts! Comment is needless. **H. G. L.**

[31816.]—As these batteries are just now forced a good deal on our attention, it would be well if those non-advocates who have used them were to give us their views and experiences. Being simple and convenient, they naturally recommend themselves to the inexperienced amateur who will not think for himself. In those which I have as yet seen the word *dry* is a misnomer; it should be *moist*, because such batteries only act as long as their packing is moist and chemical action possible. That action does not last long, because the new product, which results from the oxidation of the zinc being practically a solid, cannot fall to the bottom by its higher specific gravity, as it does in the liquid cell; it remains where it is formed, and shields the zinc against the further action of the packing.

Inventors give plausible explanations, and pretend that the waste products are absorbed and new moisture regenerated. How is that possible in a dry cell? The zinc cylinders of these cells offering a large surface, the chemical action must go on for some short time before all the moisture is neutralised; so long a current will flow. Still, the non-removal of the waste product must speedily prove fatal to every dry cell.

Most existing dry cells have been brought to my notice either by the inventors themselves or by their agents. To their invitations to take them up, I said No, because I had no wish to take people in by the reckless assertions that were made to me—assertions that were flatly contradicted by natural laws. Still, as they were positive, I tested a few, only to please them. The first that was offered to me, some six years ago, came from France, and was by far the best, though it did not last long. It rang a bell fairly three or four times a day for about a month, when I sold it. The next was Dr. Gassner's, which has been making the greatest noise in the Press, I think. What I saw of its performance during three or four weeks was very disappointing, and the agent himself agrees that it was poor. Two other cells were substituted for the first one, with a view that I should testify to their excellence; but they turned out very little better than the first one. Two in series barely rang a delicately-set 3in. bell three times a day for a few seconds during three weeks. I will grant that they may since have been improved, and that they may ring bells, on and off, for five or six weeks. But what is that compared with the common porous cell—Leclanché? A third cell brought me for testing was said to be of Belgian origin. It certainly performed better than the German, and was still able to ring a bell after it had been short-circuited for nearly a day.

Mr. E. Ball talks of regeneration. Well, that can be effected in different ways: by passing a current through them and making them a sort of accumulator, or by diluting a solution. But is this cure not worse than the disease? Who will undertake that trouble, when the ordinary Leclanché, which costs not half as much, does all the work for more than a year without any regeneration? True it is, that competition has brought the price of the latter cells so low that it scarcely pays to make them well, and that they often fail on that account. Respectable houses will always sell a proper article, because they know how to, and it costs no more to make. There are occasions when dry cells are very suitable. When you go out testing or bell-hanging, it is more convenient to carry a small dry cell than a liquid one, and even so with the medical electrician. In such cases lasting time is not of much importance. Mr. Henry Leitner, in letter 31734, hit the nail when he stated that "circulation of the liquid was of fundamental importance," only barely hard enough to drive it home to the minds of the unthinking reader, who cannot see the absolute conditions necessary to maintain a current. The moisture could easily be maintained in a moist cell; but the product resulting from chemical action cannot be removed, and it will soon clog up the zinc and stop all further action. The use of the so-called dry-cell (which can be made even cheaper than the Leclanché) is limited to experiments of short duration—for lasting bell, telegraph, or telephone work it is not suitable. **A. Caplatzi.**

[31817.]—To all appearances "J. R." forwarded his letter (31793) before my reply to Mr. H. Leitner appeared; this being so, he will have seen that there is nothing wonderful about the 3½ volts.

As regards the Gassner cell, I believe the inventor only intended it for bell work and such like intermittent purposes, as, like the Leclanché, it soon polarises, and requires rest to recover its strength. But, notwithstanding this, it will do more heavy, continuous work than the ordinary Leclanché. The Gassner will ring a bell continuously for twelve hours or more without rest, whereas the ordinary Leclanché will not give us two hours.

"J. R.'s" wet cell, with E.M.F. of 2·40 volts and low I.R., with no local action, I should consider good if it has no objectionable tricks, such as creeping, fuming, &c.; also it should be appreciated if the price is not against it. Would "J. R." kindly let us know if E.M.F. of this cell is higher than 2·40 volts on being tested immediately after regeneration by current? If it behaves after the same manner as most dry cells, it may possibly beat the 3½ volts.

Nov. 17th. **A. E. Ball.**

## RULE FOR ELECTRIC-BELL AND ALARM WIRING.

[31818.]—Mr. W. Perren Maycock is, perhaps, under the impression that he is forming some new rules as regards electric bells and wiring for them. I introduced, some 25 years ago, the following rules, which have since been strictly adhered to by all my employés:—A red wire for C pole of battery, a blue wire for Z pole of battery, all red wires to terminate at the bottom or small spring in all the pushes, all the blue wires to terminate at the right-hand terminal of all bells. As for return or line wires, no rule is required, as a workman who knows his business would not resort to testing to find in which direction the wires run.

**Adam Koerber.**

## PROBABILITIES.

[31819.]—Some time ago it was asked, I believe, in the English Mechanic, what was the probability, in whist, of each person having all the cards of the same suit in his hand.

The answer is, $\frac{\overline{4|}\ \overline{13|}^{4}}{\overline{52|}}$, the term $\overline{52|}$ denoting the product of all the numbers, 52, 51, up to 1. When developed out it gives a fraction whose numerator is 1, while the denominator consists of no less than 28 figures, and is, in fact, something more than 2,000 quatrillions—i.e., 2,000 times a million to the fourth power. Such a large number is one of which we can form no idea whatever, except, perhaps, if we state that it represents, roughly, the number of cubic inches contained in 33 globes, each of them the size of the earth!

In like manner the probability of all the trumps being in the same hand is represented by

$$\frac{4,\ \overline{13|}}{52,\ 51,\ \text{to } 13 \text{ factors}},$$

and is $\frac{1}{158,753,389,900}$.

There is another hand upon which the reader may exercise his ingenuity. What is the probability that a person will have a hand in which there is no card of a higher value than 9? He will find it to be $\frac{1}{1,828}$, if we neglect decimal places. This hand, if it had been first noticed by John Smith, would probably have received no name; but as it is, it is known as the Yarborough hand, after a nobleman who is said to have won large sums of money by bets upon it, although the odds which he gave were considerably in favour of his opponent.

The principles upon which such calculations are founded are few and simple; but in the application of them to cases there is no branch of mathematics in which an able and careful man is so likely to make a mistake as in the theory of probabilities. And this arises chiefly from the fact that so many distinctions have to be made which are liable to escape observation. And, perhaps, for this reason it may be said that the study of the subject is one of the best mental disciplines we can possibly have, in teaching us especially how needful it is to distinguish between things which look like each other, but in reality are not the same. **W. G. P.**

(*To be continued.*)

## MICROSCOPICAL SECTION CUTTING.

[31820.]—As this subject began, I think, by someone asking for information on the preparation of lung sections for photo-micrography, and as lung requires special preliminary treatment to be of any use for a real study of its structure, I propose beginning with this. Now when an animal's chest is opened the lungs partially collapse or shrink, and if they are cut up and the pieces put in any hardening solution this shrinkage is carried further, and sections cut from such material will be quite unlike the living tissue, as the air cells are all squeezed together and distorted. The proper procedure is as follows: Immediately after death, rapidly but carefully open the chest *without wounding the lungs*, and remove them with the windpipe attached; now with a syringe inject through the windpipe sufficient ½ per cent. chromic-acid solution (I prefer Flemming's chromic-acetic-osmic acid mixture) ungs are fully but not over expanded, tie pipe to prevent the fluid escaping, and :he whole mass in a large quantity of ıcid solution in a wide-mouthed jar or glass, taking care that the lungs are quite d. This may be insured by tying on some pers. Put in a cool place for 12 hours, ıge the solution and leave for 24 hours or t gently wash them in water, and put in a of equal parts methylated alcohol and olution and leave for two or three days. es will now be fixed, and the lungs may o small pieces and the hardening process l in pure methylated spirit, changing this to time until it ceases to be discoloured. rial will now keep indefinitely, the whole is retained in its natural position, and a of its histology may be gained by sections from it. I will next describe the method ring the tissue for cutting by the freezing, and celloidin processes respectively. For ing process, either by ice and salt or ay microtome, take a small piece of the material and soak it in water, changing time to time, *until it sinks*. Then transfer ion of gum arabic, not for a few minutes by "B.Sc.," but until the tissue is ly permeated by it, which will take many Treated thus, the material, when frozen, he consistency of, and cuts like, new soap; full of water, spicules of ice are formed, stroy the sections and blunt the knife. araffin process, which is the most scientific method yet devised, the material is first solute alcohol for at least some hours. It ansferred to pure chloroform in a small and shreds of hard paraffin added from ime until no more will dissolve. The then placed in a warm chamber provided hermometer and a Page's or other auto-ice for maintaining any desired tempera-ch in this process must not deviate greatly side of 130° F. More paraffin is now til no more is taken up, when the chloro-vly evaporates, and at the end of the ıe whole forms a solid mass. The tissue bsolutely interpenetrated by the paraffin istological elements are firmly retained *in* he block is removed from the surrounding n the form of a small cube, and may be ce or kept indefinitely in this condition. ng sections of material prepared in this ıo instrument equals, in my opinion, the e rocking microtome. For imbedding in prepare a very thin solution of this sub-equal parts of absolute alcohol and d ether, sp. gr. ·717. The tissue is trans-om absolute alcohol to this, and small of celloidin added daily until it becomes s syrup. It will require frequent stirring, d be kept in a moderately-warm place in a ered, wide-mouthed bottle. Make a paper r larger than the specimen, and fix the lesired position for cutting by a couple of fill up with the thick solution, avoiding s, and place in a quantity of methylated ength about 80°. In this it becomes t and as firm as boiled egg-albumin, when for cutting; this, however, is best done rit with a special microtome made on pur-tions stain well in Ehrlich's hæmatoxylin urrounding celloidin also, but this can be out by the mixture of ether and alcohol. lescribed these processes as briefly as but, as it is, it will occupy considerable cannot, however, let pass without protest " assertion, on page 252, that "when we best microscopes we have to go to for them." Who are "we"? I for one e to be offered the choice between a nd Lealand and a Zeiss, and as for ! Zeiss's objectives are admirable, more the higher powers, but the brass work, ting, and fitting on many of the Conti-ınds I have come across would be repu-a self-respecting gas-fitter.

**A Demonstrator of Physiology.**

## STAGES FOR STUDENTS' MICROSCOPES.

—The question between Messrs. Watson 251) and myself (31772, p. 228) relates to ıbility or not of retaining the pivoting of the mechanical substage in their Student's Microscope, as shown in the y reproduced with letter 31741, p. 207. t to the numbers of these microscopes sold ıat the system must be good; whilst I, on hand, point to the mechanism itself in the system is bad, and I will explain my

f aim in the application of focussing and novements to the substage is to enable r to adjust the illumination with all accuracy. Experts have long been striv-ılarise the fact that unless a mechanical provided the student is placed at a serious disadvantage, for he cannot otherwise get the best work out of his optical battery.

In the most perfect microscopes hitherto constructed, no efforts have been spared to make the mechanical substage thoroughly substantial and accurate, and its attachment to the main instrument as rigid as possible; hence the outlay on the substage is a large item of the total cost of these instruments.

In the less perfect microscopes, which are also less costly, less expensive forms of mechanical substages have to be applied, and as the outlay is reduced, the construction naturally reaches a lower grade of general stability, until finally, in order to cut down the cost to the lowest point, the optician gives up the substantial connection of the fitting with the main instrument, and attaches the substage to the under face of the stage proper by a screw-pivot, as shown in Messrs. Watson's figure. The prime motive for adopting the pivoting system originally—I do not say the prime motive of Messrs. Watson, but of the real originators, the French or German manufacturers of low-class microscopes for toy-shops, &c.—was to reduce the cost, for the attachment is of so inexpensive a character that I suppose it may be done for a shilling, and then carry a profit of 50 per cent. Such a system may be tolerable in toy microscopes, where the substage is intended as a mere diaphragm carrier, and it was formerly much in vogue even for dissecting microscopes as made by Chevalier and others; but when the substage has to carry centring arrangements on a rack-and-pinion movement on a tail-piece, the whole purpose of these appliances is frustrated by the speedy development of "wobble" and general instability that disgust the critical worker.

Good substage appliances are most essential adjuncts for all serious work, and they merit that the substage shall be soundly and substantially attached to the microscope, with reasonable assurance that the condenser, &c., shall focus and centre accurately in the optic axis of the microscope with the minimum of collimation error. These are the well-known conditions that should guide the optician in the application of an efficient substage to a student's microscope; and they are not properly met by attaching it to the stage proper by a pivoting arrangement such as that figured by Messrs. Watson.

The student cannot too soon learn that the firmness of his mechanical substage, its rigid attachment to the microscope, either by a tail-piece or other fitting, is infinitely more important in practice than the liberty of swinging it aside. He may take it for granted that the construction of his low-priced substage will be quite unsteady enough in itself without the addition of a pivoting motion.

As to the pivoting system being recommended by Messrs. Watson's medical patron at "Modern Athens," that fact suggests to me only the probability that the recommendation is based on very limited experience of high-class work; whilst their own approval of it, according to the tone of their letter, seems largely due to commercial reasons which are not in my province to discuss.

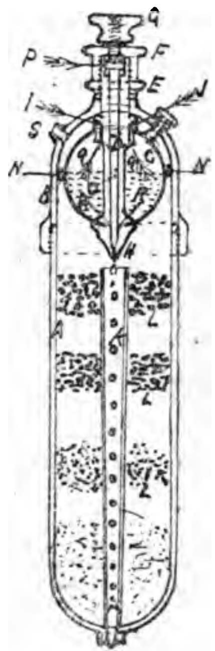
I condemn the system on its merits as totally unfit to be combined with a mechanical substage. I see in its application only the evasion of the recognised good and durable methods of attaching the substage to the microscope which are adopted wherever such matters have been seriously aimed at.

We have had, in all conscience, enough with overmeasure of inferior constructions of students' microscopes; let us now aim at something altogether better.

**Microscopist.**

## AUXILIARY POWER FOR TRICYCLES.

[31822.]—Compressed Air and Gas.—Some of "ours" have gone as far as proposing that we should come to some arrangement to compress air when on a level track. Now, they really could not have looked at this seriously. And to store this power in a receiver to help us up the inclines, they really could not have any idea of the work cut out for them. Now, we will say here is a reservoir, a tube, 3½in. diameter, 18in. long, of steel tube, $\frac{3}{16}$ thick. This will stand a pressure of from 3,000lb. to 4,000lb. per square inch, so it will be safe enough at 500lb., that is as little as we can do with to be of any use; and very little use that would be —the weight of that would be about 10lb. to 12lb. Now, two pumps 2in. diameter would be out of the question. Suppose we say two 1¼in. diameter, and 5in. stroke: I think that this will be as much as we shall be able to manage. Now, the most economical way of compressing air is by water; but even then there will be a loss of from 10 to 15 per cent., all things in working order. But for dry pumping you may safely count upon a loss of 40, if not more, hug things as close as you like. Now let us see what work we have cut out to get a charge of 500lb. per square inch. They must be single acting—i.e., rams. You will never be able to work double-acting pumps. Now, area of reservoir 9·621 × 18 = 173 square or cubic inches—we will drop the fractions; area, or rather cubic capacity of pumps, 12·27c.in. If you could take a full and discharge a full charge of air at every stroke, you would have to make between 400 and 500 revolutions; but from loss you would have to make about 700 to get a charge of 500lb. to the inch. Now, when we have got it we will want to economise it, and shall want a reducing valve to regulate it, so that we may use it at 70lb.; and suppose that we have an arrangement that we can use the pumps in return for driving power, what shall we get? About charge sufficient for, say, 88 or 90 revolutions. Now how far will that carry us over or up an incline? Not far, I am thinking, after all our slavery, for that is what we should find it, I am thinking. Now, suppose we have the means of charging this reservoir with compressed gas—i.e., coal gas, or air gas, or hydrogen—up to the same pressure, what could we do with it? Could we let this out at a cubic inch at the time, at about 10lb. pressure, or, say, 5lb. above the atmosphere, or even less than that, and mix it fit for explosion at the rate of about one of gas to eight or nine of air, and use two 2in. cylinders? How far would that go? But then there is, How are we going to get the charge compressed in the reservoir? Can we get it made up ready for use, as the oxygen is done for the lamps now, and depots about the country to supply it, that one might unship the exhausted one and ship another? Then, again, Shall we make our own gas, and how? And, again, can we get anything effective out of a thing so small in the gas line? This is what I have sketched the little experimental affair out for and submitted to you, to see what I could learn from those who would feel interested enough to try it. A great deal might be got at by that simple arrangement, both in coal-gas, hydrogen, or carburetted air, and until some experiments are tried, and we know the result, we cannot move in it. What I have put forth will, I have not the least doubt, set many thinking. Well, now, gas again. What about making our own gas on the road, as we use it? You will say, How is that to be done? Well, easily enough, and as simple as A B C. Shall it be an explosive gas? Well, I think not, in one sense, although it is in another; it is not an ignitable gas. We might generate hydrogen; but that would need metal and a corrosive acid. What do you say to carbonic acid gas? This would need no metal, in one sense, or corrosive acid. What do you say to acetic acid? With this we could do, and hard grey chalk, or free chalk, common washing soda, put upon a shelf in the fireplace, until it disposed of its water, or bichromate of soda, and after it is saturated this had no need to be wasted, as acetate of soda is marketable, and can be manufactured over again with refuse sulphuric acid into sulphate of soda and acetic acid. Now, in dealing with these agents, we can get enormous power at a moment's notice, we must not forget that a thousand pounds per square inch can be generated in a very little time, so that it wants careful manipulation; and again it is dangerous in another way—it is an enemy to all animal life. I could tell you how narrow an escape I had no less than three times; once by experiment and twice by accident; but, like a man when drowning, things pass through his mind like a vivid panorama, and, at the pinch, he realises his situation, and if he has presence of mind and strength to act, well and good; if he has not, well there is nothing for it but to peg out. Well, I have both from immersion where I have been stuck



fast, and, from a fall where I have slid into the water with the wind knocked out of me, managed to put two and two together and help myself when not a soul was near to help me, and here I am yet. Well, that is going from the question at issue. I forward here a sketch for a generator for carbonic acid gas; it is a cylinder of mild steel, such as the oxygen gas is compressed in—bottles they are called by some—3in. inside diameter, 15in. long, and $\frac{3}{16}$in. thick. This is capable of standing between 3 and 4,000lb. per square inch. It has a cap screwed on. This is made of malleable cast-iron, Mitis metal, or mild steel; in fact, it should all be well annealed. The top has three bosses cast on; the centre one, the feed-screw and valve arrangement, comes through; on one side boss the tube from the acid chamber comes, that it may be replenished, and is fitted with a brass screw-cap, and the other is to take off the gas and is connected to the wash-bottle to free it from acid, and from there it passes through the reducing-valve to the engines, the reducing-valve being adjusted to 90lb. per square inch. Now for sketch. A is the cylinder mild steel $\frac{3}{16}$in. diameter, inside 3in.; B is the cap; C is the acid-chamber, vulcanised india-rubber ball with a neck to it that comes out at V. This is for feeding the acid or replenishing it. The arrow shown there and at I shows two of four holes in the valve and shell that communicate with the inside of acid-chamber and generator to keep up a balance that no pressure come upon it to liberate the acid; S is another boss. This is where the connections are made to take the gas to the wash-bottle; N N are lugs of rubber put upon the ball to let the gas pass and keep the ball off the sides so that all shall be free; E is the lock nut that fixes the said valve and chamber in its place. F is a cap with packing that screws upon the same, and keeps the needle tight. G is the knob upon the needle that actuates the valve—this valve is so arranged that its lift is limited—see P; Q Q is showing where the holes for balancing the pressure come into the chamber; O is the acid, and in the bottom of valve shell R R is shown two of four holes that let the acid down to the cone H when the needle D is raised; K is a tin tube, perforated, that slips on a pin at the bottom; the stud or bolt M to which the pin is shown may be made large enough to discharge and wash out, if needed, supposing you use chalk granulated; L L L is showing how it is disposed of, the finest at the bottom, then the next largest, then the next larger, until the top may be as large as beans. But, I think, that if used for cleanliness, &c., soda bicarbonate will carry the day, as I think it can be got in the market for something under 2d. per lb., the rubber ball being of that rubber that the children's balls are made of; 2⅝ internal diameter would probably hold 6 or 7oz. of acid. Now is there any of ours that can tell how many cubic feet of gas can be generated at atmospheric pressure with this per lb. of carbonate, that we may know what to expect? C A = C O in chalk for weight, are they not? What is the weight per cubic foot?

The next will be acid chamber, reducing valves, snifting valves for the various purposes, and wash-bottle.

**Jack of All Trades.**

## DYNAMOS: CALCULATIONS FOR WINDING.

[31823.]—If you had read the sixth edition of my book, "The Dynamo: How Made, and How Used," you would have known all you now ask. For your sake, and for the sake of others who have not read the book, I condense the main rules for dynamo-winding. In the first place, it must be remembered that, owing to the usual slack winding of the amateur, it will not be likely that he will get more than 1 volt out of each yard of active wire on the armature at an angular velocity of 1,250ft. per minute. The angular velocity is obtained by multiplying the circumference of the armature by the number of revolutions per minute. Starting, therefore, with the assumption that the speed will have to be 1,250ft. per minute, and that we are going to use one yard of active wire for each volt, the first question becomes: What voltage do we require? In your case, 60 volts, or, allowing for loss of potential in leads, &c., say, 65 volts. The next question is: What form of armature? If the armature is of the drum or shuttle form, and the length is three times the diameter, the dead wire, which lies at the two extremities or "heads," should not exceed ¼ of the total amount of wire laid on the armature; hence 65 + 21⅔ = 86⅔, or, say, 87 yards for the sake of round numbers, is about what will be needed to give the 65 volts. But if the armature is of the ring type, and especially if it is a rather flat ring, the amount of wire which is inactive will be much greater, certainly more than half the total amount, and nearer three-quarters. Hence, for a ring-type armature, the amount of wire to give 65 volts should not be less that 152 yards. Now the next question in your case is: What must the circumference of armature be to get an angular velocity of 1,250ft. per minute, at only 1,000 revolutions per minute? A simple rule of three sum gives us 1,000 : 1,250 : : 1 : 1·25, or the circumference of the armature should be 1ft. 3in. In other words, an armature 4¾in. in diameter would fulfil the requirements were it not that there would not be sufficient space on it to wind the 152 yards of wire on it of the required gauge if it were of the ring type, unless it were made inordinately long in proportion to its diameter. If the armature were shuttle-shaped or drum-shaped, from 4¾in. to 5in. in diameter, and about 15in. long, it would answer very well. But for a ring-shaped armature, to avoid having to wind on many layers, it would be advisable that the armature were not less than 8in. in diameter, and 12in. would give greater facilities for winding. The next consideration is the gauge of wire to be used for winding. There we must be guided by the number of ampères we require, both for the outer circuit and for magnetising the field-magnets. In your case, let us say 35 ampères. On referring to a copper-wire table, we find that No. 9 will carry safely this current, if the whole current passes through it. This is the case with the shuttle armature only: in the case of the drum and ring armatures, as the current divides itself between the lower and upper coils, the amount of current passing at any time through the wire is only half the total output; hence a wire carrying 18 ampères will be ample for the purpose. This is found in No. 12. Therefore, to wind a shuttle armature to 65 volts, 32lb. No. 9 would be required, while 16lb. No. 12 would suffice in the case of a drum or ring armature. As to the field-magnets, if they are to be series-wound, the resistance should be two-thirds that of the armature; if shunt-wound, 400 times; if compound-wound, the series coils should have the same resistance as the armature, and the shunt coils 300 times. It must, however, be borne in mind, in calculating these resistances, that in the shuttle armature the resistance of the armature coils is equal to that of the entire length of the wire, whereas in the drum or ring form, owing to the two circuits being open, the resistance is equal to only ¼ the total length of the wire. Hence, since No. 9 has a resistance of 0·008 per pound, the 32lb. on a shuttle armature would have a resistance of 0·246 ohm. In a ring or drum armature the 16lb. No. 12 would have a resistance of only 0·12. The gauge of wire used for winding the F.M.'s of a series machine may conveniently be four sizes larger than that on the armature; while for a shunt machine it should be four sizes smaller. The same proportions hold good in the case of compound-wound machines. In these latter, however, owing to the space taken up by the series coils (which should be laid on first), the shunt coils may conveniently be six sizes smaller than the wire on the armature. Your engine-power is ample for 30 lights.

**S. Bottone.**

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The manufacture of cement has grown in Germany during the past 25 years so rapidly that at the present time the annual output is estimated at 10,000,000 barrels, worth 70,000,000 marks. The chief seat of the industry is North Germany, in the vicinity of Berlin, Stettin, and Hamburg. The export trade has increased from 137,000 kilocentners in 1879 to 1,341,300 kilocentners in 1889.

**Surveying by Vertical Angles.**—In a communication to the Institution of Civil Engineers, Mr. Wilfred Airy, B.A., M.Inst.C.E., gives an account of some experiments he has recently made on the probable errors to be expected in surveying by "vertical angles." In this method of surveying the distance of a staff from an observer and its level is determined by means of two observations on an ordinary theodolite. The staff has two or three bold, well-defined divisions painted on it at known heights, and the distance is determined by sighting the telescope of the theodolite first on one division and then on the other, and noting the two vertical angles. The level can be deduced from the same observations. The work can be effectually done with a 5in. theodolite, and though the office work is somewhat heavier in reducing the observations than with a tacheometer, the field work is somewhat lighter. In order to try the method fairly, Mr. Airy set out twenty-four stations in Greenwich Park, forming a circuit of rather more than 1¼ mile, and determined the distances and levels of these stations on four different days, and under different conditions as to weather, the instrument used being an ordinary 5in. theodolite. The staff was an ordinary level staff, which was, however, fitted with a small circular level to guide the staff-holder in keeping it level. The ground was very favourable for trying the method, as some parts were steep and others level, and there was a rise and descent of 118 in the complete circuit. The stations were from four to six chains apart, and the theodolite was set up at alternate stations, so that the reading distances also varied from four to six chains. After the fourth set of observations had been obtained, the line was carefully chained and levelled, and on comparing the results of this with former observations, it was found that the probable error of distance amounted to 3·64ft. per mile, and in level of 0·33ft. per mile. By shortening the sights both these errors can be largely reduced.

# REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[71802.]—**Claude Lorraine Mirror.**—This query appeared some months ago, and has been answered, but, I think, not correctly. The glass is, I believe, not intended as a help in the drawing of the picture, but in the colouring of it, and also as a guide in the choice of what is likely to make a pretty picture. I made one some years ago, or rather, had one made, as follows: A convex glass, about 4in. in diameter, or larger if preferred, such as are used for covering the faces of timepieces, black varnish concave side, and put it into a light frame with a handle. It is much the same as a convex mirror, only the convexity should be much less, or it will distort the perspective. The black back is supposed to represent the colours of nature more truly than a silvered one.

E. G.

[72168.]—**Electric Bell and Battery.**—Having read the replies hereon, perhaps the writers will kindly aid me in the following difficulty: In a bell installation I have been maintaining (put in by another firm) there has been electrolytic action at one terminal of each of the pushes on the ground-floor of the house, and early this year I covered these terminals with guttapercha, and, with the exception of two instances, I have had no further trouble with these, so far. There is no apparent dampness in the house itself, though in a damp situation, neither is there the slightest leakage to be discovered through detector galvanometer. The ground-floor pushes have all brass exteriors, and it has occurred to me that the metal occasionally causes condensation in the push when the air is moist, a slight temporary leakage from one terminal to the other is set up, and causes corrosion of one of them. Is this likely? Added to this, one of the wires running to a bedroom pressel has now given out. Two unsoldered joints, insulated by guttapercha, had been made on each wire to lengthen them, and these two wires ran along a joist under the roof, well separated, not the slightest damp being visible, but only the usual lime-dust about. On uncovering, all four joints were perfectly sound; but one wire had corroded right through in one place where the guttapercha met the cotton and rubber insulation, and similar action had begun in a similar position, just off the other joint on same wire. I have used Chatterton's compound in covering the new joints. Will this compound have any effect in corroding the wires, as I have heard that guttapercha has a bad effect on wires when tinned, as these are? What else can be the cause? I fear I may find the same destruction going on in other wires, and of course I am anxious to prevent this. As these points seem to me to bear upon the present discussion, I shall be glad to receive any information tending to prevent further annoyance from the bells ceasing to ring.

F. B.

[72341.]—**Driving Mechanism for Tricycle.**—The method suggested by "Cycloid" is not altogether new, for I remember a similar arrangement being tried eight or ten years ago. It was a failure. The loss in friction is considerably greater than "Cycloid" thinks. What does he mean by saying there is nothing for the dust to stick to? If his racks and pinions are exposed, of course dust will stick to the teeth of same and generate friction.

A. F. Shakespear.

Maternistrasse, 3 Dresden.

[72428.]—**Bookbinding.**—I was rather amused when I read D. Blackburn's remarks on the above. I must confess I have never seen book-edges filed, nor would I like to try the dodge. However, better that than have them rough; if he would finish off with a steel scraper, he would have them quite workmanlike. About cutting with the knife—it can be done; but it requires a great deal of care and patience to do it properly. In some shops binders have a great deal of practice with it in cutting indices. I have seen large hand-made super-royal account books with over 1,000 pages indexed through, and of course these had to be cut with the knife and straightedge, and when finished with a piece of sandpaper (we could not scrape them) looked almost as smooth as if cut with the guillotine. Of course amateurs are always at a disadvantage, as they have not the practice of ordinary workmen. Many thanks, D. Blackburn, for your appreciation of my articles.

Practical Bookbinder.

[72457.]—**Petroleum Burners.**—Sorry I misunderstood "Perfect Combustion," but if he will refer to his query on p. 110, he will find the words "this power" (that is 41c.p., for no other is mentioned), and, as the query reads, he wants a 1in. flat-wick burner to be "as efficient with same quantity of oil." He is "tired of seeking something suitable in shops,"—so I expect I should be; but I have a very good bracket lamp with silver reflector, which gives a powerful light from above

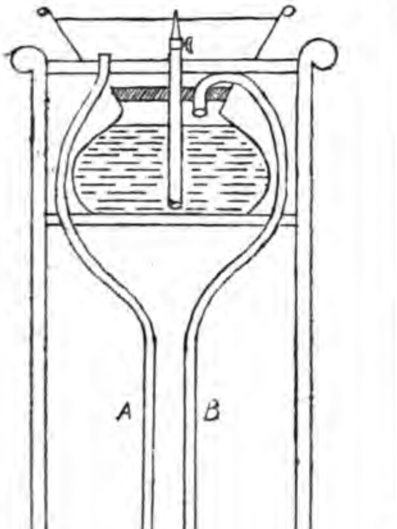
1½in. flat wick, and another with a tin reflector and ½in. wick, which gives a light quite strong enough for most purposes. NUN. DOR.

[72473.]—**Toy.**—In answer to "Simon," the ball holds the lower position, i.e.: If I place it on the table and hold over it the tube as nearly touching the ball as possible, without doing so, then blow sharply—it will attract the ball, and cause it to revolve rapidly. If "Simon" will advertise his address, I will send him one with pleasure.

SIMPLE.

[72578.]—**Sugar-coating Pills.**—If "Maud" knows the ingredients, what more is wanted? The pills are either dipped separately into the mixture of syrup and gelatine and dried rapidly, or they are rolled about in a very shallow bath of the mixture, and dried quickly in a warm room, shaking frequently. C. D.

[72584 and 72588.]—**Fountain.**—I send sketch of "perpetual" fountain. A is a tube leading from the bottom of the dish to near the bottom of the lower globe. B leads from the top of said globe to the top of the upper globe. A third tube leads from the bottom of the upper globe and forms the jet pipe. To set it in action, remove the jet pipe, and having filled the top globe replace it. Now pour water in the dish. It will run down A, and compress the air, which will react on the water in the upper globe, forcing it out through the jet. With regard to the height of the jet, the air in the globes is under the pressure of two different columns of water, that in the jet and in A. The latter is greater, therefore the water will rise (theoretically) to a height equal to the difference in the two levels. In practice it never does so, owing to the resistance of the air. Fish globes can be used for the reservoirs, the mouths being well corked. The size of the pipes is immaterial, ¼ or ⅜in. pipe being large enough. The jet pipe is tapered and regulated by a tap. It can be led through a cork in bottom of basin for easy removal when filling the top globe. B. Brooks is quite right in stating that my former answer is misleading, as it would, if correct, solve perpetual motion. The above is, however, the true theory. I have sketched the fountain to a quarter scale to suit "C. E." CALDEMONE.



[72591.]—**Cupid and the Rings.**—From the description I should imagine that the figure is made to stop just where the attendant pleases. It is most likely a mechanical arrangement, for electricity does cost money. NUN. DOR.

[72596.]—**Light Pony Trap.**—This query is rather a large order, for no one can build even a "light pony trap" without some knowledge of the work. If the querist can refer to Vols. XXXII. to XXXVI. he will find therein some useful articles on the subject, and if his abilities are equal to his desires, he should find no difficulty in building a pony trap from the instructions there given, but really a trade—a skilled trade—is not to be learned *ad aperturam libri*. NUN. DOR.

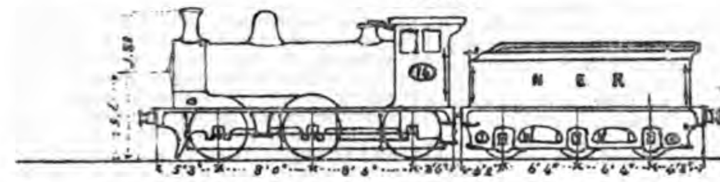
[72600.]—**Electric Bell Clock.**—The necessary details have been frequently given; but as the querist requires the clock to ring the bell at any desired hour, it will be necessary to make the contact piece removable to the hour required. There must, then, be a slot cut all round the dial, or some means devised for shifting the contact piece to the desired hour; then a little wire brush attached to the hour hand will sweep over the contact piece and complete the circuit. One wire of battery must be connected to the arbor carrying hour hand, the other to the contact piece—the bell being in the circuit. Explained many times in back numbers. T. L.

[72606.]—**Protoplasm.**—Did the discovery of protoplasm turn out to be "so great a mistake"? I presume the query has some reference to Globigerinæ, but is of the vague, vaguest. Why does not "J. S. C." quote the actual words of the statement to which he refers? Are readers to hunt them up in order to answer his question?

NUN. DOR.

[72616.]—**Engine Query.**—The questions in this query can be answered only after inspection of engine. T. M.

FIG. I.



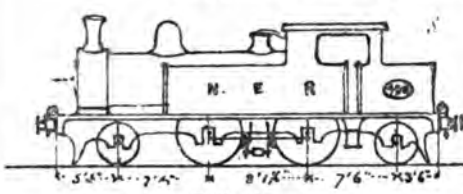


FIG. II

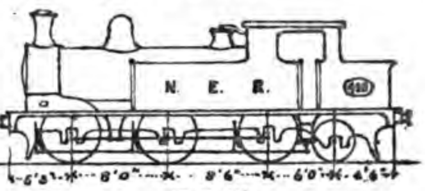


FIG. III.

[72633.]—**N.E.Ry. Locos.**—As this query has been but partially answered, the following outlines to the scale of $\frac{1}{16}$in. to a foot, and the leading dimensions, may perhaps be of service to "A. F." and other readers. Fig. 1 represents Mr. T. W. Worsdell's latest type of six-coupled goods engines. Some of these are ordinary high-pressure engines; but many are compounded on the Worsdell and Von Borries system. Coupled wheels, 5ft. 1¼in. diam.; high-pressure cylinder, 18in. diam.; low-pressure cylinder, 26in. diam.; stroke of both cylinders, 24in.; heating surface — tubes 1026·12sq.ft., fire-box 110·00sq.ft., — total, 1136·12sq.ft.; grate area, 17·23sq.ft.; boiler—length of barrel 10ft. 7in., diameter outside 4ft. 3in.; number of tubes, 203 (brass); 1⅝in. outside diam. by 10ft. 11½in. between templates. Weight of engine:—

| | Empty. | | Full. |
|---|---|---|---|
| On leading wheels. | 11 0 2 | .. | 14 3 2 |
| ,, driving ,, .. | 15 0 0 | .. | 15 10 0 |
| ,, trailing ,, .. | 13 6 0 | .. | 12 3 0 |
| | 39 6 2 | .. | 41 16 2 |

The valve-gear is on Joy's principle, and is reversed by a wheel and screw on the right-hand side of the foot-plate. The engine is fitted with a hand-brake, a cast-iron block acting on each of the six wheels. The wheels of the tender are 3ft. 9¼in. diam., the capacity of the tank 2,650 gallons, the coal-space four tons. The tender is fitted with a hand-brake, similar to that on the engine. Weight of tender:—

| | Empty. | | Full. |
|---|---|---|---|
| On leading wheels. | 6 2 0 | .. | 10 10 0 |
| ,, middle ,, .. | 5 14 0 | .. | 12 14 2 |
| ,, trailing ,, .. | 5 10 0 | .. | 9 14 2 |
| | 17 6 0 | .. | 32 19 0 |

Fig. 2 is a passenger tank engine, built at the Company's works, Gateshead, from the designs of Mr. T. W. Worsdell. It will be noticed that it is very similar to those he built for the Great Eastern Railway, when superintendent of that line. Leading wheels, 3ft. 9in. diam.; coupled wheels, 5ft. 7in. diam.; trailing wheels, 3ft. 9in. diam. Leading and trailing wheels are fitted with radial axle boxes. Cylinders, 18in. diam., 24in. stroke. Heating surface: Tubes, 994sq.ft.; fire-box, 98sq.ft.; total, 1,092sq.ft. Boiler: Length of barrel, 10ft. 7in.; diameter outside, 4ft. 3in.; weight of engine, 54 tons 2cwt.; capacity of tanks, 1,241 gallons; coal bunker, 2 tons. The engine is fitted with the Westinghouse automatic air-pressure brake, also Joy's valve-gear. Fig. 3 is a goods tank locomotive. Some engines of this class are compound, and others ordinary. Six-coupled wheels, 5ft. 1¼in. diam.; trailing wheels, 3ft. 9¼in. diam. Cylinders of compound engine: One high-pressure, 18in. diam.; one low-pressure, 26in. diam.; stroke of both, 24in.; cylinder of ordinary high-pressure engine, 18in. diam. by 24in. stroke. The heating surface, grate area, and boiler are identical with those of the six-coupled goods locomotive described above. The working pressure of the boilers of all three classes illustrated is 160lb. per square inch. The engine is fitted with a hand brake. The valve-gear is also Joy's. This class was built at Gateshead, from the designs of Mr. T. W. Worsdell. Capacity of tanks, 1,241 gallons; of coal bunk, 2 tons 14cwt.; centre of boiler from rails, 7ft. 5in. Besides these tank engines there are some small six-wheeled, all coupled, as No. 299, which have also been quite recently built, and some older classes by Mr. E. Fletcher and others.

Glasgow. METEOR.

[72699.]—**Indicating.**—To "W. S., LIVERPOOL."—Will you excuse another set of diagrams, as I only get a set when the insurance company will take me a set extra? You want more particulars. Diameter of h.p. cylinder, 18in.; diameter of l.p. cylinder, 29½in.; stroke, 5ft.; revs., 60—the engine is tandem, with ordinary valve and back-slide cut-off in h.p. cylinder; clearance in the h.p. cylinder, 1½in.; and clearance in l.p., 2in.—will have to estimate the steam ports. Initial pressure, 65lb., will take the exhaust to close at 6in. from end like the opening. Other things as per original query. Will you please say how I could make the low pressure do its share of work? Also, should I take your first reply to be correct if they were a simple h.p. engine exhausting into the air and the l.p. engine a single cylinder? Thanking you for the past, and in anticipation for the next—

YOUNG ENGINEMAN.

[72722.]—**Paint for Model Loco.**—Mix your colour with japanner's copal, and you will get what you want. A. F. SHAKESPEAR.

Maternistrasse 3, Dresden.

[72728].—**Pottery Painting.**—If you have any desire to become acquainted with the art of pottery painting, I should be very pleased to lend you a book on the subject for amateurs, but there is no satisfactory method of producing any permanent effect by merely "painting" on the article: it is a large art in itself, and requires no little amount of application before success ensues. F. VARLEY.

Gülcher Electric Works, Battersea.

[72735.]—**Barometer.**—No thumb or plug of any kind is wanted, because the flask is inverted, and contains only air. If the variation is due to temperature, why does it (to-day) amount to one inch and a quarter? Of course at first the water in the neck of the flask is depressed, and the level gradually rises and falls. My difficulty is this: the air outside and inside the flask must closely resemble each other, and yet the water column attains this height. F. W. C.

[72735.] — **Barometer.** — "Nun. Dor." is altogether wrong in saying the flask should be filled with water and inverted in the jar, the same way as a standard barometer. This would hold good if the neck of the flask were 30ft. long, when he would have a veritable water barometer. The question was "Why does the water rise and fall in the neck of the flask?" The answer is "As the pressure of the atmosphere increases, it compresses the air contained in the flask, and this is rendered visible by the rise of the water in the neck." With a decrease of pressure the air expands and the surface falls. It also acts as a thermometer, for with an increase of temperature the air in the flask expands and down goes the water, and a lowering of temperature will send it up. The only way to make it somewhat useful is to fit a sliding scale to the neck of flask, and then by means of a thermometer adjust the scale to the temperature and read off the level of the water as you would a barometer. The adjustment of the sliding scale can only be arrived at by experiment. So many errors creep in that at best it can only be called a toy. I agree with "Sm." and "B.Sc." E. PARR.

[72750.]—**$CO_2$.**—In order to estimate the amount of this gas in the air of a room, we require the following apparatus and solutions. (1) A wide-mouthed glass-stoppered jar or bottle of four or five litres capacity, to contain the sample, the content of which must be accurately measured and scratched on the bottle. (2) Some sort of bellows to change the air in the jar for that of the room—preferably better to suck the air out of the jar, and allow air of room to flow into it. I rigged up an excellent bellows for this purpose out of an old concertina by substituting wooden ends for the reeds, with a long tube at one end to go down into the jar, with suitable valve opening inwards, and valve at handle-end opening outwards. (3) 50 and 25 cubic centimètre pipettes. (4) Burette, 50 cubic centimètre, graduated in tenths, with stand and clamp. (5) A 4 or 6oz. flask, with stirrer. (6) A thermometer (Centigrade). (7) A standard solution of crystallised oxalic acid $C_2H_2O_4 \cdot 2H_2O$, containing 2·8636 grams to the litre. (8) A saturated solution of barium hydrate, pure and free from soda. (9) Some strips of turmeric paper. The first operation is to standardise the baryta water. Take 100c.c. of the saturated solution, add to it 500 or 600c.c. of distilled water, and shake well. Fill up the burette to the mark with standard oxalic acid; then take 25c.c. (with the pipette) of the diluted baryta water, and run into the flask. Now you must add the oxalic acid to the baryta until a drop taken out with the stirrer and applied to the turmeric paper, no longer gives a red stain. This must be done very carefully, adding the oxalic acid in drops towards the end of the reaction. The red stain must just disappear, and several trials with fresh quantities of the solutions are necessary in order to insure accuracy. Having got this done, we label the baryta solution 25c.c. = so many c.c. of oxalic acid, or take an actual case from my notebook, 25c.c. were equivalent to 25·6c.c. of standard oxalic acid. In order to make a determination, we take our jar, which must be dry, into the room, along with bellows, standardised baryta, and 50c.c. pipette. Place the jar in the required position, generally 3 to 5ft. from the floor, insert the bellows, and give 20 or 30 strokes so as to make sure of complete change of air; then, with the pipette, measure out and run into the jar 50c.c. of the baryta water, insert the stopper, and note the temperature. Remove to the laboratory or room where the analysis is to be made, and shake up the liquid with the air in the jar for about five minutes; allow to settle, then withdraw 25 cubic centimètres with your pipette and run into the titration flask, which, of course, has been previously well rinsed out. Fill up your burette to the mark as before with standard oxalic solution, and add as before to the baryta in the flask until the red stain or turmeric just disappears. You will then find that not so much oxalic solution is required as when standardising, as the $CO_2$ in the sample of air has neutralised a portion of the alkali. Let me now quote an actual analysis:—Capacity of jar, 3·460 litres; but deducting 50c.c. for the volume of liquid used in the jar, we have an actual capacity of 3·41 litres; observed temperature 1·6° C. Now, 25c.c. of $Ba(OH)_2$ were equal to 25·6c.c. of oxalic acid; but, on titrating 25c.c. of $Ba(OH)_2$ shaken up with this sample, we only required to use 24·4c.c. of oxalic acid. Subtracting this from original value 25·6—24·4 = 1·2c.c. of oxalic acid. Now, this is equivalent to half the $CO_2$ in the sample as we withdrew only half for titration, so that 1·2cc. requires to be doubled, giving us 2·4c.c. of oxalic acid the place of which has been taken up by the $CO_2$ in the air. Now 1c.c. of our oxalic acid is equivalent to ·001 gram of $CO_2$, and 2·4c.c. will consequently be equal to ·0024 gram. Therefore, 3·41 litres of air at 1·6° C contain ·0024 gram of $CO_2$. But 1 litre of $CO_2$ at 0°C and 760m.m. = weight of litre of hydrogen × density of $CO_2$, or ·0896 × 22 = 1·9712 gram. Therefore, ·0024 gram $CO_2 = \frac{\cdot 0024}{1 \cdot 9712}$ = ·001217 litre, and correcting for temperature, we have $\frac{\cdot 001217 \times 274 \cdot 6}{273} = \cdot 0001223$ litre of $CO_2$ at 1·6° C in 3·41 litres of air. Representing this in volumes per 10,000, which is the usual expression, we get $\frac{\cdot 001223 \times 10{,}000}{3 \cdot 41} = 3 \cdot 59$ vols. per 10,000 of air. If "H. S. M." has had any training in chemical manipulation, the above operations should easily be carried out. Of course, the calculations involved can be reduced to a factor for each jar, for each degree Centigrade, so that one has only to multiply the factor for the jar in question by the number of cubic centimètres of oxalic acid which have been replaced by the $CO_2$ in the sample.

J. FOGGIE, F.C.S.

[72761.]—**Self-Polishing Blacking.**—Is there anything of the kind except those preparations which leave a film of shellac coloured black on the leather, and do that more harm than good? I should like to ask Mr. Stanley, Analytical Chemist (p. 253), whether he has ever tried the recipe he gives, and whether he has found it successful? The most frequently adopted formula was given in the "E.M.," Vol. XXIX. p. 520. I may also ask "Pharmacist" (p. 253) whether he has tried the recipe he quotes from a patent specification. I will look it up shortly and see whether it is still a "patent." NUN. DOR.

[72764.]—**Insomnia.**—Constitutions and temperaments differ so greatly that individual experience is of little value in the way of general advice. Having suffered to a serious extent from this distressing malady, my experience may count for something should the querist chance to possess anything in common with myself. In the first place, the effect of alcohol in any form, hot or cold, was dubious; sometimes it appeared to favour a better night but equally often failed. The same experience applied to tobacco and to a meal taken shortly before resting. I am inclined, however, to favour the abstention from both alcohol and tobacco, or that a fair trial should be given. Tea or coffee were found decidedly objectionable in the long run, though seemingly acting as palliative at times, and I am sure that with many constitutions they are often more injurious than a moderate use of alcohol in causing insomnia. Drugs, even if effective at first taking, were found worse than useless afterwards. The usual hackneyed remedies were found of no avail. Washing before retiring, even if only the face and hands, especially if in cold water, was found very objectionable by freshening up the system instead of inducing sleep. Sometimes a change worked wonders; at another time no more relief was obtained when sleeping (or trying to sleep) in a country place than in a busy London thoroughfare. The following, when persisted in, was found by far the most successful treatment. To endeavour to tire out the body before retiring by walking or other exercise in the open air, so as to induce sleep by a partial physical exhaustion of the system, limiting, at the same time, the period devoted to rest to five or six hours—say retiring at midnight and rising at five or six, with or without having had any sleep. The first part of this treatment is manifestly unsuited to all constitutions. I believe I shall not be much in error in making the general statement that a harmless hobby—silly or otherwise, not necessarily physical or unintellectual, but something different from one's ordinary occupation—is often of great value in these cases by diverting the attention of the brain from itself and from one's own malady, tending to raise it out of the usual rut of thought. Reading oneself to sleep by a short piece of agreeable literature not requiring any serious thought has often been found of most effective assistance. Fresh air, in whatever weather or season, is a great inducer of sleep, and in addition to breathing all possible during the day, the bedroom-windows should be as wide open as weather will allow during the night at both top and bottom in all seasons. I am confident that if the querist will examine himself and analyse his own habits, giving the most natural treatment the fairest trial, he will be more likely to succeed in mitigating, if not curing, his malady, than by consulting the physicians of the world. A. MARSON.

[72766.]—**Morse Key.**—I am afraid Mr. H. Wilson has misunderstood my query. If he will favour me with a sketch of the under-side of the key-bed, showing how the wires are connected between the terminals and the bridge of the key, I should feel obliged. Should he prefer communicating with me, I have advertised my address in the Address Column, and shall be glad of his assistance. CESTRIAN.

[72778.]—**Cancer.**—Some time ago Lady Paget gave an account in the *National Review* of wonderful cures of cancer effected to her personal knowledge by Count Mattei's medicines, and considerable interest has in consequence been taken in the matter. Mr. Alfred W. Stokes, public analyst to Paddington, Bethnal Green, and St. Luke's, has analysed Count Mattei's "Electricities," and the results have been communicated to the current number of the *Review*. The samples were labelled "Elettricita Bianca," "Elettricita Verde," and "Elettricita Rossa." He states that to find if they possessed any special electrical properties, they were placed singly in thin glass tubes; these tubes were suspended by silk filaments. Under such circumstances an electrical body would point one end to the north and the other end to the south. Not one of them came to rest in such a position; neither were they attracted by a magnet, as an electrical body would be. Hence, they certainly are not electrical. To delicate test-paper they were perfectly neutral. Vegetable extracts are usually either alkaline or acid; even if neutral when fresh, they speedily change. Mattei's preparations had the following characters:—Colour, odour, taste, polarity, metals, and alkaloids, none; specific gravity, 1·0006 Bianca, 1·0002 Verde, 1·0002 Rossa; solid matter per cent., 0·01 in each. The microscope showed an absence of any floating particles or sediment such as are usually present in vegetable extracts. There is but one substance which possesses all the above qualities—that is water. None of the above preparations differ at all from water in any of their properties. PHARMACIST.

[72778.]—**Cancer.**—Strangely enough, I had been cogitating over the possible advantages that might be obtained from the use of the onion as an external application over the linseed meal I had generally used for external cancer. I do not look for such advantage from the ultimate principle—sulphate of allyle—as from its reputed and most valuable quality of attracting and absorbing all prevalent and infectious matters, and more particularly the slimy mucus which collects in the process of vital action and degeneration, clogging the viscera and impeding their functions. Hence its value in obstructions of the lungs, kidneys, &c. It is in this way that it might be of value in cancer of the stomach, in acting upon and resolving the "schirrous" (or leathery) lining of that organ, and absorbing and carrying off the "colloid" (sizy) matter out of the system. For external cancer it might not be so suitable, unless it were "open" cancer, or would cause the "hard" cancer to "gather" and discharge. For if it only dissolved the tumour, the colloid products would have to be taken up by the venous or lymphatic systems, and thence be re-deposited in the interior structure, or be carried to the throat, and so cause more serious complications. These complications the "diet" use might obviate, but I cannot say, as I have no experience of its use in that way. But I should strongly advise the cooking of the onions—boiled in a very little water and mashed up for external application, and stewed or fried and eaten freely as a vegetable, or for an early supper. If the stomach were ulcerated (open cancer), this would be both soothing and healing; while, eaten raw, the extreme pungency might cause severe pain and irritation, perhaps bleeding. If the latter, chew some oak bark and swallow the spittle. With these cautions I think the trial might be made with safety, and be productive of much relief—certainly not of harm. But the disease is one so Protean in its nature and development as to make advice difficult without some personal knowledge of the case and its features. But I have made the disease a study of many years, have both palliated and cured in several difficult cases, and six years ago had a five months' experience of a very serious phase in myself—so I speak with confidence. So should querist experience any doubt or difficulty in the course of his experiment, I shall be pleased to place my knowledge and experience at his service, if he will address to 118, Rushmore-road, Clapton, N.E.

S. D.

[72786.]—**Model Marine Boiler.**—If you make boiler 7in. long, 4in. wide, 5in. deep, with furnace 5in. long, $2\frac{3}{4}$in. high by $3\frac{3}{8}$in. wide, it will burn charcoal, and is about the smallest size that will. Nine or ten $\frac{3}{8}$in. or $\frac{7}{16}$in. tubes 2in. long are between furnace and smoke-box. I have one of the above dimensions, and it burns and steams well. I have also used spirit in it. A. F. SHAKESPEAR.

Maternistrasse 3, Dresden.

[72789.]—**Diamonds.**—Yes, from compressed carbonic acid, such as is used for the new Giffard gun, but more compressed. The resulting diamonds at present very small, but still diamonds, as the shape of the crystal shows. "Nemo" asks as to the natural formation of a diamond. I suppose he means—does it grow, or is it of sudden crystallisation, so to speak? I incline to the latter view. So with crystals of silica or flint, and in this case I cannot understand the flint breaking with a conchoidal fracture if the flint crystal has grown by successive layers. This might be the case if the crystals were formed instantaneously, as crystals of *glacial* acetic acid are formed—i.e., instantaneously.

Z. Y. X.

[72789.]—**Diamonds.**—The most widely-accepted opinion as to the origin and natural formation of the diamond is, that it is formed by the gradual decay of vegetable matter, with or without heat. Yes, diamonds were artificially formed about five years ago by a Scottish chemist, Mr. J. B. Hannay, of Glasgow; but they were not worth "cutting" as ornamental gems. This gentleman startled the scientific world by declaring that he had solved the great problem of diamond making, and there appeared in newspapers several letters of a surprising and fascinating character, which led many people to believe that diamonds, instead of being dug out of the bowels of the earth in distant parts of the world, would henceforth be obtainable from our laboratories at home; but the excitement soon subsided and the subject was allowed to drop, and nothing has since been heard of the chemist and his diamonds. It is not very likely that human skill will ever be able to produce diamonds equal to those that have probably been hundreds of years developing themselves in the bowels of the earth. The following is a brief outline of Mr. Hannay's method of diamond making, as taken from Edwin W. Streeter's work on "Precious Stones and Gems":—"Paraffin spirit was submitted to prolonged heating in company with one of the alkaline metals, lithium, and in the presence of bone-oil which contained certain nitrogenous bases, ı of which in facilitating the reduction of ıı from the paraffin was by no means clear. nge mixture of substances was placed in a -iron tube, having its ends securely welded It was then subjected to the heat of a ıting furnace. In most of the experiments s exploded, even shattering the roof and d injuring the assistants." The great ıttending the experiments and the small of diamantoid carbon obtained, even when riments were most successful, rendered that of diamond making a poor-paying business. no" is experimenting, and should he meet cess, I hope he will not be slow in pub- he results of his labours. Diamond dust is from faulty diamonds called "bort" by them and crushing them in a hardened rtar until fine enough for use.

NORFOLK HOROLOGIST.

.]—**Diamonds.**—Your correspondent, Mr. irey, gives a slightly erroneous impression communication, in saying that diamonds occur in the vicinity of itacolumite. Mons. Fabre's generalisation. Diamonds, esent at all, invariably occur in rocks of a ature to each other. In Southern India the a sandstone breccia of clay-slate forma- ı Bundal Kund diamonds are found in a e, which Captain Franklin supposed to be d, of which at least 100 yards underlaid the iamondiferous beds. In Brazil diamonds n found in the granular, laminated, mica- uartz, itacolumite, or in a ferruginous e conglomerate. Sir Isaac Newton re- the similarity in the refraction of light by nd diamond, and from it inferred a similarity rocess of solidification. The flecks and air- generally found in diamonds (the Koh-i- s three) communicate a polarised structure surrounding substance, four sectors of l light surrounding each globule. An imita- his effect can be artificially produced in glass latinous body, such as gum-arabic, by its between two plates of glass whilst contain- ite air-bubbles. On heating, the expansion contained air produced the four sectors. is fact Sir David Brewster argued that, like liamonds originated in the solidification of e matter by the slow action of corpuscular On reference, I find MM. Despretz and obtained crystals by the action of an elec- urrent passed through liquids contain- bon, such as sulphide of carbon. M. 's diamonds were black or colour- tahedrons and plates, which entirely ıred on the application of moderate heat. uet, in the description given by him in the *Rendus* of his experiments, omits to e conduct of his crystals in the presence of Prof. Roscoe remarks: "It (the diamond) however, have been produced at a high ture, because, when heated strongly in a incapable of acting chemically upon it, the l swells up and is converted into a black sembling coke." I think this settles the of its volcanic or plutonic origin. The l is a remarkably indestructible stone, and ed crucible can be brought to a white heat: begins to burn a little below the melting silver. Hardness 10, sp. gravity 3·52 to light I ask "Eos" to give us some notes on rrence of diamonds in different countries? been everywhere, *beyond* the sight of a tele-

CHISEL-BORER.

2.]—**M.S. and L. Bogies, Type 561.**— 7ft. 6in.; bogie, 3ft. 3in.; stroke, 26 by nders, 140lb. per square inch. The old class s have—Drivers, 6ft. 6in.; bogie, 3ft. 3in.; 26 by 17½ cylinders, 140lb. per square inch.

D. LEITCH.

5.] — **Water - Tube Boilers.** — To L."—I must thank "G. T. L." for his Would he kindly give me an opinion on the g? I propose to construct a boiler in this he ends would consist of iron or steel ; the tubes would be 20, of steel, 1½in. inside r, placed five in a row, with a clear space between each tube. Tubes would be 4ft. refully turned at ends, and the holes accu- red to receive them; then expand them into with expander; each vertical row of tubes in a space at top, to which would be bolted pper or steel tube running the whole length , to act as a receiver for the steam. At of castings a mud box would be left, and of fire-door one end. In middle of boiler e a brickwork baffle-plate, to return flames gases on to tubes, and then to smoke-box of boiler. The water-line would be just over row of tubes. Opposite each tube end a screwed plug, removable for cleaning, e whole series of tubes would then be en- a cast-iron casing, with fireclay on it, say . I should then arrange for several w.i. go outside casing. This is to drive a pair engines 3½ by 4½ at a pressure of 150lb. per sq.in., but should test it to 250lb. per sq.in. Would "T. G. L." kindly say if I should be able to get either iron or steel castings free from blow-holes, &c., or could he suggest any improvement? Where tubes are expanded into ends I propose to allow ¾ of metal if iron, and thinner if of cast Bessemer steel.

VOLCANIC.

[72809.]—**Magnetism.**—Yes; to go near a powerful dynamo at work means to spoil your watch. I had professionally to do this, and forgot my watch. It was affected for a long time; but I believe the effect has worn off; but, then, I was only with the dynamo five or six hours, on a case of death by completing the circuit contrary to orders.

Z. Y. X.

[72825.]—**Municipal Engineers' Exam.**— The course of study for this exam. is one which can best be learned in a municipal surveyor's office. "Cram" is soon detected by the examiners. For engineering as applied to municipal work, read Usill on "Land Surveying," Baldwin Latham on "Sewerage," any good book on water supply, Codrington and Clark on "Roads." For building construction, &c., read Rivington, Knight's "Annotated Model By-laws." For sanitary science as applied to towns and buildings, read Crimp on "Sewage Farms," Boulnois' "Municipal Surveyors' Handbook." For Public Health Acts, Glen on "Public Health Act," and Glen on "Highways," River Pollution Commission Reports. The Secretary will supply any information.

MEMBER MUN. AND SAN. ENGINEERS.

[72832.]—**Bombay.**—I never took note of the water temperature, but as there is no frost in the vicinity of the city, the supply is moderately cool; November to March, inclusive, have a delightful season; ice hardly requisite as an addition to beverages; but there is a well-stocked ice-house, from which at all seasons it was sent to me by rail; ice very cheap. A strong corduroy suit, two stout tweed ditto, two merino vests, three pair ditto socks, one pair bed blankets, two ditto sheets, and two pillow-cases; a good supply of London-made boots; on arrival get a sun hat with muslin turban wrapper at a native shop. If possible, have a small tent and its furniture; for all strangers who wish for cleanliness and pure air encamp on the esplanade, thereby enjoying sea breezes and quiet nights, taking their meals in town; but you can manage your own breakfast at any hour by getting a light kettle, a small native stove of sheet iron (sold everywhere), and a stock of charcoal. Take a large-sized chest, with patent lock, on board ship with you, which will be found an indispensable article in a tent, so that you can secure your property when going out for the day, as thieves are rather numerous. Lodgings and hotels are very dirty and expensive. An alarum bell with spring catch fitted inside the lid of your box I suggest as a great improvement on security. Never keep cash in room or tent.

EOS.

[72832.]—**Cooling Water at Bombay.**— To "Eos."—The Bombay water is tepid all through the year. The usual and simplest way to cool it is to let it stand for a few hours in an earthenware "chatti." The evaporation from the surface of these unglazed and porous vessels soon lowers the temperature. Chattis can be bought in the Crawford Market for a few annas. The most suitable clothes for a mechanic, or what I should take, if going out for a few months only, are as follows:—3 pairs strong boots, 12 pairs socks (merino), 4 flannel shirts, 4 pairs drill trousers, 4 jackets (stand-up collar like military undress jacket), 12 coloured handkerchiefs, waterproof coat, hat, and leggings. Solar topee you will buy out there; you can get one suitable for working in for one rupee eight annas, and Meadow-street is the street to find the right shop in. The things mentioned above are all you will require for working about in, but take what you like for evening and Sunday wear. The height of London and Paris fashions reign in Bombay. I know of no book giving useful information to suit mechanic's life in India; you can get them, written for the use of military and civil service people, showing how to live on a trifle of 2,000 rupees to 5,000 rupees per mensum. But the best information I can give you in a letter to "E.M." must be short, and to make it plain, I shall give a typical case of the finding your level in Bombay. You arrive in the harbour; Prong Light, on Colaba Point, is the extremity of the island. Custom House officers rummaging your baggage for spirits, scents, and firearms. If you leave ship in the harbour, you must engage a place in a shore boat, get your baggage down the side, and you will soon be landed at the Apollo Bunder, fare about eight annas (or one shilling) according to size and capacity of boat. You will then want to find your office and report arrival. Leaving your baggage in charge of the cloak-room on bunder, get into a buggy (a little hansom cab, with the body over the wheels and driver in front), state the place you want him to go to, and the buggy-wallah will soon put you there. The fare from Apollo Bunder to Elphinstone Circle, Rampart Row, or any part of Fort, is six annas. Having got that far, you should be all right.—If you go up into the docks with the ships at Mazagon, the fare to Fort will be: buggy, fourteen annas; shigram, one rupee four annas. A shigram is like a funeral hearse! and is very comfortable. Finally, remember you must learn the language as quickly as possible, and keep away from Commattepoora. See if you can get an Indian Railway Guide from G. Street, 30, Cornhill, London.

BIJLI.

[72835.]—**Cubic Contents.**—I beg to apologise for an absurd mistake of mine in the above reply. I have used the expression for the "circumference" instead of that for the "area" of a circle. The number in my reply expresses the area of the sides of the shaft in square feet, and not the contents.

ASSOC.N.S.S.

[72836.]—**Voss Machine.**—From accidental surface inequalities a slight difference of potential is established by friction between the brushes and buttons, and the construction of the machine is such as to accumulate the initial charge, however small, on the compound-interest principle. In working the machine the plate is rotated in the direction of the arrows shown in the figure. I assume initially a small potential difference between the armatures A A, and will show how this difference is increased. Omitting the conductor C C, which takes no part in the initial stages of charging, each button passes during a revolution four brushes, two belonging to the armatures, and two to the diagonal conductor.

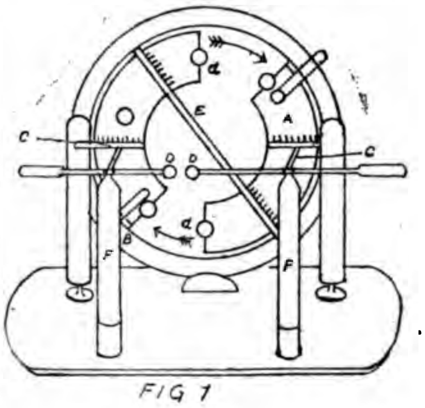


FIG 1

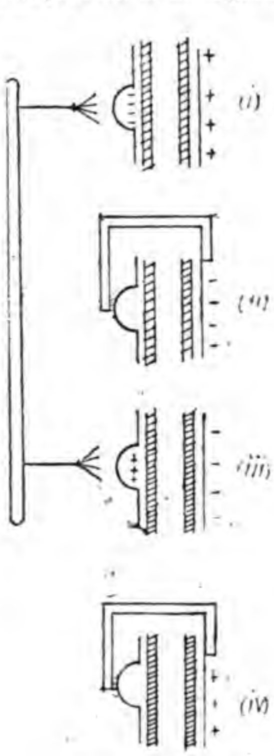


FIG 2

Fig. 2 shows one button in four consecutive positions, or four buttons simultaneously, remembering that pairs of buttons always occur at ends of a diameter. Consider first the pair of buttons in position i. and iii. in Fig. 2., in which i. represents a portion of the positive armature, and iii. a portion of the negative armature. At i. the + armature

No. 22, and driven in suitable fields,
, as a dynamo, 75 volts, 1 ampère =
ınd this same armature, if supplied with
f 1·5 ampère at 75 volts, would give $\frac{1}{10}$th
power, which is equal to 74·6 watts.

S. Bottone.

-**Mercury.**—Add a few drops of acid,
e a strip of bright copper. The mercury
ısit on the copper in the form of a bright

Sm.

— **Mercury.** — Acidify with dilute
:id, and place a clean strip of copper in
n. If mercury is present, it will be
a the copper. Assoc.N.S.S.

-**Mercury.** — To test for mercury,
portion of the mixture to dryness, mix
with dry sodium carbonate and heat in
e. If mercury is present, it will be
s a grey film in the cool part of the tube.
ıay be collected into small globules.

Dubito.

-**Mercury.**—Put a little medicine into
ogether with a slip of thin copper foil
ınt hydrochloric acid to make it acid,
y; if medicine contains mercury it will
copper. Take out copper, gently dry
lds of blotting-paper, place it at bottom
lry test tube, warm gently at the bottom
ıbe, holding tube horizontally, when
ill be sublimed and condensed on cool
ube. By collecting sublimate by pushing
ıther with a clean glass rod, metallic
ll be plainly visible. Pharmacist.

-**Mannessmann Tubes.**—I see no
ı making tubes with both ends closed by
ısmann rolling-process. The statement
ıat it is possible to do so; and as a matter
done much in the same way as a baro-
ıermometer tube is closed—that is, by
ing the ends whilst in a viscous condi-
illustrations which have appeared give
notions of the devices adopted. Where
ulty? S. R.

— **Bookbinding.** — To "Practical
:r."—1. I have never seen anything
the way of composition used for fixing
locks in the blocking-press. I know all
;lue cracking, and the stamps dropping
you were to tell me that in the binding-
ıld tell you that they had not been pro-
p. I will tell you how I used to do it (I
now—it is my business to see it done).
ɜce of strawboard the size ot my case (if
ıll-sized stamp), and marked where the
ɔther portions of the stamp were to be
his I glued all over, and after heating
of the stamp a little, I laid them
lown on the glued board with the
f course. When this was done I laid
ɜce of board over it, and put it in the
·ess, which had been heated previously,
ht the pressure down upon it, and
it to remain until properly set.
ıg the stamp to the plate, I generally
ıuch of paste at the four corners quite
o hold it. I have used this method for
ily Bible work, and seldom had any
N.B.—Never rub your plate with oily
en cleaning, scrape with knife only. 2. I
k not; you had better not have any dirty
nder my supervision, if you had any
your own peace of mind. Do you not
dry albumen dissolved is as likely to
as glair? Use the glair or albumen
and coat the cases all over, avoiding
using a large sponge with plenty in it.
·cked cases without glair or size of any
ɾould not advise you to make a practice
'he best way to get up a high gloss with
s is to get good ink to begin with, and
your cases blind, and afterwards with
en the press is cold. For this to be done
ou require a blocking press adapted to
f work. I hope this will suit you. I
er it a privilege to assist my fellow-
ıt any time to the best of my ability.

Practical Bookbinder.

-**Pump.**—Shorten the lift of the valves,
too high off their seat, I think, and so
. Mind to put a back-pressure valve
ump and boiler in delivery pipe.

J. A.

-**Pumps.**—It is a mistake to make
l things with conical valves. The best
ke them is to chuck a piece of hard rod
turn down the pin the size you want
e in the chuck; file three flat sides upon
p to the valve, bringing the feathers up to
a knife edge. Now take a fine pointed
undercut it under the head and into the
recessing the head to the diameter of the
w turn the head down to size, leaving
of valve just so that you can
ake off the wire edge clean, leaving
are 64th for seat; turn the face of your
other seat nice and true flat, and the job is done; restrict your valve to about $\frac{1}{16}$in. rise, recess your pump in the neck for a gland as large as you can, and get a sound piece of bone, and make a bush that will fit the gland tight, and the plunger will recess the bush, or countersink it next the plunger, and pack it with a ring or two of darning or lamp cotton soaked in some clean tallow. Now put your gland on, and you will be right.

Jack of All Trades.

[72902.]—**Coin.**—Why not make electrolytic copies? Sm.

[72902.]—**Coin.**—I don't think it very advisable to profess a knowledge of "smashing." Bijli.

[72902.]—**Coin.**—Try fine pumice powder one part, and powdered French chalk, if you are going to try it dry; but if you are going to work it wet, take off the above equal parts, and mix with another part of finely-washed pipeclay, mould with pressure, and dust with French chalk tied up in a piece of fine muslin; dry and burn at a good red heat; smoke the mould and cast. Or use plumbago with turps, and polish with a soft brush. Either must be done clean and regular. Make mould hot before pouring. Jack of All Trades.

[72903.]—**Boiler.**—Make this of iron 16in. diam., 3ft. 6in. high; put in 18 tubes; firebox, 26in. by 14in. But much better to have one properly constructed by workmen that you can depend upon. A boiler this size is too much for any "amateur" to attempt, and may lead to danger if imperfectly constructed. J. A.

[72904.]—**Shop Lighting by Electricity.**—To Mr. Bottone.—A 16c.p. 48-volt lamp will light brilliantly 33c.ft. of space. Say your shop-front is 4ft. deep, 10ft. wide by 9ft. high; you would want about 10 lamps of 16c.p. to illuminate it brilliantly. This means a dynamo capable of giving nearly 200c.p., taking nearly 1½H.P. to drive. The armature should be of the ring or drum type, about 6in. diameter. For full working details, with description of mode of winding, dimensions of parts, and proportions of wire, &c., I must refer you to my "The Dynamo: How Made, and How Used." S. Bottone.

[72907.]—**Electric Bells.**—To Mr. Allsop.—Move your battery from where it is at the bottom to the place at the top A. Connect up pushes as shown by your dotted lines, and insert a switch in the wire, so that they can be cut off in the daytime. Disconnect the wire that runs from the bell B and joins into the bottom wire, and connect it to the wire between the battery at A and the call-bell. I fancy you will be able to understand this without sketch; but if not, write again, and I will send one. There is a similar diagram to this in Figs. 122 and and 123 of my book, "Practical Electric Bell-Fitting." F. C. Allsop.

[72908.]—**Boiler.**—Make this of strong sheet copper—perhaps No. 20 may be strong enough—13in. diam., 26in. high, with 15 fire-tubes; fire-box, 12in. by 12in. Braze all the joints. J. A.

[72909.]—**Model Boiler.**—You had better braze all the joints, and then finish off as you like.

J. A.

[72910.]—**Sectors for Wimshurst Machine.**—"Puzzled One" will find the best results from 16in. plates may be obtained by using 14 sectors, each 3in. in length, ½in. in breadth at the outer end, and ¼in. in breadth at the inner end, placed so that the outer ends are ¼in. from the outer edge of the plates. The length of spark will, however, depend greatly upon having suitable Leyden jars and suitable-sized and well-polished terminal balls. The jars for 16in. plates may be made up from thick test tubes, say, 8in. in length and ¾in. in diameter, the tinfoil coat being about one-third their length. The tubes should be coated with shellac varnish, and all the ends of the wire connections must be well covered, a single point if exposed will spoil the results. The terminal balls should be ⅜in. and 1¼in. diameter respectively and highly polished.

J. W.

[72911.]—**Brighton Engines.**—The following is all the information I have at hand:—No. 19 built 1875; No. 97 built in 1874; Nos. 42, 114, and 115 built in 1877; Nos. 268 and 269 built in 1880. The cylinders of No. 157 are 18¼in. diam. and 26in. stroke. North-Western.

[72912.]—**Engine and Dyname.**—See my reply in last week's number of the "E. M." to enable you to calculate the power of your engine. If well made your engine should give, at the pressure stated (is this not a mistake?) about 5½H.P., sufficient to drive a dynamo capable of lighting 60 incandescent lamps of 50 volts and 16 c.p. each. A drum armature, about 8in. diameter, 16in. long, wound with 24lb. No. 8, would do this. This should run in Kapp, or Edison-shaped fields, the cores of which should be wound with about 55lb. of No. 16, and connected in shunt with the brushes. For further particulars and sketches, see "The Dynamo: How Made and How Used." S. Bottone.

[72913.]—**Photographing the Moon.**—Have you clockwork driving-gear to your telescope? Because you cannot photo. the moon without it. Any sort of a plate carrier will do, carried by a rod fixed to telescope, and covered with a velvet sleeve to exclude extraneous light. You must find the focus by successive trials. Sm.

[72914.]—**To Mr. Allsop.**—See my book, "Electric Bell Construction," and study the construction of the relay described there. Slightly increase the size of parts and quantities shown there. There is no need for it to be of the shape shown in "Practical Electric Bell-Fitting"; but if you wish it of this shape you can get the size of bobbin, &c., from the Jensen indicator, shown in Fig. 106 of "Electric Bell Construction."

F. C. Allsop.

165, Queen Victoria-street, E.C.

[72915.]—**Canal Boat.**—Suppose A. is going north, B. south. Then at the moment of jumping I have a northerly motion of three miles, which I retain while in the air. But the instant my feet touch B. the friction checks their northerly motion, and imparts to them a southerly motion of three miles; but my head retains its northerly motion, so that if no precaution is taken my feet will be pulled from under me towards the south, and I shall fall with head to north. The precaution is to run a few steps towards the north at the moment of alighting, so as to keep my feet under my head. It follows that in jumping I must face towards the north, unless I am prepared to run sideways or backwards. Latris.

[72917.]—**Cardboard Plates for Wimshurst Machine.**—Would it not be better for E. H. Tomlin to use dermatine or guttapercha rather than cardboard? I have found good results from the former, but never obtained any satisfaction from the latter. Unfortunately all these flexible materials alter in shape and give a good bit of trouble.

J. W.

[72917.]—**Cardboard Plates for Wimshurst Machine.**—I do not recommend the above, now that perforated glass plates can be had so cheaply. Still, a very effective machine can be made from them. Procure two sheets of millboard about $\frac{1}{16}$in. thick; cut these to the required diameter; let them dry thoroughly, by standing some hours over the kitchen mantelshelf. Now procure a flat iron dish or tray, rather wider than the discs; put ¼lb. best hard paraffin wax into this dish, place it in the oven, and let the wax melt perfectly. When quite hot place the millboard discs in the melted wax, and let them remain therein until they cease to give off bubbles; then take out, and allow to drain and get quite cold. They will act better if not varnished. The sectors, however, should be stuck on with white hard or shellac varnish. Allow the varnish to harden thoroughly before attempting to use the machine, or else the brushes will tear up the tinfoil.

S. Bottone.

[72917.]—**Cardboard Plates for Wimshurst Machine.**—As the writer of the article referred to in this query, it may perhaps help Mr. E. H. Tomlin to describe my method of preparing the plates. In the first place, a great deal depends upon the kind of cardboard used, the common sort being altogether too soft for the purpose. What is wanted is a very stiff, close-grained board, not too thick in substance. Having cut the discs, lay one upon a flat surface (I used a metal plate), and with a flat iron, as hot as can be used without burning the paraffin wax (not oil), work the latter well into the disc, treating each side separately. This operation wants doing thoroughly, without sparing the wax, and it is very important that it should be finished off so that the surface of the disc is covered uniformly with a thin film of wax, about 1-16in. thick, thereby securing good surface-insulation. If the plates are large, some difficulty will probably be experienced in getting them perfectly flat after this process; but fair results can usually be obtained with a little trouble. Then varnish with shellac, and stick the sectors on. Such plates work very well; but it is impossible to prevent them touching one another at top and bottom when at work, being pulled together at these points by electric attraction. This does not hurt the plates or affect the results; but it makes a very disagreeable noise; and chiefly in consequence of this I prefer to use glass, which never breaks or gives any trouble when properly fixed.

Leicester. E. E. B.

[72918.]—**Fluoride of Ammonium.**—Surely you can get it in London; it is the white acid used by glass etchers. Take a guttapercha bottle to any glass etcher, and no doubt he would oblige.

Bijli.

[72918.]—**Ammonium Fluoride.**—I cannot understand how you failed to procure this. You evidently did not go to Hopkins and Williams, of Hatton-garden. Anyhow, you might have got hydrofluoric acid and ammonia and mixed them.

Sm.

[72919.]—**Ammeter, Voltmeter, &c.**—Both forms are equally good; the one described Oct. 10

is somewhat easier to make. You are quite right—it must have been a very small arc light with 30 volts. S. BOTTONE.

[72920.]—**Sound Copper Castings.**—I think I should be right in saying it is practically impossible to cast copper otherwise than spongy. BIJLI.

[72920.]—**Sound Copper Castings.**—Fuse your metal, and don't get too hot; and see that your moulds are dry and hot if you can get it. Don't let your metal lob into the mould, but pour it into a well or bay, and allow it to run down. JACK OF ALL TRADES.

[72921.]—**Spherical Valves.**—Be content with the conical valves which act well, and can be easily turned; or buy spherical balls and seat ready made. J. A.

[72921.]—**Spherical Valves.**—Easiest way to get a sphere $\frac{5}{16}$in. is to call at a bicycle material shop, where you can get steel balls of $\frac{3}{16}$in. to $\frac{3}{4}$in. diam., which are ground true by special machinery. To turn a ball in a lathe requires a cup chuck and a tool like a steel ferrule on a handle; in this case $\frac{5}{16}$in. bore. SNOWBALL.

[72921.]—**Spherical Valves.**—To do these properly, you want a cup tool and bush or hoop. Get a piece of sound cast steel about $\frac{3}{4}$ diameter and 4in. long, centre it, and bore a hole up one end about $\frac{1}{4}$, $\frac{1}{32}$, and 1in. deep at the bottom of this hole. Bore three holes from the outside $\frac{1}{16}$ full into the large one, place between the centres, and turn down about $1\frac{1}{4}$in. to about $\frac{1}{2}$ diameter for handle, and square it. Turn the other end from the holes taper down to the ends, leaving that $\frac{1}{32}$ thick full, and with a fine-pointed tool make a fine line about $\frac{1}{16}$ from the end. Now get some fine wood charcoal dust and mix with a little salt and water, and fill the hole and bury it in a little trough of tin or sheet-iron. With the same get a nice red heat and plunge it either into water or tallow. Leave until cold, take out, and try with a file. If hard, lap the inside hole out with a lead or copper lap and flour emery, and make as true as you can. When you have done that, bring the end square off down to the line, finish square upon a good level oilstone and it is ready for use. Your cup-chuck should be held in a chuck made of brass or type-metal. When you have roughed your balls and got them up to as near as you can with a gauge, put them into the cup-chuck and finish them with the tool, letting the ball run in hole of same, and keep turning it about until you find it full of eyes or centres a good face and can take next to nothing off, and your balls will be as near true as it is possible to get them. JACK OF ALL TRADES.

[72922.]—**Removal of Rust.**—Put it in pickle in 1 of sulphuric acid to 14 or 16 parts of water. JACK OF ALL TRADES.

[72923.]—**Ball Bearings.**—Stamped from rods with oliver, hardened and ground, same as marbles. BIJLI.

[72923.]—**Ball Bearings.**—The small steel balls used in cycle bearings are ground true in special machine, which is a patent, I believe. As far as I can remember, it consists of two revolving discs whose centres also describe a circle somewhat like the earth motion round the sun; the discs are fed with emery. SNOWBALL.

[72924.]—**Model Gun.**—I don't think anyone would care about taking the trouble of calculating the velocity, trajectory, &c., of your model gun. You can easily get drawings to scale of any large gun and carriage, and books from any military publisher of any calibre gun you require for a few pence. CORAL.

[72925.]—**Substitute for Stereotype.**—Since nothing will excel the proper metal, the ordinary reader cannot see the necessity for a substitute. You certainly cannot "cast" guttapercha. SM.

[72925.]—**Substitute for Stereotype Metal.**—You can make plate of vulcanised rubber by subjecting the rubber to the vapours of bisulphide of carbon, then pressing the rubber into moulds, subjecting them to heat. But unless you are acquainted with the materials used, it is a dangerous game. You can soften percha in hot water, and press it into moulds; but they are a very poor substitute for metal. JACK OF ALL TRADES.

[72926.]—**Enamel for Brass.**—There is the crystal varnish and the colourless lacquer. Will not they do? JACK OF ALL TRADES.

[72927.]—**Resistance.**—This effect is due to the fact that the gradually increasing E.M.F. of the cells acts as a resistance. This can be overcome by increasing the speed of the engine, or by coupling some of the cells in parallel during charging. See Salomon's "Management of Accumulators" on this subject. S. BOTTONE.

[72929.]—**Binding-Screw Clamps.**—I never saw a good platinised surface yet, and I don't think that one could be got that would stand acid. Platinum is very dear just now. S. BOTTONE.

[72932.]—**Delezenne Circle.**—You need a good deal of wire of low resistance—say No. 18. The commutator used is similar to that on Clarke's machine, which reverses the current at every half-revolution, so as to obtain a continuous current. SM.

[72932.]—**Delezenne Circle.**—If the hoop is 1ft. in diameter you may wind it with about 1lb. No. 24 silk-covered copper wire, and get good results. The commutator is precisely the same as that of a Siemens H-armature, and consists of a short piece of brass tube encircling an ebonite or ivory rod. The tube is fastened on by two short screws, not reaching to the spindle; and is slit with a fine fret saw at two diametrically opposite points of its circumference. S. BOTTONE.

[72934.]—**Rubber.**—You will not get anything to do it, as the rubber being elastic it spews about, and you cannot help it unless you have it confined in a ferrule. Why not stick a piece of smooth sole leather with some glue and treacle, or Prout's glue, or some of the shoemaker's stick-fast cement? JACK OF ALL TRADES.

[72935.]—**Unidirection Machine.**—Such a machine could be made; but it would not be advisable so to do, since large permanent magnets are costly, lose their power quickly, and at best are not nearly so effective, bulk for bulk, as electro-magnets. An armature to give 20 volts and 8 ampères, should be 6in. long, 2in. in diameter, and wound with 1lb. No. 16. I should strongly advise you to make a dynamo instead of a magneto. S. BOTTONE.

[72937.]—**Birkenhead Gold.**—A local jeweller, after applying the nitric-acid test, pronounced the "find" to be gold, and the matter got into the newspapers. A sample was then submitted to a well-known analytical chemist, who found that though it stood the nitric acid and some other simple tests, a more complete examination showed the article to be a *silicate* coloured with oxide of iron. The gravel was disintegrated granite. F. M.

[72937.]—**Birkenhead Gold.**—The following appeared in the Birkenhead papers of Saturday last:—[COPY.] "I consider the following explanation to be due to the public. Accidentally the supposed discovery was reported in the Birkenhead and other papers. The deposit of gravelly spar found in sinking a well upon my premises was tested with acids by a neighbouring jeweller, and pronounced to be gold. Since then a sample has been tested by a member of the Liverpool Geological Society, and he declares it to be silicious, coloured yellow by coming in contact with iron."—(Signed, H. DODD, Haymarket, Nov. 14th)." H. T. W.

[72938.]—**Salt Glaze.**—Ordinary clean salt, I believe, is used, and it appears to me as if it was thrown in over the articles, as more than once or twice I have had stone bottles and jars with a good cake inside like a cake of salprunella. JACK OF ALL TRADES.

[72944.]—**Telescope for Box Sextant.**—To "W. S. P."—I happen to know of one for sale, detached from the instrument, but with the required bracket-fixing. If you write to me at Starnes's (late Pitcairn's) Library, King's College-road, N.W., I will let you know what I can do for you. J. K. P.

[72944.]—**Telescope for Box Sextant.**—Generally about 3in. long, and of a diameter suited to the ring in which it is screwed. The focus of your object-glass will consequently be slightly less than the length of telescope with draw-tube closed. The focus of the eye-lens will depend upon the magnifying power required, say 1in. SM.

[72945.]—**Compound Engine.**—I should not recommend you to use compound engine for launch if not condensing—you will save nothing by it. Field boilers are very good for steaming; but my advice is to use a horizontal boiler—your boat won't roll so much. CORAL.

[72947.]—**Indiarubber.**—It seems impossible in this query—at least, as I look at it—to arrive at what "F. S." wishes to know, with the data he supplies, unless we know, besides its weight, the length and breadth of a given thickness of rubber as a standard. Happening to have at the moment a piece of rubber at hand, I found its dimensions to be $1\frac{3}{8}$in. by 1in. by $\frac{3}{8}$in., and its weight as nearly as possible $\frac{1}{2}$oz. The problem can now readily be solved by the double rule-of-three, and may be stated thus:—If a certain quantity of rubber measures $1\frac{3}{8}$sq.in. in superficial area, with a thickness of $\frac{3}{8}$in., and a weight of $\frac{1}{2}$oz., how many square inches would another quantity of rubber measure whose thickness is $\frac{3}{16}$in. and weight 16oz.? The terms will stand thus—

$$\begin{array}{l} \frac{3}{16}\text{in.} : \frac{3}{8}\text{in.} :: 1\frac{3}{8}\text{sq.in.} \\ \frac{1}{2}\text{oz.} : 16\text{oz.} \end{array}$$

The answer is 88sq.in. AUTOLYCUS.

[72948.]—**Curious Musical Instrument.**—I think I saw at the French Exhibition both wind and stringed instruments in which the notes were made to sound by passing perforated paper. Has "Puzzled" tried the organo-piano, a stringed instrument with pedals and knee levers. I consider it a splendid instrument. E. R. DALE, F.S.Sc.

[72949.]—**Faulty Dynamo.**—The output is very small compared with the large amount of wire you have on the armature. Premising that I have never known a + shaped armature to give good results, owing to the interaction of the adjacent coils, I should imagine there is considerable leakage in the armature. Change the armature to H shape, replace the cast cores by wrought-iron ones, and wind them with about 10lb. No. 22 connected up in shunt with the brushes. This machine should give 10 ampères at 24 volts pressure. S. BOTTONE.

[72952.]—**Depositing Vat.**—Glass would do; but to pitch box inside would do better. SIEBERT C. HART.

[72952.]—**Depositing Vat.**—The simplest way to deal with a vat of such small measurements is to make one of one-inch wood, watertight. There is no difficulty in this. If you cannot cut the wood square and smooth enough for tight joints, lay a bit of cotton wool and thin paint in them. For large vats lead lining is correct where $CuSO_4$ is used, and iron vats for cyanide of silver or potassium. BIJLI.

[72952.]—**Depositing Vat.**—Make a good sound base and get some stout glass cut to line it; now take equal parts of gas pitch and paraffin wax and melt and mix, line your box with that. If your wood is from the saw so much the better; with a hot iron melt the compound, and the glass being well cleaned and warmed, put into its place and wipe all the joints off with a warm iron. You can put a little rosin with it if you like. I have made boxes without the glass for putting nitric acid in for dipping, and it does not seem to affect it. JACK OF ALL TRADES.

[72953.]—**Boring Taper Holes.**—The best tool for doing this job in the lathe is the taper D bit, which, when once started true, will not run out of truth; it must be fed to its work very slowly, as it has a lot of cutting edge. If the holes are of any depth, you will find a description of the tool in most handbooks on the subject. SNOWBALL.

[72954.]—**Brazing by Electricity.**—I have seen lead that has been welded by it; perhaps the same apparatus might do; but I was told it was not a plaything—might soon put me into the other world; so take care. E. R. DALE, A.I.E.E.

[72955.]—**Telephones and Microphones, Connecting.**—This is a most interesting query, and I have searched Preece and Main's "Telephone," but I cannot find any reference to it, so I hope Mr. Allsop will supply the desired diagram showing the battery connections at each end of the circuit. It evidently is important which way the wires are connected to the telephones, because Lockwood, in his "Practical Information for Telephonists," on p. 53, says: "Should it ever happen that telephones are used on a battery circuit, see that the zinc pole of the battery goes to that screw-post of the telephone which is marked Z. In other words, if the copper pole of the battery at the office is to line, the wire leading from the office must be connected to that screw-post which is not marked Z. If the zinc pole is to line, the wire from the office must be connected to the post which is marked Z. Then if the battery has any effect on the telephone, it will be to strengthen its magnetism, instead of to weaken it, as would be the case under the opposite conditions." From this I gather the terminals of telephones in America are marked. It is years now since I saw a pair lettered, and then one terminal had L and the other E on it, for line and earth respectively; so, in days gone by at any rate, even without using batteries, there seems to have been a right way of connecting telephones only. AN A. I. E. E.

[72956.]—**Turning Cylinder.**—The fault may be due to want of truth of the running centre. SM.

[72956.]—**Turning Cylinder.**—The fault is in the centres, either not true or not in line with bed. BIJLI.

[72956.]—**Turning True Cylinder in Steel.**—I expect your centres are straight cones. If so, you may keep shifting with the same result. I always worked with a barrel centre, and had no difficulty. These are things you have to learn when you are pushed for time and price, and the job expected to be A 1. JACK OF ALL TRADES.

[72958.]—**Microscopic—Celloidin Section.**—In reply to "A. G. E.," particulars of this method will be found in the *Journal of Anatomy and Physiology*, October, 1884. Celloidin is a pure pyroxyline made by Schering, and is sold by Martinda 10, New Cavendish-street, Portland-place, eit dry or in solution. Imbedding: Cut the tissue small tubes (from $\frac{1}{8}$in. to $\frac{3}{8}$in., if possible), and if the squares must be larger, make them proportionately thinner, in order to allow the celloidin to penetrate the mass thoroughly. Harden in the chen" fluid or alcohol in the usual way. in absolute alcohol, and then in sulphuric hours in each; then in a thin solution of for from seven to ten days, until the thoroughly saturates the mass. Remove boxes which are filled with the solution, se to the air; when the ether and alcohol porated, a crust forms on the surface. boxes in a mixture of methylated spirit r for about three days, until the celloidin solid. Cutting: Usual way; but see that is flooded with alcohol. Staining: Usual Clearing: Do not use absolute alcohol or es; use alcohol at 95 per cent., and oil of , sanders, or origanum. Mount in Canada Note.—The dry celloidin is dissolved in rts of 95 per cent. alcohol and sulphuric

nth. B.Sc.

]—**Sound.**—The cracking of a whip is to be caused by the sudden return and nt vibration of the two columns of air into original mass is separated by the motion ip. DUBITO.

]—**Sound.**—The sudden condensation of front, and rarefaction behind the lash of set up waves, which waves, striking on of the ear, give rise to the sensation of S. BOTTONE.

## ANSWERED QUERIES.

*bers and titles of queries which remain unan- five weeks are inserted in this list, and if still are repeated four weeks afterwards. We trust will look over the list, and send what information r the benefit of their fellow contributors.*

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## QUERIES.

—**Muslin Stamp Making.**—Could any form me how the stamps for marking muslin for broidery work are made? Those I have seen are make. Some are of thin brass bent into shape in o blocks of wood the end way of grain; evidently cast in apparently type metal, and acked to pieces of wood; others are bent into mounted on rollers. What I want to know is: terial is the pattern moulded in? I have tried lay, but it cracks in drying. Plaster of Paris ickly to enable any but a very short pattern to and this is not satisfactory. I have also tried der's sand with better results; but this is rather d not sufficiently adhesive to allow of the near of the parts of the pattern to each other which ry, and yet not break down. The lines of the only about a 1-50in. thick, and they are raised above the basis of the stamp, which is, perhaps, ck. The lines seem to be without taper from as though the pattern was made with a piece of al bent to shape and stuck into the sand, or the material is in which the casting is made. Jack of All Trades" may know something of oblige, with any information he has, the—

—**Atmospheric Pressure.**—How is the ic pressure shown by means of the siphon used in chemical work?—W. H.

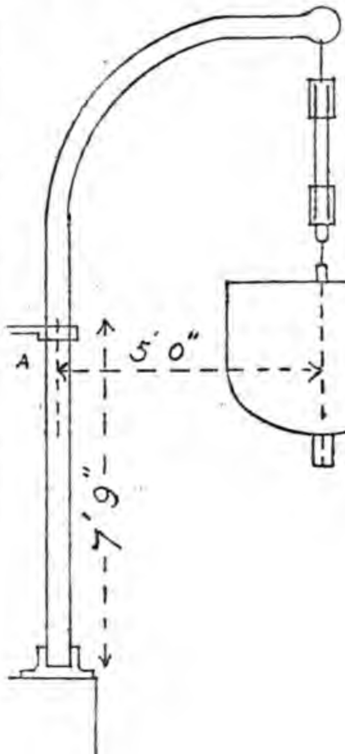
—**Transparent Unbreakable Material.** meone name me a substance as above—ivory like, but cheaper, and that will allow of writing rly seen through it? Also a white, tough, hard hat will take ink or pencil readily to be washed the material to be written on repeatedly.—

—**Telephone.**—Would any reader say the best communication between two parts of house 40 stant? Is there any telephone would do with- ttery, such as have been described in the ?—ULSTERMAN.

—**Magnetising Steel.**—How can I mag- el, bent into horse-shoe shape? Also what e steel should be? I have a battery of 24 (large) cells, also a compound wound dynamo s, 100 volts. Give size and quantity of wire to NET.

—**Lighting.**—To MR. BOTTONE.—I have made after the Fuller type, but used flat zinc plates rods, nd have put carbon packing round carbon plate. I charged them as described on page 428 in "Electricity in the Service of Man." The zinc plates become coated with a brown substance, which I think is mercuric acid. Should this be so, and ought it to be brushed off? What work can I expect from a number, say, 6 to 10 of these cells, beginning with 6 and adding others as required, for a 10-volt 5c.p. lamp, and from a 12-volt 8c.p. lamp, working at interverals of about two hours per day? Is the charge right, and would it be best to use parallel connections instead of series? Any information will oblige.—ELEMENT.

[72968.]—**Davits.**—I would esteem it a favour if you or some of your readers would give me a good rule for getting at the diameter of davits required to suit the over-reach and weight, as shown on accompanying sketch? Also how to arrive at the size of collar marked A′ on the same sketch.—JUNIOR.



[72969.]—**Indicator for Medical Coil.**—To MR. BOTTONE.—Having read your book, "Electrical Instrument-Making for Amateurs," I have made a medical coil, and wish to have an indicator the same as they use for public purposes. Please tell me the simplest way to connect the same. Am using a brass regulator.—N.

[72970.]—**Magic-Lantern Screen.**—What is the best portable screen for magic-lantern, disc 5 to 6ft.? Is a roller-blind feasible?—A. Z.

[72971.]—**Magic-Lantern.**—I am greatly plagued by the front glass of my refulgent lamp continually breaking during an exhibition. Can anyone tell the cause, and suggest a remedy?—A. Z.

[72972.]—**Model Boiler.**—Should like to know if this boiler will steam with coal for a pair of cylinders (loco.) 1½in. stroke, ¾in. bore; barrel 8in. long, 3in. diameter; firebox 3¾in. high, length 2¾in., breadth 1¾in., with seven ⅝in. tubes; also what gauge of metal (brass)? Should like to do without staying firebox top. If this won't steam, should like dimensions of one that will. Pressure 10 lb. sq.in.—AMATEUR MODELLER.

[72973.]—**Manufactured Jewels.**—In the *Globe*, a few weeks ago, there was an account of some sapphires and rubies which are said to have been manufactured at the Sèvres china works from silicate of alumina. I have followed the process there described several times, and have maintained a heat that would melt cast-iron for as much as six hours; but cannot get anything like the result above indicated. I should be much obliged if any of "ours" could tell me how it is done?—LIBERATOR.

[72974.]—**Electric Boat.**—To MR. BOTTONE.—In the "E. M." of Oct. 17, I asked a question (No. 7262C) about propelling a boat, 3ft. 4in. long, by electricity. I see you recommend double-magnet type motor with Siemens armature, 2½in. diam., and 2¼in. deep. Would you mind giving a rough sketch of same, showing winding both of F.M.'s and armature? How much wire would be required on F.M.'s, and how much on armature, and what B.W.G. for an output of 2 ampères at 12 volts pressure?—H. T. E.

[72975.]—**North Western Engines.**—Will some reader kindly tell me the names, numbers, and dates of the engines of the "Lady of the Lake" class, between 76 and 167? I believe there are nine. Also 6ft. coupled engines of the "Diomed" class, between the same numbers? How many are there of this class altogether? Are there any compounds with 6ft. wheels? How many are there with 6ft. 3 wheels "Dreadnought" class? I should be very glad also of the names, dates, and classes of Nos. 2, 285, 373, 805?—C. F. DENDY-MARSHALL.

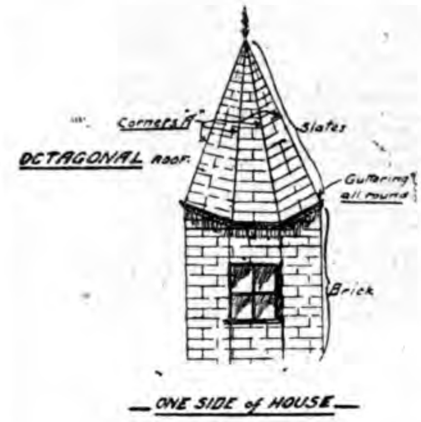
[72976.]—**Wheel Driven by Pendulum.**—Required to drive some mechanism by the motion of a pendulum, which is actuated by separate machinery. The work to be driven has no attachment for accumulating power to overcome dead points. If this can be done effectually please show form of teeth and pallets.—LINK.

[72977.]—**Pulvermacher Chain.**—How can I make a simple battery that will give a current of similar quantity and intensity to the Pulvermacher chain? This chain was recommended for a certain purpose, and in query 69900, Vol. L. page 169, I asked for a description of it. The reply on page 206 did not give the information, saying no substitute was available. As, however, the form of the battery is not important (except for convenience), I do not care to send to the other side of the globe for an expensive article till I have satisfied myself of its necessity.—SOUTH PACIFIC.

[72978.]—**Cometary Orbits.**—I want to study the method of computing a comet's orbit from three observations. I believe it is given in the "Encyclopædia Britannica," but that is not accessible here. Can any of our kind correspondents furnish a précis of the process, or refer me to any book on the subject which I might send for, naming publisher and price?—J. G.

[72979.]—**Dissolving Amber.**—Will any of your readers kindly inform me of the best method of dissolving a small quantity of amber? Textbook information is not always to be relied upon. I have tried sp. vin. rec., chloroform, ether, benzole, without effect.—R. D. PEDLEY.

[72980.]—**Tower Roof Ridging.**—Inclosed is a rough sketch of a tower roof showing the slates. Will some kind reader give a sketch showing how the slates are laid so as not to allow the rain in at the corners at A on sketch? Ridging is not used for these towers as in other buildings. Will you say what is used and how substituted for ridges to not let in the rain?—A. B. T.



[72981.]—**Turbine.**—Would any kind friend advise me how to make a turbine or waterwheel to give 3H.P.? Sketch would oblige.—600 X.

[72982.]—**Dynamo.**—I have got a dynamo, horseshoe type, the following dimensions:—Drum armature 8in. long, 6in. diameter, magnets 8in. by 8in. by 2½in., cast iron. Would anyone be kind enough to tell me the size and quantity of wire to give 50 volts, 40 ampères? Speed 800 per minute.—600 X.

[72983.]—**Noisy Piano.**—Can anyone kindly suggest some means to prevent the sound of a grand piano (Broadwood) being heard in the rooms below? I live in a flat (top floor), and wish to practise without annoying my neighbours?—CROCHET.

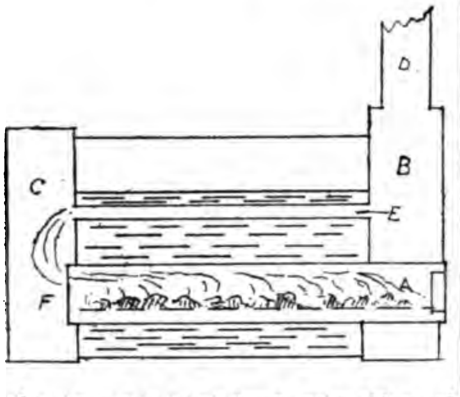
[72984.]—**Railway Bridge.**—I want to make a railway bridge over a mill stream to a brickworks, trucks to carry 7 tons. Width of stream 7ft., depth of water about 4ft., rather swift, which cannot be turned off only in the night. Having plenty of bricks, but no stone without great expense, will some kind reader give his opinion on the following plan?—An 18in. wall built on both sides, and build the bricks through cement above water in blocks of, say, 6ft. long and 2ft. deep, and let them dry for a few days before laying them down, or shall feel greatly obliged for any other plan or suggestion.—BON.

[72985.]—**Water Cycle.**—I shall feel obliged if any one will kindly give me sketch of a paddle wheel suitable for propelling catamaran, to be worked on the same principle as a tandem tricycle? Also would it be advisable to have both chains on one side, or one chain on either side of axle on paddle-wheel, the objection to the latter being that one pulls against the other? Which would act the most satisfactorily?—MOTIVE.

[72986.]—**Pure Dissolved Bones.**—I have been trying for a long time now to make the above, but find I always get the same result. The mass will not dry, consequently it is unfit for the market. Can any of our chemical friends put me right? The mixture must be bones and acid only. I would not mind paying a small fee for the information.—FORSMAN.

[72987.]—**Gravity Electric Clock.**—I have an electric clock on the Bain principle beating seconds; but after many trials it now lies useless. Could I convert it into a gravity electric clock by having a compensated pendulum and a small weight falling against the pendulum, the weight being at the end of a rod that would swing like a pendulum, then the battery catch away the weight immediately it has fallen, and a small catch hold the weight and relieve the battery? Again, could not the clock itself release the weight; but how could this best be done, and would the release of the weight every 30 seconds be sufficient? If this would work, what batteries would be best, and how is the contact best made? In the clock I have the contact was made by a piece of brass rubbing against another piece of brass in a small vessel of paraffin. As the weight would always be the same and always fall the same distance, would not this insure a uniform rate in the clock?—Mem.

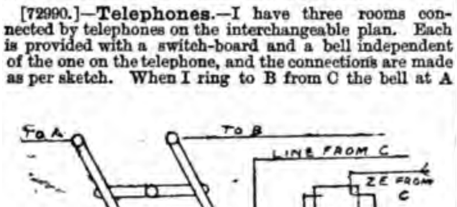
[72988.]—**Launch Boiler.**—I am about to make a boiler as shown in the drawing, and would like to know



what size to make it for a launch engine, 2¼ bore, and 3½ stroke, to get the best results. I would work it at 80lb. Please say size of firebox and number and size of tubes, and if 3-16 plate would be strong enough. A firebox, B and C smoke-boxes, E tubes, F grate to prevent cinders falling into smoke-box, D funnel.—F. H.

[72989.]—**Surface Condenser.**—What would be the H.P. of an engine, diameter of cylinder 10in., length of stroke 12in., 160 revolutions per minute, boiler pressure 5lb. square inch, surface condenser, vacuum gauge indicating 12lb.? Also what size of surface condenser would be right for this engine, number of tubes, length, and diameter? Also size and spread of air-pump. I wish to have an engine and boiler not liable to explosion. I know there is such made and working cheap with every satisfaction. The makers refuse information as to sizes, &c.—Poor Joe.

[72990.]—**Telephones.**—I have three rooms connected by telephones on the interchangeable plan. Each is provided with a switch-board and a bell independent of the one on the telephone, and the connections are made as per sketch. When I ring to B from C the bell at A



rings also, and causes confusion. Will any reader please say whether this fault is traceable to the connecting up of switch, or to a short circuit?—A. B.

[72991.]—**Dynamo - Winding.**—Will any reader kindly tell me the quantity and gauge of wire required to wind (compound) a dynamo for (1) 60 volts and 10 ampères, and (2) 60 volts and 26 ampères? The field-magnet core is 3in. diameter and 8in. long, armature core (laminated drum) 4in. diameter by 5in. long; spaces between pole-pieces 6in.—T. S.

[72992.]—**Purifying Vitriol.**—I wish to purify about five tons per week of vitriol which contains arsenic and other impurities, and shall be glad if any reader will give particulars with scale sketch of best plant. I have spare steam-power. I can also obtain alkali waste cheaply on the spot.—Frank Farley.

[72993.]—**Sour Claret.**—I was induced some months ago to buy a few dozens of claret for my wife, then slowly recovering from influenza. It is now decidedly acid, and I am afraid injurious. Is there known to any of your correspondents any wholesome way of correcting this acidity?—Arthur Pullman.

[72994.]—**Sewing-Machine.**—To Mr. Bottone.—What power is required to drive an ordinary sewing-machine, and what speed is the best for it?—G.

[72995.]—**Fluid for Writing Zinc Labels.**—Wanted, best preparation for the above purpose. I have tried several, but cannot get one lasting enough.—A. R. P.

[72996.]—**Vacuum Tubes.**—Are there any of the above that will give a light sufficient to light a small room? What are they called, and the design? Would a coil giving a 2in. spark work them satisfactorily? Would the shock from such a coil be dangerous if taken through the body?—Bichromate.

[72997.]—**Battery Lighting.**—Is there any fear of lightning completing the electric circuit and damaging the battery? Would a wire from the negative taken to the water-pipe save anything being damaged? Would some-one kindly assist me?—Crymo Bach.

[72998.]—**Watt's Bleaching Process.**—In reply to "S. R." it was an error on the part of the printer of the "E. M." in printing "Wall's" instead of "Watt's." What I wished to ask was: how was it that after experimenting on bone-fat—as specified in Watt's "Art of Soap-Making"—that nearly all the water added to the liquid fat along with bichromate and the acid (see page 214) failed to separate on the fat solidifying? If "S. R." will look in last week's, he will find "Omicron" (No. 72829) is in a similar position as myself, though he has been working on fish-oils and chloride of lime, instead of bone fat and bichromate. The query is, why won't the water separate?—Fat.

[72999.]—**Colliery Pumping Machinery.**—Will some of your readers kindly give their ideas as to the best class of valves and arrangements for delivering the maximum quantity of water possible with the following pumps, having regard to the least possible vibration of machinery, and least noise:—We have a pair of double-acting 8in. diam. pumps, driven by a pair of 20in. diam. steam cylinders, direct, with a steam-pressure on gauge by engine of 35lb., with a pair of Korting Bros.' condensers attached which gives about 10lb. vacuum. The water is raised by the suction from 15ft. vertically below pump barrel, and delivered 280ft. above pump barrel. The diameter of suction pipes (one for each pump) equal 8in., and the rising delivery pipes equals 10in. diameter, which acts for both pumps. Our present valves in pumps are of Cornish type made of brass, and have also brass seatings, with a diameter of 7in., and we allow ⅝in. lift to same. And when we run the engines over 20 of 3ft. strokes per minute, they shake and clash until we think the pumps will break. Kindly describe the best class of valves, and the maximum speed at which the pumps can run with same? By so doing, you will assist the—One in Charge.

[73000.]—**Electric Light.**—I have two square Bunsen's modification, quart size. I have charged the inner cell or porous pot with strong nitric acid—the outer cell with 1 part sulphuric acid, 10 parts water. I have made a coil wound with 1lb. No. 20 B.W.G. cotton-covered copper wire, 2 brass terminals. From coil to small incandescent lamp No. 18 B.W.G. cotton-covered copper wire. I have made a switch with brass lever and connections mounted on hard wood. All the effect I get is the small wire in lamp becomes red-hot. Will any brother-reader tell me through this valuable paper where I am wrong? A sketch will greatly oblige a young beginner.—W. L.

[73001.]—**Flue Gases.**—To "Marienberg."—Many thanks for your reply, which proved very useful to me. I have made some further experiments on a series of seven boilers, and should be glad if you would give me your opinion on the results. No. 1 boiler (nearest the chimney) indicated a pressure of ·45in. water; No. 2, ·40in.; Nos. 3, 4, and 5, ·35in.; and Nos. 6 and 7, ·30in. Pressure in main flue receiving the gases from the seven boilers ·55in. Should the pressure be the same for each boiler, and also for the main flue? Am I right in supposing that if the area of the main flue is only half the total area of the boiler dampers, that the velocity of the gases will be doubled? I find that the area of the chimney at the base is two or three times as great as the main flue. Should this be so?—E. A. B.

[73002.]—**Heat of Flue Gases.**—What should be the temperature of the flue gases in main flue when the boilers are working economically and efficiently? I find the temperature in a main flue to be 610° Fahr. Is not this too high? I may mention that there are no Green's economisers to utilise the waste heat.—E. A. B.

[73003.]—**Accumulators.**—I use occasionally two or three small E.P.S. accumulators, type 5. 5., which have to be recharged with 3-5 ampères. We have an electric-light circuit of 50 volts in use, supplied by two sets of 24 accumulators, 15 L type, charged by shunt dynamo of 50 volts, at 20-25 ampères. How can I connect small accumulators for recharging, without interfering with light circuit? I use also sometimes set of 2 accumulators, 15 L type, same size as used for light. Can I recharge these in circuit with others, and how should I connect?—Ratio.

[73004.]—**Seamless Tubes from Solid Blocks of Metal.**—To "E. T. B.," 1412, Neath-road, Landore.—May it be asked of this correspondent to supplement the information he has already given in letter 31747 on the Mannesmann Bros. patented process, by stating if the tubes drawn by this new invention are applicable to cycle construction, and if they are calculated to supersede and entirely supplant the weldless cold drawn tubes now exclusively used in the manufacture of bicycles, &c.? A letter has been addressed to "E. T. B.," 1412, Neath-road, Landore, and returned to the writer through the "dead letter" office, officially endorsed "not to be found." And it may here be asked why in a journal of the high-class standing of the English Mechanic apparently *bonâ-fide* addresses should be given by correspondents which are incorrect and misleading? Reliable information is earnestly solicited on this important matter from any reader who practically understands the new process of the Mannesmann Bros., now being exploited at Landore.—Mining Engineer.

[73005.]—**Conic Sections.**—In Chambers's "Etymological Dictionary" (1888), is the following respecting the ellipse:—"So-called because its plane forms with the base of the cone a less angle than that of the parabola." So that by analogous reasoning extended to the other curves, the hyperbola would presumably be so termed because its plane forms with the base a greater angle than that of the parabola, and this latter because the cutting plane is parallel to the side. W. Wallace in his "Conic Sections" (1837) gives the following as the reasons of Appollonius for so designating these curves. The parabola "on account of the equality of the square of the semi-ordinate to a rectangle, contained by the parameter of the diameter and the absciss." The ellipse "on account of the deficiency of the square of the ordinate from the rectangle contained by the absciss and parameter," and the hyperbola "on account of the excess of the square of the ordinate above the rectangle contained by the absciss and parameter." I should be glad to know which of the two interpretations of these terms adopted by the great geometer is in acceptance amongst mathematicians?—A. M.

[73006.]—**Problem in Heat.**—Will any reader solve the following for me:—Show how to find the momentary temperature of a quantity of air, which, being at a temperature of 40 degrees, has its volume suddenly reduced to one-half?—Juvenis.

[73007.]—**Problem.**—Will one of your readers kindly solve this problem geometrically? Describe a square, so that each side touches one of four given circles.—Pi.

[73008.]—**Boring Pistol-Barrel.**—Will our fellow-reader "Armourer" kindly tell me best way to bore a new barrel for my saloon pistol No. 1 size, out of octagon steel? Also how to properly adjust the sights afterwards? Have 3½in. lathe and all tools.—Bristol B.

[73009.]—**Leclanche Batteries.**—I should esteem it a great favour if a reader of the "E. M." would kindly give me the correct proportions of carbon and manganese used in filling porous pots of Leclanché cells. I have looked up back numbers, and find it says equal parts. Does that mean by weight or measure? I have tried both, but with very inferior results.—A. C. Fort.

[73010.]—**Electric Bell Magnets.**—I have been making some bells, the magnets of which I cannot get of sufficient strength. I have read in books about small magnets being able to sustain hundreds of times their own weight with very small batteries. I use cotton wire, slightly finer than is generally used on bells. I have wound on bare iron, and I have wound on thin paper tubes with no better effect. The iron is a shade over ¼in. I make eight layers 40 convolutions in each, making 640 turns in all. I sometimes soak it with French polish. The most it will sustain is about four times its weight. Will some kind reader tell me where I am wrong?—G. Ryan.

[73011.]—**Milk.**—Can anyone recommend an inexpensive instrument for testing the purity of milk, and also say by what means it is known that part of the cream has been removed? Is milk that has come from a distance, and is sold in a refrigerated state as wholesome as that freshly milked? And by what means can the cream be made to rise to the top, which I am told it does not? Can refrigerated milk be tested for purity in the same way as any other milk?—E. G.

[73012.]—**Hair-brushes.**—"Jack of All Trades" was kind enough to answer my question on this subject some time ago, but not intelligibly to me. Will he kindly say what middlings and a flicking comb are, and how they should be used to clean brushes?—E. G.

[73013.]—**Electric Lighting.**—To Mr. Bottone.—Having nearly completed a single-fluid chromic-acid battery of 60 cells, each with two carbons and one zinc plate 7in. by 3½in. by ¼in., at ⅛in. apart, and well put together, I should be pleased to know the best way of connecting the cells for best results for both arc and incandescent lamps, and method of calculating the same; also best lamps for the purpose. The cells when tested singly seem to give fully 2 volts each, and fully 20 ampères on short circuit. In several books I have purchased it states that any number of the ordinary incandescent lamps can be lit up with a current of 110 volts, and a similar statement appears in "Ours" of the 7th inst., page 222, in respect to St. Pancras. Could similar results be obtained by a primary battery giving 110 volts? If so, I should like to know the method of calculating for the same.—G. White.

[73014.]—**40c.p. Shunt Dynamo.**—Will Mr. Bottone kindly tell me if the following type of dynamo and dimensions would be right to light to full brilliancy two 48-volt 20c.p. lamps in parallel to run continuously without heating? If so, please give size and weight of wire for armature and F.M.'s. Laminated Siemens H armature, 5in. long, 2¼in. diam., F.M.'s about 9½in. high, 5in. wire space each way, wrought iron cores ⅞in. thick. I should like to use this sometimes as a series machine for a small arc lamp. Will you please (if not troubling you too much) answer the following questions? 1. Does a ring armature take double the wire a Siemens H would to get the same voltage, as I understand that the wire inside a ring A. is dead, or has no effect; but in your book on "Electrical Instrument Making" you give an example of winding a ring armature to give 55 volts with 50 or 58yds. of wire, so I suppose this wire would have to be all active to give 55 volts? 2. If the fields of a dynamo are wound with barely sufficient wire and if more is put on, what is the gain? Is it in volts or current?—Electrical.

[73015.]—**Locomotive Funnels.**—Could any reader oblige me with a list of the different patterns of funnels used by the various British railway companies? Sketches and details would be welcome.—Caucasus.

[73016.]—**Boiler.**—I have a horizontal boiler made of 1-16in. copper plate, 6in. diameter, 24in. long. All joints brazed by experienced man. It has been tested to only 80lb. by water pressure, but I want to work it at 70lb. steam. Will it be safe at that pressure?—A. Smith.

[73017.]—**Brighton Railway Loco. Boilers.**—Will some reader kindly give height of centre of boiler from rail level of the locos. belonging to the A, B, C, D, E, and G classes on the above line? Also height of top of chimney from rail level would oblige.—North-Western.

[73018.]—**Dynamo.**—Will Mr. Bottone kindly give me the dimensions of a Gramme dynamo for an engine of 1¾in. bore, 2½ stroke (vertical), steam pressure 15lb. per square inch? Also the length and gauge of wire used, the quantity and number of sections on armature. Also length on each field-magnet. The machine to give 30 volts and 6 ampères.—Apprentice Patternmaker.

[73019.]—**Watch Movements.**—Will one of "ours" kindly give me a few hints how to judge the quality of watch movements when buying, as I find the majority of new cheap lady's watches either continually stop or won't go at all?—Fourth Wheel.

[73020.]—**To Mr. Bottone.**—Kindly tell me what kind of battery is that which has a narrow strip of silver, divided from what appears to be a small plate of zinc by means of a pad of, I think, blotting-paper. The pad is moistened by some solution. What solution? Does this act as a dry battery? Would there be a continual cur- from such, and how long would it last? Size of plat Silver, ¼in. wide, 3in. long; thin zinc, 1in. broad, 1 long.—H. R.

[73021.]—**Tin and Steel Ironwork, to Flang** —Is there any kind reader who can tell me how to kn the flange over of tin and sheet ironwork, such as to kn the edge over of a pan to take a ⅛in. rod, or the edg part of an elbow, so as to join them together, and w tools are required for the work?—T. H.

[73022.]—**Broken Wrest-Pin.**—Can anyone tell me how to extract a broken wrest-pin from a piano? The pin is broken short off to the plank. Also how can I stop the buzzing of a covered string?—Fred Foster.

**'iano Dampers.**—To Mr. Davies or Mr. eing about to purchase a piano, I find that nents which have under-dampers are more in the ordinary ones. Will you kindly say advantages of the under damper?—L. S. D.

**. and Y.R. Locos.**—Would some corre-idly give principal dimensions (1) of 5ft. l goods tank engines, and (2) of Mr. J. A. F. ew 5ft. 8in. four-coupled, double-ended ık locos.?—Compound.

**)leate of Lead.**—Can this be converted r? It is now of the consistency of soft soap?

**.eclanche Battery.**—I have a Leclanché pair (corrugated cells). I could not get them without using diluted sulphuric acid, which very well, and after they were charged and gave a very good current; but in a few ost stopped, and the zincs all in holes. Will or Mr. Allsop kindly tell me the best way to ides of the cells, and how I am to get the ells, as I think it is through that that the en?—P. B.

**Harmonium.**—I have recently purchased onium containing four rows of reeds, and am dding a set of pedals with independent reeds. ent measures 3ft. 10in., and there is ample h the bellows. Can any reader give me a uitable arrangement, and state approximate ere the reeds can be bought? I should pre-pedals were to organ pattern. I am also earning how to tune, and stop the occasional ne or two of the larger notes.—Hautbois.

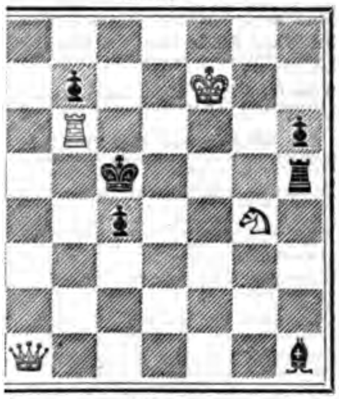
**Precipitation of Silver and Copper.** f your chemical readers kindly inform me the reduce silver and copper to finest possible chemical means as metallic dust? Also the form salts of the two metals, either separately , which will easily melt on a piece of charcoal wpipe into the pure metals or alloy? What can I use except borax?—F. J. F.

## CHESS.

munications for this department must be "J. Pierce, Knollside, Yawl, Lyme Regis,

### PROBLEM MCCXXIX.

*Black.*



*White.* [5 + 6

hite to play and mate in two moves.

Solution to 1227.

| *White.* | *Black.* |
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| 4. | 1. Any. |
| ι, or P mates. | |

### 'OTICES TO CORRESPONDENTS.

solutions to 1227 by F. W. N. Lambert (key J. H. Eastwood, Lieut. Col. Ryan, Biene, ght (second solution will not hold if 1. B-Q 4), a clever and well constructed problem), Fr. A. A., W. Jay, A. Fellows, W. Gleave (a ting of a nice, but much used, idea), T. H. (capital), W. D. Clark, W. L. Martin, Link, ; to 1226 by T. H. Billington, J. H. Eastwood. ght (very ingenious), F. W. N. Lambert (near p), W. Jay, and Link.

s.—If in 1226, 1. B-Q 6, Q-K B 2 (ch), and if Q (ch), B covers.

n official document just published Italy is st consumer in Europe of English coals. wing is the proportion of coals provided the principal Powers:—Italy, 1,465,690 nce, 757,829 tons; Germany, 902,957 tons; 13,937 tons; Spain, 724,972 tons.

there is a thumping or knocking in a piece nery, it is often difficult, the surrounding terfering, to locate the one particular The *Revue Industrielle* mentions the use of tube about a mètre long, one end of placed in the ear and the other passed suspected spots. The vibrations from all ts than the one covered being excluded, to be an easy matter to locate jarring , when found, to observe the intensity and with which it occurs.

## ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

### HINTS TO CORRESPONDENTS.

**1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.**

**⁂ Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

**The following are the initials, &c., of letters to hand up to Wednesday evening, Nov. 19, and unacknowledged elsewhere:—**

A. Marson.—D.—A. E. Litton.—Constant Subscriber.—J. R.—E. Dollin.—Galvo.—W. H. H.—Sudbury.—Cambridge.—A. J. Dew.—H. A.—Water Jacket.—Turner.—H. C.—A. E. D.—Cellist.—J. H. Bootle.—Elektron.—Caldemone. — C. — R. S. S. — K. C. B. —A. C. Walker.—H. S. C.—J. A.—Edward M. Nelson. —J. Phillips.—F. A. M.—Idris.

J. J. B. (Full details as to lighting a house by means of electricity have been given several times; but the most important detail is that it costs much more than gas. If you have a dynamo and power to run it during the daytime, you can charge accumulators for use at night; you can use the dynamo direct, or you can have primary batteries; but the last are out of the question from the economical point of view. Many people seem to think that electricity can be easily generated at a nominal cost, whereas it is really expensive as compared with gas or paraffin-oil lamps, unless laid on from a centre station, and even then it is costly. Please see indices of back volumes.)—Buckeye. (Directions for making indiarubber stamps have been frequently given; but a suitable plant is required, and it is generally cheaper to buy them. The type is set up and a plaster cast taken of it, which, when dry, is dusted with French chalk. The rubber is masticated and mixed with sulphur, and is then gently pressed into the plaster mould, the mould and the rubber being then placed in a flask, which is put into a vulcaniser, where it is subjected to heat and pressure by means of steam until the rubber is "cooked." A simple method is to place the plaster cast and the rubber between two iron plates, which can be screwed together as they are heated over a gas-jet; but if you require "many" stamps, as you say, it will pay to get a proper plant.)—R. N., Grays. (We do not think the lathe attachment is made in the ordinary way of business, and as the author is travelling, we cannot give any further information at present, but may be able to do so shortly. We will remember the question; but we believe the device is the inventor's, and is not made for sale.)—Repols. (No room for anything about the divining-rod just now; besides, it has been fully discussed in back volumes. As a rule, those who "find" water by the aid of the divining-rod know a likely spot to find it without the assistance of the twirling twig. For a history in brief of the superstition see No. 1078, Nov. 20, 1885, where the experiments of Chevreul, made so long ago as 1812, are mentioned, and a similar story to that given in the cutting forwarded by you is related.)—A. Z. (The sixth edition of a work should be better than any previous edition; but if you are offered the second edition of that named "cheap," it would be worth buying, for we believe it is better than the fifth. As a guide, we may inform you that the sixth is published at two guineas.)—Tardigrade. (Directions for dressing rabbit skins have been given many times. Clean the flesh side and dress with arsenical soap if you want to stuff them; but the simplest way is to rub alum into them. They must be well worked between the hands, and pulled over, say, the back of a chair after the final washing if they are wanted soft.)—Joe. (For etching metals, the most common thing is nitric acid (aquafortis), the surface being protected by a layer of soap or wax; but powdered bluestone or green vitriol can be used. See indices, or p. 383, June 27 last.)—G. Young. (The office of the *Nautical Almanac* is at Verulam-buildings, Gray's Inn, and it is published four years in advance by John Murray, Albemarle-street, price 2s. 6d. Do not know the other work.)—Stumped. (Please see the index of Vol. L., under heading "Arithmetical Puzzles." You will find all about your query in that volume—that is, within the last twelve months.) —Anxious One. (Maxton's "Workman's Manual of Engineering Drawing," Crosby Lockwood and Son, Stationers' Hall-court, E.C., 3s. 6d., is as good a book as you can have.)—J. Clift. (No recollection of such an article.)—H. H. (Kerl's "Practical Treatise on Metallurgy," Longmans, £4 19s.; Phillips's "Elements of Metallurgy," Griffin, £1 14s. There are several works at lower prices, for which see booksellers' catalogues.)—G. W. S. (The most likely place would be the Finsbury Technical College; but electro-plating is not a nice occupation for class work. Probably if a sufficient number of students joined, a class might be formed to do practical work.)—W. H. Simcox. (Yes; those were the depths given us for a reply to J. C. Siphon. The principle of the siphon is explained, we should think, in every textbook of physics. The question has nothing special to do with shafts; the siphon once filled, the water will run up the short leg and down the longer leg, provided the orifice of that is below the orifice of the short leg.)—A Reader, Bolton. (We answered you distinctly on p. 196, telling you that the 16 numbers can be had. Do you wish us to make out a list of their dates when we have spare time? It is useless to send questions and neglect to look through the Answers to Correspondents.)—A. Y. Y. (There are the gelatine copying presses, the electric pen, the trypograph, and some others, for which see indices and advertisements, and read "Hints" above.)—Mac. (Where do you find any mention of the "universal" system? 2. We presume you mean a shocking coil—which explains itself.)—Stickum. (Marine glue, or good glue with tannin added until it becomes ropy.)—Polish. (It is Japan work properly stoved. See indices of back volumes.)—Cassing. (Carnauba wax is an article of commerce, coming mainly from Brazil. It forms a coating on the leaves of Corypha cerifera, and is especially useful on account of its high melting-point—for a wax. Other query inserted.)—G. N. R. (Not necessary: it is a matter of taste. 2. What sort of tubes? Spirit would be best. See the articles on "Model Loco. Making.")—J. M. K. (The gas used in lighting railway coaches is mostly that made on what is known as Pintsch's system, which is the property of a company. It is pressed into iron cylinders, and conducted to lamps through a regulating valve. 2. Blotting-paper is simply a loose-textured paper made of good stuff and left unsized. It is made nearly at all paper mills. 3. Depends on the composition of the gas. A compressor pump. 4. Some patented system, we suppose. 5. A "patent" is for an "invention," but a mere design can be registered.)—Engines and Details of Locomotives. (We must restrict the number of these queries, and cannot be bothered with the requests for mere names and numbers that correspondents so inconsiderately make.)—W. J. Payne. (You can only appeal. It may be, of course, that the house is worth £26 10s. though you only pay £20. As to getting anything back, we expect there is little chance of that.)—A Poor Invalid. (Read Dr. Allinson's articles in the *Weekly Times and Echo*, and try his No. 2 diet for three months.) — Vindex. (There *must* be something wrong in the question as you have written it. One might as well try—given the longitude and latitude, to determine the colour of the captain's whiskers!) — Anglo Kelt. (There is no such school of Aërial-navigation in England.)—A Countryman. (We really cannot discuss the folly of people who are donkeys enough to swallow pewter filings as a cure for boils at the dictates of old pedlar women!)—C. J. Little. (We have no room for the controversy you seek to raise. Our own opinion coincides with that of Mr. Stretton.)

**Nervousness in Men** is seriously on the increase. Check it at once by wearing one of Harness' Electropathic Belts. They are a perfect boon to all sufferers from nervous, muscular, or organic weakness. Thousands of unsolicited testimonials. Pamphlet and consultation free on application to the Medical Battery Company, Limited, 52, Oxford-street, London, W. Address letters to Mr. C. B. Harness, President.

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**The address is included as part of the Advertisement, and charged for.**

**Advertisements must reach the Office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.**

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PAYABLE IN ADVANCE.

**6s. 6d. for Six Months and 11s. for Twelve Months, post free to any part of the United Kingdom. For the United States, 13s., or 3dol. 25c. gold; to France or Belgium, 13s., or 16f. 50c.; to India (via Brindisi), 15s. 2d.; to New Zealand, the Cape, the West Indies, Canada, Nova Scotia, Natal, or any of the Australian Colonies, 13s.**

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**Messrs. James W. Queen and Co., of 924, Chestnut-street, Philadelphia, are authorised to receive subscriptions for the United States for the ENGLISH MECHANIC, at the rate of 3 dols. 25c. gold, or Thirteen Shillings per annum, post free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the receipt of the subscription. If back numbers are required to complete volumes, they must be paid for at the rate of 3d. each copy, to cover extra postage.**

**Vols. XXIV., XXX., XXXII., XXXVI., XXXIX., XL., XLII., XLIII., XLIV., XLV., XLVI., XLVII., XLVIII., XLIX., L., and LI., bound in cloth, 7s. each. Post free, 7s. 9d.**

**All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each, post free from the office (except index numbers, which are 3d. each, or post free, 3½d.)**

**Indexes for Vol. VII., 2d. each. Post free 2½d. each. Indexes to Vol. XL., and to subsequent vols., 3d. each, or post free 3½d. Cases for binding, 1s. 6d. each.**

**Holloway's Pills.**—Nervous Irritability.—No part of the human machine requires more constant supervision than the nervous system—for upon it our health—and even life depends. These Pills strengthen the nerves and are the safest general purifiers of the blood. Nausea, headache, giddiness numbness, and mental apathy yield to them.

## NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a PINK Wrapper, as an intimation that a fresh remittance is necessary if it is desired to continue the subscription.

## OUR EXCHANGE COLUMN.

*The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.*

**Astro. Telescope,** 6½in O.G., Cooke, six eyepieces, finder, equatorial mounted, no circles. Exchange. 4in. wanted.—BASSETT, 82, High-street, Stoke Newington.

**Telescope Equatorial,** 12½in. With reflector. slow motion R.A., 2in. finder, 6 eyepieces, Barlow's lens, diagonal set of stops. Photo 12 stamps.—Below.

**Transit Instrument,** 2⅝ o.g., silver circles, striding level, collimating eyepieces; photo 6 stamps. Photometer by Hilger, micrometer by Grubb, astronomical books and instruments.—Below.

**Barometers,** 2 aneroid, Patterns for Equatorial stands, dynamos, tricycle, Cromartie lamp, new ebonite Wimshurst machine, 9in. spark; lantern photos. List stamp.—Box 20, Liversedge.

**American Organ wanted,** with several rows reeds, would do out of repair. Good exchange given. — SEKORFIELD 282, Stubbins, near Manchester.

Wanted, **Autograph Letters** of Celebrities, or picture books, or anything relating to coaching. Exchange MAGIC LANTERN, &c.—COLLECTOR, 18, Lowbaxter, Bury, Suffolk.

**Village Cart,** 12 hands, light running, sound. What offers in exchange?—FENN, 72, Queen's-road, Bowes-park London, N.

Will exchange Cassell's "**Dictionary of Cookery,**" cost 11s. 6d., unbound, for good Electric Bell or offers.—R. T., 15, Ruth-street, Bolton.

**Safety,** hollow rims, tangent spokes, balls throughout; Tricycle, Cripper, balls throughout. Exchange Lathe or ½H.P. Otto Engine.—ENCORE CYCLE DEPOT, Kirkwood-road, Nunhead, London.

4½in. Gregorian **Reflecting Telescope,** by Burton, London; equal to new. Exchange for Object Glass about 4in.; offers. —OLIVER CORNWELL, 117, Ditchling-rise, Brighton, Sussex.

**Model Steam Engine,** ½ by 1in., and brass boiler, with internal flue, and taps; also water motor.—J. W. DRABBLE, The Mount, Matlock, Derby.

**Set of Castings.**—Plates, Cylinders, Pinions, and all Steel Work for quarter or chime clock, 15s., or will exchange for anything useful; mechanical preferred.—THOS B. HOWE, Newbury, Berks.

Wanted, named Foreign Shells and any Books on Microscopy, in exchange for choice Microscopic Slides of every description.—SUTER, 5, Highweek-road, Tottenham.

Several **Gas Bags,** new and second-hand; Limelight jets, and 6in. Lenses. What offers in exchange.—SWIGG, 36, Drummond-road, Bermondsey, London.

Several **Lockstitch Sewing Machines,** nickel-plated, warranted complete. What offers in exchange.—SWIGG 36, Drummond-road, Bermondsey, London.

**Mitring Machine,** Booth's 4in.; list, 35s. Will exchange for anything useful. Equal to new.—F. HEAVEN, Redland-road, Bristol.

For exchange, S. P. Thompson's "**Dynamo Electrical Machinery,**" second edition. Wanted, Rivington's "Building Construction," third vol., or Parke's "Hygiene."—ISAAC LOW, Junior, Weaver-street, Glasgow.

Large **Sea Boots,** two good Revolvers, Binoculars, Ear Trumpet, 18in. Spirit Level, Toy Lantern Slides. Exchange 24 or 26 silk-covered wire, rubber and cotton-covered wire.—DALTON DEAN, Kimbolton.

"**English Mechanic,**" 14 volumes, to date, with indexes, offered for S.B. Breech-loading Gun.—S., care of Mrs. Morton, 8, Keir-street, Edinburgh.

Wanted, small Launch Boiler, with about 20 square feet of heating surface; working pressure not less than 100lb.; horizontal preferred. Good exchange.—W. H. BROWN, Pyle-hill, Newbury.

**Two Double Relays,** suitable for distant bells or telephone; one on ebonite, other wood bases. Exchange for Magneto Machine or offers.—JAMES C. TAYLOR, West-street, Ilminster.

For **Bicycle** or Camera, Magic Lantern, 3in. double condensers, 80 slides; particulars.—R. NORRIS, 5, Dean-street, Islington, N.

One-horse **Engine,** good working order, wood bed 20in. flywheel. Exchange about 60c.p. good dynamo, or smaller Engine.—W. O., 1, Elgin-villas, Hatherly-road, Hoe-street, Walthamstow.

Offers wanted.—**Musical Box,** 24 by 6in.; large zither, flute (real ivory mounted), microscope, 6in. high, and twelve slides in mahogany box, silver albert, electric light battery of 12 carbon cells, cost £4, electric motor, steam engine (¼H.P.—W. N. NAYLOR, 36, Lower-road, Rotherhithe.

"**English Mechanic,**" 15 volumes, in exchange for Model Engine—partly finished not objected to—or any offer entertained. —TRENCH, 346, Hawthorne-road, Bootle.

**Gravity Clock Great Wheel,** 144 teeth, and pinion of 12, made for gravity clock; never used. Useful exchange.—RICHARDS, 56, Monier-road, Bow.

**Hand Shaper,** by Selig, 4¾ stroke, 10in. traverse, cost £10. Gunmetal saw-table and fence, fit hand-rest socket, suit any lathe, cost £4. Essex Chuck, three sets jaws, by Britannia Co. Two Centre Punches by Holtzapffel, cost £3 3s. Small universal Cutting Frame by Hines, cost £3 3s. Propellers, three blade 22in. One gun, 2 bore, good pattern. {Duck Gun, 4-bore, C.F., complete with apparatus, cost £20. Small Tortoise Stove; another similar Rippingill Oil-stove, two 4½ wicks, cost £3. 16in. plate Electrical Machine, Leyden Jars, &c. in box, all good as new. Offers wanted.—J. F., Heathfield, Hansler-grove, East Molesey.

Back volumes ENGLISH MECHANIC wanted. Offer NOVELS, &c., in exchange. Good exchange offered for American Organ, Tube-board, reeds fittings.—M., Stretton Stop, Rugby.

Any of the back volumes of "**English Mechanic**" given in exchange for old Magazines (with plates )or old Music.—T. SLADEN, Cank-street, Leicester.

**Bench Lathe,** 2½in. centre, gunmetal collar, face-plate, four chucks, carrier, two tool rests, heavy two-power flywheel, and crank; almost new.

Will exchange **Above** for Magic-Lantern, Microscope, or small Model Engines.—MARTIN, 75, Forest-lane, Forest-gate, Essex.

**Tandem,** Rudge convertible, first-class machine, in excellent order; cost £28. Exchange Photo Requisites and part cash, to value £6.—A. D. CLARKE, Pailton, Rugby.

Small **Steam Engine,** vertical boiler, 22 copper tubes, lagged and brass bands. Full particulars given. Heated by gas.—WICKS, 17, Bridge-terrace, Croydon.

Wanted, small Gas Engine, in exchange for 3H.P. Vertical Engine, four-horse boiler, combined, on water tank foundation, by Hindley, little used, been driving dynamo, or 400c.p. Gramme dynamo by the British Electric Light Co.—HELLYAR, 144, Dalling-road, Hammersmith.

Complete set **Limelight Lanterns,** 4in. best condensers, tripod, gas-bags, retort, dissolver. Photo sent. Exchange to value of £12.—COOK, Newmans-road, Sudbury, Suffolk.

Wanted, small sound **Mincing Machine,** perfect, enamel burnt on inside. Exchange.—COLLINS, Carpenter, Havant.

Lathe, backgeared or screw-cutting, wanted, in exchange for new Safety Bicycle, ball bearings throughout. Beautiful machine, cost £14.—CONFECTIONER, 129, Lordship-lane, Dulwich.

**Astronomical Telescope,** length 5ft., O.G. 2⅝, brass body, rack to eyepiece, on stand. Exchange good Photo. Lens. —S. CLARKE, Wormwood Hill, Kirton Lindsey.

**Horizontal Engines,** 2in. stroke, 1in. bore, cost £2; also one 1½in. stroke, ⅝ bore, cost 25s.; only wants little repairing. Exchange.—Below.

2½in. centre **Lathe,** iron bed 21in. long, and five chucks, worth 35s. Australian Parrot and Cage, good bird, worth 35s. Exchange.—Below.

**Goat,** young Nanny, value 12s.; Magic-Lantern and 30 slides, value 7s. 6d.; set of Brass Castings, double Marine Engine, nearly finished, value 15s. Exchange.—Below.

**Steam Boat** hull 42in. long, 12 deep, 10 wide, propeller fixed, deck fittings, cost £2. Exchange offers only.—ARTHUR, 1, Stamford Cottage, The Crescent, Stamford Hill.

**Medical Coil,** 6 powers, battery in lock-up mahogany case; Stereoscopic Camera, by Ross. Offers.—TUNE, Trinity House Yard, Hull.

**Boiler,** ½H.P., cost £14, take £7, or exchange for Camera or anything useful.—GEORGE, 1, Albert-terrace, Cloudesley-road, London, N.

Genuine Kangaroo **Safety Bicycle,** for 4½in. Screw-cutting Lathe, gap bed.—A. T. DURRANT, Queen-street, Great Yarmouth.

Bench **Drilling Machine,** drills ⅞, small, accurate steam gauges from 1in. dia., Whitworth 5in. Lathe, with chucks. Exchange.—COOKE, King-street, Southsea.

"**Cassell's Popular Educator.**" What offers? —Mrs. H., 14, Islip-street, N.W.

"**Kitto's Cyclopædia,**" complete. What offers? —Mrs. H., 14, Islip-street, N.W.

Vertical **Boiler Shell,** all fittings and pump. Offers. Will exchange for 15 Daniell's Cells.—Apply A. S., 4, Broseley Villas, Wood-green, N.

What offers in Model Engine for 3½ **Mandrel,** 3 chucks, pair lathe standards, small driving wheel.—H. BYATT, 61, Oakfield-road, Stroud-green, N.

Exchange good **Slide-Rest,** suit 3½ lathe, for a model slide-valve loco., out of repair, or offers.—H. BYATT.

**Engine,** all iron, cylinder 5in. stroke, 3in. bore, on bed-plate, with bearings, crank, eccentric, flywheel, and driving wheels 2in. wide; been used as experimental gas-engine; can be altered for steam with little trouble. Offers wanted.—GOODWIN, 3, North-street, Pentonville, London.

Handsome **Silver Watch,** perfect timekeeper, value 25s. Wanted Model Boiler Fittings, Steam Gauge, or 1½ bore Cylinder. Offers.—ADVERTISER, 14, Argyle-street, King's Cross.

Very powerful **Shocking Coil,** velvet covered, with regulator; and 5c.p. Electric Light Battery set, with Lamp. Exchange for Gem Air Gun.—JAMES SHARP, Sanquhar.

**Silver Watch,** in perfect going order, good appearance, and silver Albert. Exchange value 25s. Useful offers invited by—J. WALTON, 6, Goldsmith-road, Peckham.

**Rubber Type Printing Outfit** (Richford's), new, with all accessories. Useful exchange, value 4s. 6d., accepted; also Melton Cloth Coat and Waistcoat, large size.—WALTON.—Above.

One pair **A Standards,** for 2in. shafting, weight 60lb. Useful exchange, Tools.—MAYNER, Brighton-road, Redhill.

What offers for 24-cell **Daniell Battery,** 6 Sun Ammeters, Medical Coil, and job lot of Pushes.—HUDDLESTON, 21, Upham Park-road, Chiswick.

Small **Engine and Boiler,** 2 sets of Taps and Dies, Bench Drill, and Set of Drills. What offers?—HUDDLESTON, 21, Upham Park-road, Chiswick.

Pair of **S.N. Instruments,** 7 S.N. Keys,, 9 2-way Switches, several Iron Pulleys. Offers required. Stamp reply.—HUDDLESTON, 21, Upham Park-road, Chiswick.

Siemens **Dynamo,** series wound, 55 volts, 25 amps., shunt wound, 55 volts, 45 amps. What offers?—PERCY HUDDLESTON, 21, Upham Park-road, Chiswick.

Crompton-Bergin **Dynamo,** 75 volts, 100 amperes, compound wound; also quantity of 7-20 and 3-18 Cable. What offers? —HUDDLESTON, 21, Upham Park-road, Chiswick.

2 **Local Sounders,** 5 Sounders with relays, 7 Induction Coils, and quantity of Burglar Alarms. What offers?—HUDDLESTON, 21, Upham Park-road, Chiswick, W.

**Steam-Gauge** up to 120lb., ditto 40lb., McNaught's Steam Indicator; also several small Pulleys. Offers.—HUDDLESTON, 21, Upham Park-road, Chiswick, W.

## THE SIXPENNY SALE COLUMN.

*Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.*

**New Illustrated Price List of Screws, Bolts and** NUTS for Model Work, drawn to actual size, sent on receipt of stamp. —MORRIS COHEN, 132, Kirkgate, Leeds.

**Millar's Electric Depot, 14,** Deansgate, Manchester.—Best of everything electrical. Large stock. Low prices. Catalogues 3d.

**Tam o' Shanter Hones.**—Fine, medium, sharp qualities—razor, knife, joiner's—1s. 3d., 1s. 6d., and 2s., according to size, post free. Try these famous hones.—TAM O' SHANTER HONE CO. Dalmore, Stair, Ayrshire.

**Wheel-cutting and Dividing** to 12 inches diameter, in brass only.—CLEGG, Belinda-street, Hunslet, Leeds.

**Manchester Electrical Stores.** — For Bells, Cells, Wires, Chemicals; Medical Coils, Magnetos. Best terms.—BENTLEY, Newton-street.

**Fretwork, Carving, Repousse, and Leather** WORK. Catalogue of all requisites, six stamps.—HARGER BROS. Settle, Yorks.

**Fretwork Parcels,** 10ft., assorted, 4s. Fretwork Outfit, 2s. 6d. Fretsaws, 1s. 6d. gross, carriage paid.—Below.

**Turning Woods.**—Ebony, Box, Lignum Vitæ, Rosewood, parcels 5s. and 10s. each. Good value.—HARGER BROS., Settle.

**Practical Dynamo Building for Amateurs.** How to wind for any output, by F. Walker, illustrated, post free 2s. 1½d.—ILIFFE, 3, St. Bride street, E.C.

**Nicotine Difficulty Solved.** — All users of "Roll Call" Pipes say so. Splendid briars. Healthful, clea luxurious.

"**Roll Call**" **Pipes,** post free 1s. 2d. and 1s. 8d.— DEWSNAP, 268, Upper Brook-street, C. on M., Manchester.

**Brass Name Plate,** 9in. by 4½in., 4s. 6d. Lists free. —GILKES, Engraving Works, Reading.

**Machine Engraving and Dividing** on brass, ivory, and ebonite. Style and price unsurpassed.—GILKES, Engraving Works, Reading.

**Brass Window Plates,** engraved, for shop-fronts, any style or shape.—GILKES, Engraving Works, Reading.

**Zinc Stencil Plates** for sack, box, and ticket marking. All lists free.—GILKES' Engraving Works, Reading.

**Electric Light.**—Complete Installations, arc or incandescent. Catalogue three stamps.—J. SUNDERLAND and Co. Electrical Engineers, Halifax.

**To Earn Money.** — Particulars, specimens, and sample pen and pencil, with name and address, free to Agents. Best paying agency ever offered.—THE RICHFORD RUBBER STAMP COMPANY, 44, Snow-hill, London.

Self-centring **Lathe Chuck,** takes ⅛ wire to ⅝ drill, 4s. 3d. post free. Marvel of cheapness.—Below.

**Copper Bit,** with patent locking joint, several solder- irons in one, from 3s.—Below.

**Economic By-pass Workshop Gas Tap** and BURNER, save its cost in one week, 1s. 3d. post free.—Below.

**Spindles** for grindstones, emery wheels, &c.; Screw flanges, anti-friction rollers, hand and treadle, from 4s. 6d.—Below.

**Telephones,** guaranteed clear articulation any distance, free from infringement, unaffected by atmospheric changes, from 12s.—Below.

**Agglomerate Blocks and Bands,** No. 2, 5s. doz. sets. Send stamp and card for list, bells, indicators, &c.— BAUGHAN and Co., Charlbury.

**Dynamo,** 200 candles, improved armature, price £5. List and testimonials, one stamp.—D. WALTON, Engineer, Hebden Bridge.

**Dynamo,** 120 candles, improved armature, price £4 10s. List and testimonials, one stamp.

**Dynamo,** 60 candles, improved armature, 45s.; 30-candle, 28s.; 10-candle, 20s.; 5-candle, 14s. List and testimonials, one stamp.

**Dynamo Castings,** from 2s. 6d. per set. Wire, from 1s. per lb.; Punchings from 4s. 6d. per gross; Lamps from 1s. List, one stamp.

**Gas Engines,** from ½H.P. (Butterworth's patent) List and testimonials, one stamp.—D. WALTON, Engineer, Hebden Bridge.

**Microscopic Mounting Materials** of all kinds. List on application.—NORMAN, 178, City-road, E.C. Estab. 1848.

**On Hard Soldering.**—A useful work issued by Charles E. Rose, Jeweller, Bolton. With sample of solder, 1s. 6d.

**On Hard Soldering.** — A sample of easy running hard solder inclosed, with practical instructions.—ROSE, Jeweller, Bolton. 1s. 6d.

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English Mechanic
ORLD OF SCIENCE AND ART.
IDAY, NOVEMBER 28, 1890.

# TO CONSTRUCT A QUARTER CHIMING CLOCK.—V.

### —The Striking-Train Barrel.

s exactly like the going-train barrel ore described, and of same dimen-

### 12.—The Fusee.

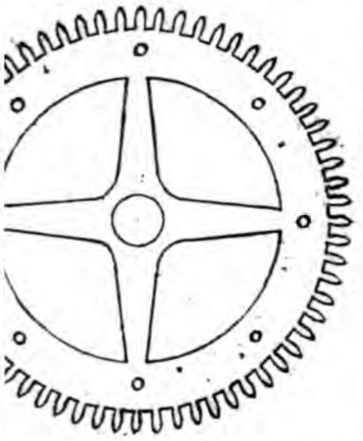
made in the same manner as going-isee, but dimensions are rather

ass body is of the same dimensions, great wheel measures $2\frac{1}{16}$in. diam. thick, and contains 84 teeth. The ing smaller, the ratchet is smaller ng 1in. in diam. The click and ing, key and fusee-arbor, and are same dimensions as in going

### 13.—The Pin-Wheel.

he next wheel in the striking train, $1\frac{5}{8}$in. in diam. by $\frac{3}{32}$in. thick, and 64 teeth. It is mounted on the ead in the same manner as the centre the going train. Its pinion has aves. The position of wheel and n arbor can be seen from Fig. 36.

Fig 37



hows plan of wheel, from which it een that the outer rim is left wider other wheels, to allow the eight e firmly planted. These pins should lly spaced out, or irregular striking the result. They must be made of l and polished steel, left as hard as and should be quite perpendicular. best riveted tightly into wheel, as, ed they may have a tendency to se. The pins should be about $\frac{3}{16}$in. care must be taken that they are e of the plate. The pivots of the l should be of good thickness, y that next the wheel, which should strong, as shown in Fig. 36.

### -The Striking-Hammer Arbor.

8 gives dimensions of this arbor. ts must be stout. Close to the back re is a short arm, as shown in Fig. should be fitted on a square formed f arbor, and riveted on. The whole ist be hardened and tempered, and lished. It will not do to leave the he square where the arm is riveted work against the plate: a second must be formed just beyond the id back cut, as shown in the figure, it the oil being drawn away from . It will be seen that this arbor

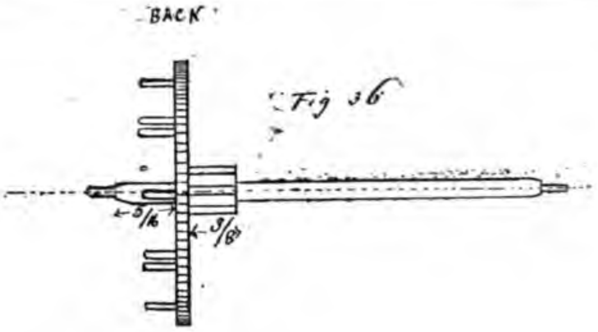
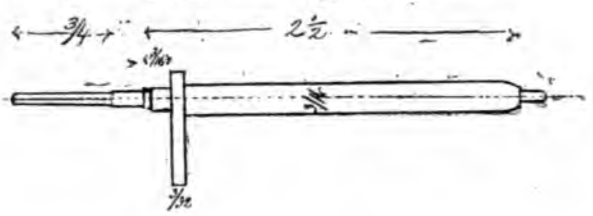


Fig 36

Fig 38



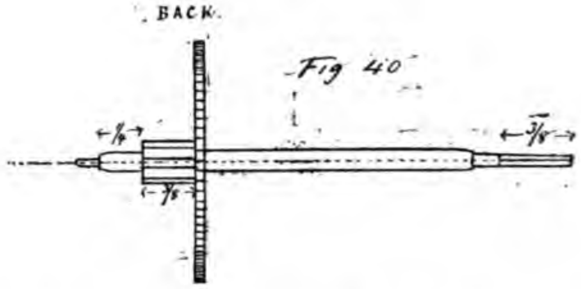
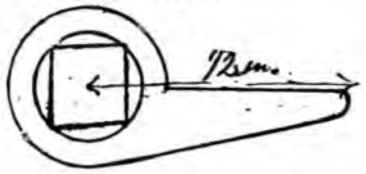


Fig 40

projects $\frac{3}{4}$in. through the back plate. This is squared and slightly tapered, to receive the hammer. The arm upon which the pin-wheel operates must be as hard as possible, and well polished. The tip must not be left

FIG. 39.



as a sharp edge, but should be rounded off slightly, or it will cut the pins badly.

### 15.—The Pallet-Wheel.

Fig. 40 shows the pallet-wheel. It measures $1\frac{1}{2}$in. diameter by $\frac{3}{32}$in. thick, and contains 63 teeth. Like the pin-wheel, it is mounted on the pinion-head. Its pinion has eight leaves, arrangement and dimensions as figure. It will be seen that the arbor projects through the front plate to the extent of $\frac{3}{8}$in., and is formed into a small tapered square, upon which the gathering pallet is fixed. The pivots should be of fair thickness, the front one being the stouter of the two.

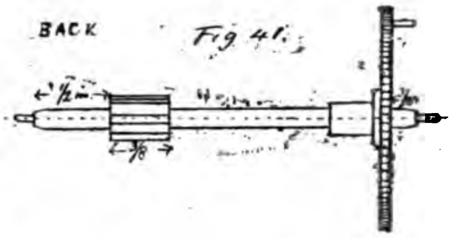
### 16.—The Warning Wheel.

The warning wheel (Fig. 41) is $1\frac{3}{8}$in. diameter and $\frac{3}{32}$in. thick, contains 56 teeth. It is mounted on a brass collet in same manner as the third wheel of the going train. The figure shows position of wheel and pinion. There being no great strain on this wheel, the pivots are made rather fine. There is a pin projecting from the rim of the wheel, which engages with the lifting-piece shown in Fig. 1, which is a general view of the striking mechanism, &c. This pin is of hardened and polished steel, rather less than $\frac{1}{16}$in. thick, and projects $\frac{1}{8}$in. from the wheel, the end being just free of the plate. It should be riveted in, and care taken that it is quite perpendicular. The pinion has seven leaves.

### 17.—The Fly.

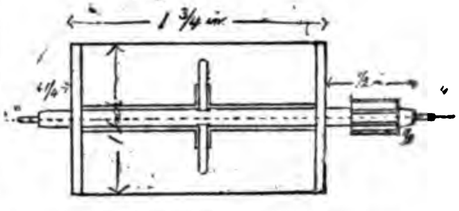
The fly is shown in Fig. 42. It consists of a pinion of seven leaves, upon which is mounted a fan. This fan is free to revolve

Fig 41



upon the pinion-arbor, but is held friction-tight by a small steel spring A, which works in a shallow groove on the arbor. In the figure the dimensions of the parts are all given. Fig. 42 is a general view. Fig. 43 is a section taken at the point A, where the fan is held by the small spring. Fig. 44 shows the construction of the fly. It should

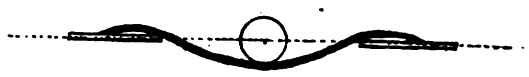
Fig 42



be made of very thin brass. The end pieces may be $\frac{3}{32}$in. wide, and must be made as light as possible. It is to be soft-soldered, and riveted together. The whole fly is made very lightly, and should be quite easy on

LII.—No. 1340.

Fig 43.



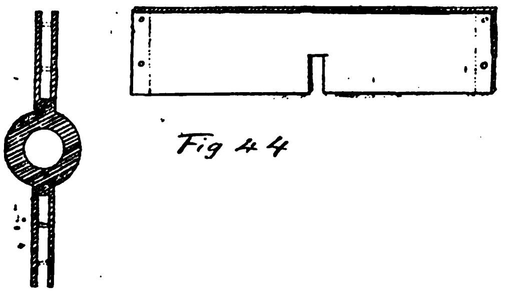


Fig 44

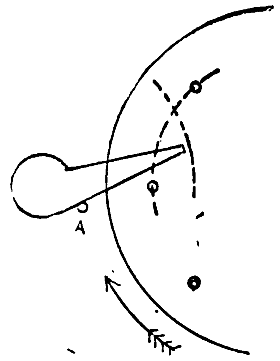
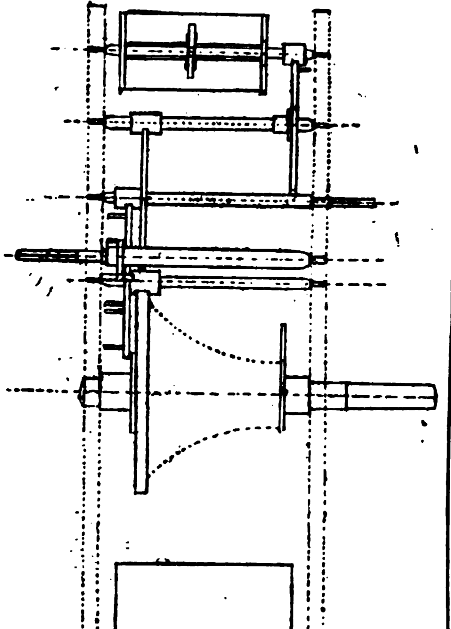


FIG 46

the arbor—easy enough to drop off when the piece of spring is removed. This steel spring may be 1/16in. wide and as thick as watch-spring, and just strong enough to hold the fly to the pinion arbor so that one cannot revolve very easily without the other. If the fly were made solid in one piece with the pinion, there would be too great a shock on the stopping of the train suddenly by the pin in warning-wheel or the gathering pallet, and the pins and pivots would be strained. But this arrangement allows the fly to run forward on its arbor until its impetus is spent. When the train is running, the pallet-wheel, warning wheel, and fly act as a sort of flywheel, and when stopped suddenly by the wing on the gathering pallet, have a tendency to run on and cause an injurious strain on the pivots, &c. This cannot be entirely avoided, but is greatly reduced by arranging the fly in the manner described, and making the train-wheels as light as possible. This should be borne in mind when crossing out and finishing off these wheels, as well as those in the chiming train. If slow striking is preferred, a regulating fly should be used, like that to be described in connection with the chiming train.

Fig 45



### Pitching the Striking Train.

Having now completed the striking train, the next thing will be to pitch the depths.

Take the back plate and draw a line straight across it through the centre-wheel hole. On this line, 2⅝in. from the centre-wheel hole, drill the hole for fusee back pivot, and mark off the place for front pivot as before described. Immediately above this, in a straight line, mark off the pin-wheel pivot-holes; above this, but about ¼in. further to the right, drill the pallet-wheel pivot-holes. In a line with the pin-wheel and pallet-wheel, and above them both, drill holes for warning-wheel pivots. The fly is placed above the warning wheel, but somewhat to the left. A reference to Fig. 1 will show their positions. The barrel is planted 2¾in. below the fusee-holes and somewhat to the left as shown in Fig. 1. Fig. 45 shows the arrangement of the striking train. The hour-hammer arbor is planted rather higher than the centre of pin-wheel and near the edge of plate. The depth to which the arm engages with pins in minute-wheel is shown in Fig. 46.

The ratchet and click for barrel-arbor are exactly the same as in the going train (No. 10). Stopwork and chain, &c., to be described later on, when all the train-wheels are completed.

## REVIEWS.

*The Chemistry of Iron and Steel Making.* By W. MATTIEU WILLIAMS, F.C.S., F.R.A.S: London: Chatto and Windus.

THE author of this work is well known to our readers by repute, and if we mention that he was formerly chemist in the works of Sir J. Brown and Co., they will understand that he has some pretensions to be able to write a book which will instruct workers in iron and steel manufacture in the technology of their trade. Mr. Williams, pertinently, we might almost say necessarily, draws attention to the difference between "technical" and "technological" education, the former a word much hackneyed of late, but which means merely the learning of the operations necessary to produce a desired result, whereas the latter word means the learning of the "why and the wherefore" of those operations—in other words, the principles underlying the work of the craftsman. It is technological education that is wanted—not technical—for the apprentice learns that in the ordinary workshop routine. The present work deals with the chemical technology of iron and steel, and, to a certain extent, is a history of the development of the industries of the iron trade. In some parts Mr. Williams is argumentative, and differs from the "authorities," but when he does so he states his reasons and the experiments or data on which they are based. The chapters headed "What is Steel?" "Fallacies Concerning Steel," and "A Theory of Steel" possess special interest to many of our readers. Beyond those, however, the work is full of information of great value to all who wish to understand the reason for this and that in the manufacture, working, and treatment of iron and steel. The work is readable as well as "scientific," and some of Mr. Williams's remarks are almost amusing, as, for instance, where he quotes a well-known work on Physics, in which "tempering" is confused with "hardening."

*The Metallurgy of Gold, Silver, and Mercury in the United States.* By THOMAS EGLESTON, LL.D. London: Offices of *Engineering*. New York: John Wiley and Sons.

THIS is the second volume of an elaborate treatise on the metallurgy of the more valuable metals as practised in the United States, but its publication has been delayed by circumstances beyond the author's control. The first volume dealt with the metallurgy of silver—a metal which has been the source of enormous fortunes to several well-known men, and another will treat on the methods of dealing with the silver-bearing lead ores. Gold and mercury run together, so far as metallurgy is concerned, and the importance of the subject was well shown in some letters which appeared not long ago in our columns, as it seems that no process has yet been devised which will extract all the gold. Modern appliances have, however, materially reduced the expenses of extracting the gold, and the author informs us that in one instance at least a mine was worked at a profit on a yield of only 60 cents a ton of material treated. That is an exceptional case; but in California gold-bearing quartz is profitably worked on a yield of 5 dollars per ton. The matter included in these volumes is the result of personal inspection by the author during several tours, in which he visited the principal metallurgical establishments of the United States and the Territories, and as it is freely illustrated, the work forms the most useful and elaborate treatise on the subject that has been published. Dr. Egleston says that it seems to have been clearly proved that gold is not only not insoluble, but that in nature it is constantly being dissolved out of the rocks and placers—the waters of filtration dissolving out of the rocks, in their passage through them, all the materials necessary for the solution of the gold, which is carried in dilute solutions until it meets some substance that precipitates it. This volume contains over 900 pages, and is a work that will be found of great value to those engaged in the labour of extracting the precious metal and in separating the mercury from the ores, which, in the form of metallic mercury and cinnabar, occur in large quantities in California.

*Electrical Engineering.* By W. SLINGO and A. BROOKER. London: Longmans.

MESSRS. SLINGO and BROOKER are two well-known teachers of electrical engineering, and having been asked by artisans and students to recommend a work covering the whole field of electric lighting, their inability to comply with the request prompted them to endeavour to supply the wants of both workmen and students, while giving such information as will assist those who have, to a certain extent, the supervision of electrical machinery. The authors recognise that the most successful electrical engineers are, a rule, evolved from men who are go mechanical engineers, and while giving clear insight into the purely scientific as wel as the practical part of the subject, so far a the former is concerned it is limited to th principles of electric lighting and electri transmission of power. At the same time, the work covers the syllabus of the City and Guilds of London Institute, and as mathematical formulæ have been avoided as far as the work may be commended to dually increasing number of those ire to become acquainted with the applications of electricity. There illustrations, which include nearly ıost useful machines and appliances.

*c Chemistry, Theoretical and Prac-* By WILLIAM JAGO, F.C.S., F.I.C. ın: Longmans.

thor of this work has had so much ıce that his manual for students in d classes (one of the publishers' ıd Science Manuals) will probably be ıd by teachers as well as by students, the author has assumed that the ; possessed of such knowledge as can ired from an elementary textbook. : methods are not included, because o has recently written a short treatise branch; but he has taken advantage vorks of Miller, Mayer, Roscoe, and and has produced a volume which ıseful to many who have no thought ;ting in examinations.

*History of the Animal Kingdom for Ise of Young People.* By W. F. r, F.E.S. London: Society for oting Christian Knowledge.

mirably-produced volume is divided ee parts, comprising the Mammalia; rds; and the Reptiles, Amphibia, Insects, Worms, Molluscs, and tes. It is abridged from the German y Prof. von Schubert, by the well-entomologist whose name appears on ı-page, who has judiciously executed :. Too much praise can hardly be the illustrations, which are numerous ellent. For use in schools, or for a ıtion volume to young people, one ırdly select a better book of its class.

*s of Articles on Food, and How it is ted.* By T. R. ALLINSON, L.R.C.P. ın: F. Pitman, 20, Paternoster-E.C.

LINSON, the Medical Editor of the *Times and Echo*, has, in this plainly-and sensible sixpenny treatise, put yspeptics and the rest of the sufferers ıdigestion the one real and natural He explains the process of diges- ints out the merits and demerits of t kinds of food, shows how the im- :e and excessive consumption of ıolesome food engenders disease, and s the easy and certain method of g perfect health without the aid of ; doctor. As most people know, Dr. ı is, in practice and precept, a an; but he is not a bigoted one, and ate flesh-eater who will live by his ill find, not the greatest benefit , but certainly the utmost security the troubles which beset over-fed ıngly-fed humanity, to the gain of ck-medicine mongers and the ruin of onstitutions.

ave also received *Traité d'Astronomie* ;, by GELION TOWNE (Paris: E. :), a work which is well said to be ous," and which will be welcomed mateurs and others who read French. sphère Céleste, by Léon Fenet, show- magnitudes of the stars with an ın of the colour, renders the work to all who have occasion to observe rs in either hemisphere.——*Science to Work*, by JOHN A. BOWER ı: Cassell and Co., Limited), is a ork that has been written specially Artisan Section of the National Home ; Union; but is also adapted as an :tion to the science of practical ics, notably in technical schools.——*t of Bookbinding*, by JOSEPH W. DORF (London: George Bell and ; the second edition of an illustrated work on the art of bookbinding by a well-known worker. It forms one of the technological handbooks of the publishers, and has plates in colour illustrating choice specimens of binding.——*Printing*, by CHARLES THOMAS JACOBI (London: George Bell and Sons), is another "technological handbook"; but the author more correctly says that it is a contribution to the advancement of technical education. It is a practical treatise on the art of typography, freely illustrated, and well adapted for those who wish to understand the whole art of printing a book.——*Coral Reefs: Geological Observations on the Volcanic Islands and Parts of South America*, by CHARLES DARWIN (London: Ward, Lock and Co.) is a volume in the Minerva Library, containing three of Darwin's works, with a critical introduction to each by Prof. John W. Judd, F.R.S., illustrated with maps, plates, and engravings. Those who remember the voyage of the *Beagle*, and the attention which was drawn to the writings of Charles Darwin, will be glad to have this work in so convenient a form. Prof. Judd may well call it a remarkable "trilogy," and as the book is clearly printed, it will be welcomed by all students who cannot afford the price of the original editions.——*A Treatise on the Metallurgy of Iron*, by H. BAUERMAN, F.G.S. (London: Crosby Lockwood and Son) is the sixth addition of a well-known textbook. The necessary additions have been added as supplementary notes, bringing the work practically up to date.——*My Life and Balloon Experiences*, by HENRY COXWELL (London: W. H. Allen and Co.), is the "second series" of the veteran aëronaut's interesting and amusing record of his adventures with his balloons. In concluding, Mr. Coxwell says that "ballooning is still an infant, but it will lead to aërial navigation."——*How to Make a Dynamo*, by ALFRED CROFTS (London: Crosby Lockwood and Son), is the third edition, revised and enlarged, of a useful practical treatise for amateurs which has already had a large sale.——*Cycles and Cycling*, by H. HEWITT GRIFFIN (London: George Bell and Sons), is a history of the origin and development of the "cycle" under various names, accompanied by some curious illustrations of the ancient machines. Mr. Griffin, in Chapter II., does full justice to the part played by the ENGLISH MECHANIC in developing the modern cycle:—"The thanks of the cycle constructors and riders all the world over are due to this journal for having acted as foster-mother to 'countless germs of thought.'" Every cyclist will be glad to have this little work, for it is freely illustrated, and there is much useful information in its pages.

## JONES'S IMPROVED PUZZLE.

THE puzzle illustrated in the annexed diagram has been patented in this country by Mr. F. Jones, of Pompton Plains, New Jersey, and is of the kind in which it is the object of the operator to get all the "marbles," &c., into one division. This invention, then, is claimed to form a new device wherein a different arrangement of compartments is provided, giving a new and possibly more difficult game, the object being, as in all such puzzles, to get the animals represented by marbles or other spheres from one or more compartments into a predetermined compartment. The novelty in the present instance resides in the peculiar construction of the box or receptacle whereby a new arrangement of compartments and passage-ways is produced. Fig. 1 is a plan, and Fig. 2 a cross-section of the device. A designates a suitable receptacle. It may be a box or any other analogous receptacle having side and end pieces, *a*, which serve to prevent loss or displacement of the marbles or other spheres. The interior of the box is divided by means of suitable strips, B, which are arranged as follows:—Beginning at one end, substantially at the middle thereof, is a short strip or piece, *b*, which is glued or otherwise fixed in place, and joining the end piece of the receptacle with a strip or piece, *c*, which is arranged substantially parallel to the end, but of less length than the end piece, so as to leave a passage at each side. From the strip *c* there extends a strip or piece *d*, substantially parallel with the side piece of the receptacle, but of less length than the side piece, so as to leave a passage-way, *e*, the full length of the box. Upon the opposite side there is a piece *f*, of less length than the strip or piece *d*, and extending in a slightly-angular direction instead of parallel with the side piece. Extending from the strip *c*, between the strips or pieces *d* and *f*, and of less length than the strip *f*, is the strip *g*, which extends at an angle to these strips, as clearly shown in Fig. 1. At the end of the receptacle, opposite the strip or piece *c*, there are arranged the three strips or pieces *h*, *i*, and *j*, the two latter being arranged substantially parallel with the sides of the receptacle and the other at an angle thereto, as shown, the piece *j* being shorter than the piece *i*. In practice the game will be to get the spheres from the receptacle or passage-way *e* into the compartment *l*. This, owing to the peculiar arrangement of strips and passage-ways, will be found to be a very difficult task. Any number of spheres may be employed in playing the game, and marbles or any other suitable devices may be used.

Fig. 1.

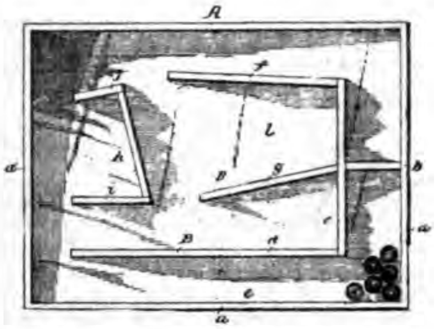
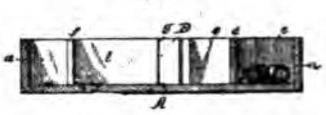


Fig 2



## ASTRONOMICAL NOTES FOR DECEMBER, 1890.

### The Sun.

| Day of Month. | Souths. | At Greenwich Mean Noon. | | |
|---|---|---|---|---|
| | | Right Ascension. | Declination South. | Sidereal Time. |
| | h. m. s. | h. m. s. | ° ′ ″ | h. m. s. |
| 1 | 11 49 13·43 AM | 16 30 24 | 21 51 25 | 16 41 10·69 |
| 6 | 11 51 14·41 ,, | 16 52 8 | 22 32 14 | 17 0 53·47 |
| 11 | 11 53 28·73 ,, | 17 14 5 | 23 2 3 | 17 20 36·27 |
| 16 | 11 55 52·47 ,, | 17 36 12 | 23 20 29 | 17 40 19·06 |
| 21 | 11 58 21·03 ,, | 17 58 23 | 23 27 13 | 18 0 1·85 |
| 26 | 0 0 50·28 PM | 18 20 35 | 23 22 11 | 18 19 44·64 |
| 31 | 0 3 16·34 ,, | 18 42 44 | 23 5 26 | 18 39 27·43 |

The method of finding the Sidereal Time at Mean Noon at any other station is explained on p. 353 of Vol. L.

The student will continue his watch for spots and faculæ on the solar disc, whenever the sun is visible.

At 8h. 45m. p.m. on December 21st the Sun is said, technically, to enter (the sign) Capricornus, and winter is supposed to commence. He is in reality at this instant at the right angle of a right-angled triangle formed with μ and λ Sagittarii. This is the theoretical date of the shortest day; but in London no sensible difference in this respect will be visible from the 20th to the 22nd inclusive, the sun remaining for 7h. and 44m. only

### Occultations of (and Near Approaches to) Fixed Stars and an Occultation of Neptune by the Moon.

| Day of Month. | Star's Name. | Magnitude. | Disappearance. | Moon's Limb. | Angle from N. Point. | Angle from Vertex. | Reappearance. | Moon's Limb. | Angle from N. Point. | Angle from Vertex. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | h. m. | | ° | ° | h. m. | | ° | ° |
| 3 | η Leonis | 3½ | †4 30 a.m. | N N E | 25 | 37 | | | | |
| 8 | B.A.C. 4647 | 6 | 4 47 ,, | Bright | 83 | 117 | 5 41 a.m. | Dark | 340 | 8 |
| 18 | 30 Piscium | 5 | 8 35 p.m. | Dark | 57 | 33 | 9 41 p.m. | Bright | 239 | 208 |
| 18 | 33 Piscium · | 5 | 10 27 ,, | Dark | 97 | 62 | 11 15 ,, | Bright | 206 | 168 |
| 20 | ν Piscium* | 4½ | 7 35 ,, | Dark | 61 | 62 | 8 49 ,, | Bright | 233 | 218 |
| 21 | B.A.C. 741 | 6½ | 3 8 ,, | Dark | 104 | 143 | 3 53 ,, | Bright | 201 | 239 |
| 21 | B.A.C. 755 | 6 | †5 16 ,, | NWbyN | 330 | 3 | | | | |
| 22 | 38 Arietis | 5 | 3 13 a.m. | Dark | 59 | 21 | ‡4 5 a.m. | Bright | 265 | 230 |
| 23 | NEPTUNE | — | 9 7 p.m. | Dark | 133 | 149 | 9 38 p.m. | Bright | 182 | 189 |
| 25 | 5 Geminorum | 6 | 10 40 ,, | Dark | 97 | 118 | 11 58 ,, | Bright | 247 | 243 |
| 27 | 52 Geminorum | 6 | †3 52 a.m. | N by E | 9 | 329 | | | | |
| 28 | γ Cancri | 4½ | †6 29 p.m. | S | 185 | 219 | | | | |
| 30 | B.A.C. 3579 | 6 | 10 43 ,, | Bright | 174 | 215 | 11 8 ,, | Dark | 219 | 259 |
| 31 | ι Leonis | 6 | 12 30 a.m. | Bright | 146 | 182 | 1 33 a.m. | Dark | 258 | 287 |

†Near approach to. ‡The Moon has set.

An illustrated explanation of the above Table will be found on p. 353 of Vol. L.

above the horizon (and, of course, for 16h. 16m. below it) on all three of the days specified. This affords a very favourable opportunity for the determination of the Meridian by the ancient method of equal altitudes.

At 7 p.m. on December 31st, the sun will be in Perigee, which is only another way of saying that, at the time specified, the earth will be in that part of her orbit where she approaches within the least distance of him. If we accept the official parallax adopted in the *Nautical Almanac*, 8·848″, the centres of the earth and sun will then be separated by an interval of only 90,842,919 miles. There will be an

### Eclipse of the Sun

on December 11; but as it will only be visible from the Southern half of Australia, New Zealand, &c, the mere mention of its occurrence will suffice here.

### The Moon

enters her Last Quarter at 1h. 26·6m. p.m. in the afternoon of the 4th., and is New at 3h. 10·9m. a.m. on the 12th. She will enter her First Quarter on the 18th, at 8h. 36·3m. p.m.; and be Full at 5h. 57·1m. in the early morning of the 26th.

| Day of Month. | Moon's Age at Noon. | Souths. |
|---|---|---|
| | Days. | h. m. |
| 1 | 18·9 | 3 40·4 a.m. |
| 6 | 23·9 | 7 20·5 ,, |
| 11 | 28·9 | 11 16·5 ,, |
| 16 | 4·4 | 4 18·5 p.m. |
| 21 | 9·4 | 8 24·9 ,, |
| 26 | 14·4 | *12 40·7 a.m. |
| 31 | 19·4 | 3 52·4 ,, |

* Early morning of 27th.

The Moon is in conjunction with Saturn (3° 44′ N. of him) at 7h. p.m. on the 4th; with Venus at 7h. a.m. on the 11th (Venus 0° 36′ N.); with Mercury at 5h. a.m. on the 13th (Mercury 0° 23′ S.); with Jupiter at 2h. p.m. on the 15th (Jupiter 3° 44′ N.); and with Mars at 9h. p.m. on the 16th (Mars 4° 14′ N.)

At noon on December 1st the Moon is just to the North of γ Cancri; but passes out of Cancer into Leo at 6h. a.m. on the 2nd. She remains in Leo until 6h. 30m. a.m. on the 5th, when she leaves it for Virgo. Her journey through Virgo terminates at 8 p.m. on the 8th, and then she enters Libra. Crossing Libra, she is found, at 4h. p.m. on the 10th, in the western confines of the northern spike of Scorpio over which she travels, and comes out in Ophiuchus at 3h. a.m. on the 11th. She is in Ophiuchus until 1 p.m. on the 12th. She then quits it for Sagittarius; as she does Sagittarius, in turn, for Capricornus on the 14th. Her passage through Capricornus finishes at noon on the 16th, when she crosses the boundary into Aquarius. She continues in Aquarius until 2h. p.m. on the 18th, and then enters Pisces. In travelling through Pisces she enters an outlying portion of Cetus at 4 o'clock in the early morning of the 19th, re-entering Pisces at 7 a.m. on the 20th. After travelling a little further through Pisces, she plunges, for the second time, into Cetus at 4h. 30m. a.m. on the 21st; and when she finally quits Cetus at 1h. 30m. p.m. on the 21st, she emerges in Aries. By 9h. p.m. on the 22nd she has left Aries for Taurus, and is travelling through the last-named constellation until 7h. 30m. p.m. on the 25th, when she enters Gemini. She is in Gemini until 10h. 30m. p.m. on the 27th, at which hour she leaves it for Cancer. Having crossed Cancer, which she does by 2h. p.m. on the 29th, she passes into Leo, through which she is still journeying when the year 1890 terminates.

### Mercury

is, nominally, an Evening Star, and attains his greatest elongation East of the Sun (19° 36′) at noon on the 28th; but as his South Declination is between 25° and 26° during the earlier part of December, merely diminishing to between 21° and 22° at the end of it, he is shrouded in the mists of the winter horizon, is to all intents and purposes invisible, and an ephemeris of him would only occupy space uselessly.

### Venus

comes into inferior conjunction with the Sun at 5h. a.m. on December 4th, having then between 23° and 24° of South Declination. This diminishes towards the end of the month, and she *may* be picked up in the East before sunrise. As in the case of Mercury, however, she is, for the observer's purpose, practically invisible, and, also as in his case, an ephemeris would needlessly fill space we cannot afford.

### Mars,

for the observer's purpose, may be held to have left us until the summer of 1892, and

### Jupiter

until the corresponding season in 1891.

### Saturn

Rises about 11h. 50m. on the night of the 1st, and about 9h. 55m. on the last night of the year. Hence towards the end of December he is fairly observable by midnight, though, of course, he gets into a better position in the early morning. He is in quadrature with the sun at midnight on the 8th. His angular equatorial diameter increases, quite imperceptibly, from 15·8″ on the 1st, to 16·6′ by the end of December. The gradual closing up of his ring system will strike the attentive observer.

| Day of month. | Right Ascension. | Declination North. | Souths. |
|---|---|---|---|
| | h. m. | ° ′ | h. m. |
| 1 | 11 13·4 | 6 59·8 | 6 33·1 a.m. |
| 6 | 11 14·2 | 6 56·0 | 6 14·3 ,, |
| 11 | 11 14·9 | 6 53·2 | 5 55·3 ,, |
| 16 | 11 15·4 | 6 51·4 | 5 36·1 ,, |
| 21 | 11 15·7 | 6 50·7 | 5 16·8 ,, |
| 26 | 11 15·9 | 6 51·1 | 4 57·3 ,, |
| 31 | 11 15·9 | 6 52·6 | 4 37·7 ,, |

The path indicated in the above ephemeris lies a few minutes to the North of the 4th magnitude Star σ Leonis.

### Uranus

Is invisible, but

### Neptune

May be seen all night long, and is, in every respect, well placed for the observer.

| Day of Month. | Right Ascension. | Declination North. | Souths. |
|---|---|---|---|
| | h. m. | ° ′ | h. m. |
| 1 | 4 14·7 | 19 33·1 | 11 31·6 p.m. |
| 6 | 4 14·1 | 19 31·7 | 11 11·3 ,, |
| 11 | 4 13·5 | 19 30·3 | 10 51·1 ,, |
| 16 | 4 13·0 | 19 29·0 | 10 30·9 ,, |
| 21 | 4 12·4 | 19 27·7 | 10 10·7 ,, |
| 26 | 4 11·9 | 19 26·6 | 9 50·5 ,, |
| 31 | 4 11·4 | 19 25·5 | 9 30·4 ,, |

The short retrograde arc thus shown lies somewhat to the west, and, roughly, ½° to the north of the 4-3 mag. star ε Tauri.

### Minima of the Variable Star Algol

will happen on December 8 at 5h. 52m. a.m.; on the 11th at 2h. 40m. a.m., on the 13th at 11h. 29m. p.m., on the 16th at 8h. 18m. p.m., on the 19th at 5h. 7m. p.m., on the 28th at 7h. 33m. a.m., and on the 31st at 4h. 22m. a.m., as well as on other occasions, when the phenomenon will be invisible.

### Shooting Stars

are less numerous in December than they are in the previous month. The most likely nights on which showers might be expected are from the 10th to the 13th (notably on that of the 10th) on the 21st, and again on the 24th.

### Greenwich Mean Time of Southing of Fifteen of the Principal Fixed Stars on the Night of December 1st, 1890.

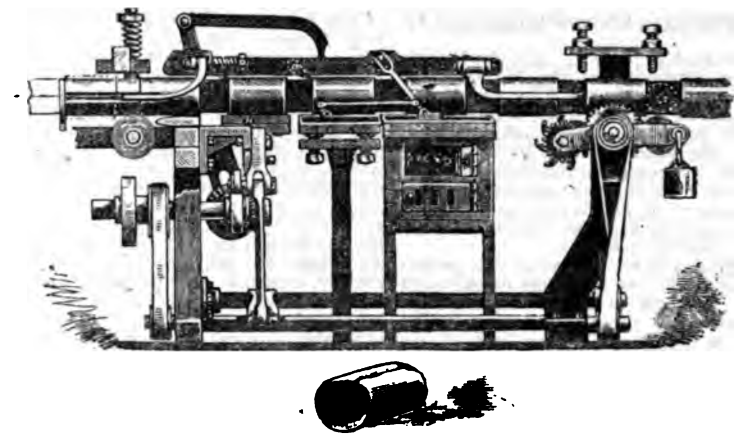
| Star. | Souths. |
|---|---|
| | h. m. s. |
| α Aquarii .. .. .. | 5 18 6·52 p.m. |
| Fomalhaut .. .. .. | 6 9 24·89 ,, |
| Markab .. .. .. | 6 17 5·98 ,, |
| ι Piscium .. .. .. | 6 52 1·23 ,, |
| α Andromedæ .. .. .. | 7 20 21·24 ,, |
| α Cassiopeiæ .. .. .. | 7 51 50·58 ,, |
| Polaris .. .. .. .. | 8 36 39·02 ,, |
| α Arietis .. .. .. | 9 18 18·85 ,, |
| α Ceti .. .. .. .. | 10 13 43·17 ,, |
| α Persei .. .. .. | 10 33 37·64 ,, |
| γ¹ Eridani .. .. .. | 11 9 36·00 ,, |
| Aldebaran .. .. .. | 11 46 33·06 ,, |
| Capella .. .. .. .. | *12 25 25·02 ,, |
| Rigel .. .. .. .. | *12 26 4·80 ,, |
| α Leporis .. .. .. | *12 44 39·30 ,, |

* Early morning of 2nd.

The method of finding the Green Mean Time of Southing of either of the sta the above list for any other night in Decemb also that of determining the Local instant o Transit at any other station, will be found p. 354 of Vol. L. It must be noted, how that the rules there given are not rigidly acc as applied to Polaris, or, in fact, to any circumpolar star, although they will probably found to be quite sufficiently so in actual prac

## JENSEN SOLDERING MACHI

THE illustrations show a device adopted by Jensen Can-Filling Co., of Astoria, O U.S.A., for soldering the cans used for salmon, lobster, &c. The machine is provid bending in the ends of the can body at the shown in the detached view, preparatory to them through the machine. The machine intermittent feed motion, which takes the can from the horn at the front of the machine, the body forward to the bending dies, where ends of the body at the seam are curved shown. The next forward movement of the carries it through the fluxing device, which the seam to touch the flux, while the flux is prev from entering the can by the turned-up ends. next forward movement carries the can through the soldering device, which closes up seam with solder. Another movement carries can across the wiper, which removes the fluous solder. The next movement carries the between a pair of dies, which straighten the and restore it to its original form. Another ment carries the can out of the machine, when is ready for further manipulation. The sev



s of the parts of the machine are effected mious arrangement of cams and gearing, aole is driven by any suitable power. By this improved machine the solder is the seam, and is prevented from entering of the can during the process of solder- his manner the spoiling or poisoning of its of the finished can is avoided, and, re, a considerable saving in solder is

## EL METHOD OF MOUNTING PRINTS.*

rous are the styles in use at present for ·mounting, and so various the colours and pearance of the mounts used, that it ost impossible to suggest anything new. d we are about to describe is particularly r use with platinotype, gelatino-bromide, nds of prints where the black engraving ffect are to be preserved, and it has the advantage of extreme economy.

the favourite methods, if not the most style at the present time, is the k" mount, with or without India yle which undoubtedly adds a most ish to prints in the now popular tone. mounts are comparatively expensive, e we have to recommend give a nearly t at a mere nominal cost, and may be k," if desired, with very little extra

ce of material for the mounts may take e range, though for general purposes we most suitable a slightly-tinted cartridge paper of not too rough a texture. For triking effects, the roughest drawing, or ping papers, may be used in much the ner as modern bookbinders adopt for he public eye by means of an uncon- or even eccentric, cover. We have en a series of prints so mounted on a drab wrapping paper of not too super- ity.

, of course, one important precaution to taken in using such common materials , that is, in the sense that they are not free from chemical impurities—namely, emove or in some other manner render ny foreign matters that may be present nt. Fortunately, from the nature of the well as the process of mounting, this be a difficult matter. As will be seen, process consists in thoroughly damping as well as the print, which in the case of er does not present the same difficulties ase of a built-up cardboard; while the ndergoing the damping process, it is an r to submit it to a little extra washing, ssary, chemical treatment, in order to impurities if such be suspected. Or to the print may be at least lessened g a more or less impervious varnish to which, while not preventing the absorp- er, forms a protective coating when dry. nish is found in bleached lac dissolved in lution of borax; if this be applied to nount before damping, it will dry with- g any gloss, and when the mount is ly soaked any excess of borax will be and when dry the impurities will be m the print.

hod of mounting consists in immersing ng paper previously cut roughly to size ater, assuming that any necessary pre- as been already effected. When per- the sheets are taken out of the water ired, blotted off between blotting-paper. ints are similarly treated, and then both ount—the latter over such part only as the print is to occupy—well impregnated with the mountant. If the print only be treated, it will in all probability peel off at the edges on drying. Nothing answers so well for mounting as arrowroot paste made pretty thick and allowed to cool, then squeezed through fine cambric to remove lumps. It should be used fresh, as it soon becomes watery, in which condition it loses its adhesive power.

A convenient plan for applying the mountant to the centre of the mount consists in making a mask from stout, smooth paper, or perhaps better still, from thin sheet zinc of the outside dimensions of the mount with a central aperture a little larger—say ⅛in. each way—than the print. If this be laid on the damp mount, the arrowroot is easily applied to the proper portions with a sponge, and the print can be laid down in its position before removing the mask. The narrow strip of arrowroot extending beyond the edges of the print may be removed by means of a damp sponge after the print is rubbed down; but this is scarcely needful, as it dries perfectly matt, and is only likely to show on a coloured mount.

With regard to the rubbing down, this is not so simple a matter with gelatine-surfaced papers as with albumen or platinotype; but all difficulty is surmounted by interposing a sheet of the thin paraffin-wax-saturated tissue paper sold for wrapping or waterproof purposes. This, while it adheres closely to the gelatine surface during the rubbing, comes easily away from it when it has served its purpose.

We next come to the drying, which is the most important part of the process if perfection of result is desired. It will be noticed that in order to avoid "cockling" of the dried print, the mount as well as the print has been moistened so that each may swell and shrink equally; but this is not alone effective. If left to dry alone, the edges of the mount will dry first, the extra thickness of the print-covered portion remaining damp for a considerably longer period, and taking a saucer shape from the contraction of the surrounding portions. To obviate this, the print as soon as mounted may be pinned to a flat board, or laid on a sheet of glass and the edges of the mount turned over and stuck at the back. But by far the better plan is to have a quantity of sheets of clean blotting-paper slightly larger than the mounted prints. Let these be thoroughly dried by exposing them for some time in a hot oven, then packing in a mass, and wrapping in tinfoil until required.

The prints are allowed to become partially dry; but before they lose their limpness, or show any tendency to curl, they are taken singly and placed between the blotting-pads, at least two sheets of drying paper intervening between each pair of prints. In the case of gelatine-surfaced prints a sheet of waxed tissue paper is also necessary. If the pile of interleaved prints be now placed under gentle pressure for a few hours, they will be found perfectly dry, and as flat as if they had been rolled. It only now remains to trim the mounts to size, and, if desired, to apply a "plate mark" by giving the print a "squeeze" in a copying press between folds of paper or in the copying-book, a plate of zinc of the proper size, and with its edges slightly bevelled, being laid over the face of the print.

Such prints are equally suitable for framing, for binding, or for keeping loose in a portfolio; for the two last purposes, indeed, this method of mounting is more convenient than any others we have tried.

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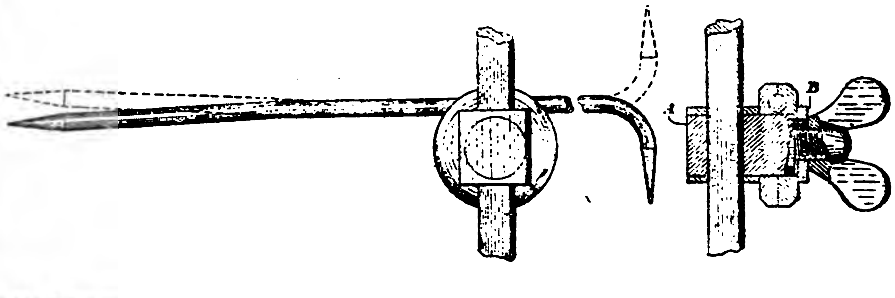
m the *British Journal of Photography.*

## FINE ADJUSTMENT FOR SURFACE GAUGE.

THE surface gauge with fine adjustment shown in the annexed illustration is considered by Mr. W. Gribben, who writes to the *American Machinist*, an improvement, as it combines the desirable features of simplicity, rigidity, and convenience in use, and the adjustment is accomplished in a manner radically different from any he had seen up to date. It is in the washers that clamp the scriber and in the scriber itself that the chief features lie. The washers were cut out square from sheet steel and soldered together; the hole for the scriber was then drilled and finished with a rose reamer made of the same sized wire as the scriber. After this the centre hole was made in the washers, and they were turned up round, polished, and then unsoldered. After cleaning off the solder, the washers will bring up solid on their inside faces at the same time that they clamp the scriber. Although the clamping is tight enough to prevent the scriber from being moved endwise through the washers, or the washers from being rotated on the stud A, the scriber can be twisted in its bearing by grasping its hooked end, as this latter has so much leverage over the comparatively small diameter of the wire. This being the case, a slight bend in the scriber, about one-quarter of its length from the point, would cause its point to run eccentrically when the scriber was rotated in its bearing in the washers, if the latter held it at about its mid-length. The cut of the scriber shows the bend in an exaggerated degree, it being made in the same direction as the hook, the dotted lines showing the parts after the scriber is given a half-turn in its bearing. If the hook is set horizontally at first, the point at the other end will then be in the middle of its range of adjustment, and may be raised by twisting the hook up, or lowered by twisting it down. The scriber has about ·02in. range of adjustment, which was found amply sufficient. However, the scriber may be bent more if necessary, but it would detract somewhat from the looks of the tool, as well as from the sensitiveness of the adjustment. The washer B has a small pin to keep it from turning, which prevents the nut from loosening when rotating the large washers in making the coarse adjustment. If the scriber fits too loose, a few strokes of a smooth file on the inside faces of the washers will fix it, or, if too tight, its hole may be lapped out.



WHEN Sir John Herschel was defending the science of astronomy in view of a mistake of nearly 4,000,000 of miles in estimating the distance of the sun, the correction was shown to apply to an error of observation so small as to be equivalent to the apparent breadth of a human hair at a distance of 125ft.

**Christmas Novelties.**—Messrs. J. Theobald and Co., of 20, Church-street, Kensington, send us some specimens of their Christmas Novelties, which will commend themselves to all—young and old. The 2s. 6d. packet of Christmas and New Year's cards is wonderful value for the money, and so is the 1s. booklet, which is presented gratis to every purchaser of two half-crown packets. The Royal Old Maid Game, which sells at 1s., will keep many a round party interested. Dollie Daisie Dimple, Dimple Villa, and Romping Rollicking Roderick are well established favourites, and as the English Toy Company has gone into liquidation, Messrs. Theobald and Co. have purchased the stock of over 40,000 of these popular toys, and are selling them at half-price—viz., sixpence each. The Caledonian skates, which require only one screw at the back to fasten the entire skate, and which cannot loosen in skating, will doubtless delight many a skater if only we get any ice this winter to try them on.

# SCIENTIFIC SOCIETIES.

## ROYAL ASTRONOMICAL SOCIETY.

THE first meeting of the new session was held at the Society's rooms, Burlington House, on Friday, November 14, General Tennant, President, in the chair.

Mr. Maunder read a paper by Father Cortie, entitled "Spectroscopic Notes and Queries, and Observations of Spectra of Sunspots made at Stonyhurst 1882-89." The first point discussed was whether the bright line of the chromosphere near D, which is known as the $D_3$ line, has any dark line in the solar spectrum which corresponds to it. After discussing the measurements made by different spectroscopic observers of dark lines in the neighbourhood of $D_3$, Father Cortie comes to the conclusion that the only dark lines in the neighbourhood are variable, and are fainter in the spectrum of the sun when high above the horizon than when it is setting: consequently they are evidently atmospheric absorption lines. His conclusion is confirmed by a photograph of the solar spectrum which has been taken by Mr. Higgs, of Liverpool. Light from the east and west equatorial limbs of the sun was brought together on the slit, and the two spectra, each sharply defined, were photographed one above the other. The solar lines were all displaced, while the atmospheric lines retained their place in the two spectra. The dark line in the neighbourhood of $D_3$, which was supposed to have some connection with the chromosphere line, was thus shown to be an atmospheric absorption line, and not to have its origin in the solar envelopes. The variability of two dark lines in the solar spectrum referred to by MM. Thollon and Ångstrom, was also discussed. Father Cortie comes to the conclusion that there is not sufficient evidence of change in the intensity or breadth of these lines, and that the suspicion of variability is probably due to a mistake of Ångstrom's.

Mr. Maunder also read a paper of his own on the "Sunspot Groups of 1890—August 25 and Sept. 5—and on the Sunspots of 1888." The first of these groups was very persistent, and was traced through three solar rotations. It was very large, and there was a considerable shift of the separate nuclei of which it was composed generally towards an axis which was roughly parallel to the solar equator. During 1888 there seem to have been many intermittent spots which disappeared and appeared again after a little time in the same locality.

Prof. Alex. Herschel asked if these intermittent spots of 1888 were all in the neighbourhood of the solar equator?—as one would expect, according to Spörer's law, that the spots at minimum as they decrease in number are all in low latitudes near to the solar equator, whereas the first spots of a coming sunspot maximum break out in higher latitudes.

Mr. Maunder said that all through 1889 there were clearly traceable two classes of spots of somewhat different character, the one all within 10° of the solar equator, and the other with heliographic latitudes of 20° and more. There was a very distinct gap between them in which there were no spots in 1889, so that he considered that the coming sunspot maximum had already begun to show itself before the spots of minimum character had died out.

Captain Noble said: When does Mr. Maunder consider that the absolute minimum was reached? Does he place it as early as 1888.

Mr. Maunder: I should rather prefer to put it in the middle of 1889.

Mr. Ranyard: I should like to ask Mr. Maunder what he means by the axis of a sunspot group. Does he consider that there is any line with respect to which the parts of a sunspot group move symetrically?

Mr. Maunder: Yes. I think that very frequently there is a tendency to elongate with respect to a line which is roughly parallel to the solar equator. In the case of the great spot groups I have mentioned, the axis made an angle of 9° or 10° with the solar equator.

Mr. McClean read an important paper, illustrated by photographs, of the spectra of the high and low sun, with notes on the chemical methods he had employed for photographing the red end of the spectrum. The photographs passed round to the meeting showed the striking similarity of the great A and B groups, each of which consists of a bundle of lines forming the head of the group, followed by a long series of double lines, evidently arranged according to some harmonic law.

The President, in thanking Mr. McClean, mentioned the Sir Isaac Newton Astronomical Scholarships which have recently been founded by Mr. McClean at Cambridge, and which are intended to promote the study of gravitational, as well as physical, astronomy.

A series of beautiful photographs of portions of the Milky Way in the southern hemisphere were passed round the meeting. They have been taken by Mr. H. C. Russell, of the Sydney Observatory, with the 13in. refractor, with which he proposes to join in the photographic international survey of the heavens.

Mr. Knobel read a paper on Mucktar Pasha's proposed new alteration of the Mohammedan calendar. At present the Mohammedan year, which is founded on the lunar cycle, is most inconvenient, for it causes the Mohammedan feasts to shift all round the year. Mucktar Pasha proposes to substitute, with the approval of the Sultan, a solar year which will be still more accurate than the Gregorian system we at present make use of, as the rule for dropping Leap years will more accurately approximate to the true solar year.

Dr. Spitta read a paper on photometric experiments with respect to the brightness of objects of sensible area, in which he showed that while the angular magnitude of the object remained small compared with the angular magnitude of the fovea of the retina of the observer, the size of the object made no practical difference in making photometric comparisons. But with objects of larger angular magnitude, the image falls on less sensitive portions of the retina, and allowance must be made for consequent loss of light.

Mr. A. Fowler read a paper entitled "On the Duplicity of $\alpha$ Lyræ," and he showed some photographs of its spectrum, in which the K line is doubled in some, while it is single in others. The principal lines of the spectrum of $\alpha$ Lyræ are due to hydrogen, and are very broad and nebulous; but the K line, which is due to calcium, is very narrow in the spectrum of this star. Fourteen photographs of the spectrum of Vega have been taken; in some of them the K line is single, while in others it is doubled by different amounts. The only way of explaining this duplication is that suggested by Prof. Pickering, namely: that the star is double, and that the two components move in an orbit, which nearly passes through the sun's place. Mr. Fowler announced the astounding fact that in this case the revolution is completed in a period of a little over 24 hours, and that the joint weight of the components must be over twenty times that of our sun.

The following papers were taken as read:—Prof. F. Folie, "Real and Apparent Variations of the Latitude of Greenwich"; H. C. Russell, "Electrical Control for Driving Clocks"; H. Jacoby, "Correction of Micrometic Measures for Refraction"; J. E. Keeler, "The Red Spot on Jupiter"; J. E. Gore, "Orbit of 99 Herculis"; John Tebbutt, "Observations of R Carinæ, 1886-90"; Royal Observatory, Greenwich, "Observations of Comet *a*, 1890"; J. I. Plummer, "Observations of Comets at Orwell Park Observatory, 1889-90"; Rev. T. E. Espin, "On the Spectra of R Coronæ, R Scuti, R Aurigæ, and R Andromedæ"; R. Inwards, "On a Mechanical Method of Describing a Parabolic Curve"; G. Higgs, "Photograph of the A line in the Solar Spectrum"; A. Marth, "Ephemerides of the Satellites of Saturn, 1890-91"; Royal Observatory, Greenwich, "Observations of the Solar Eclipse of 1890, June 16, 17"; S. R. Peal, "On a Possible Cause of Lunar Libration other than an Ellipsoidal Figure, with Postscript."

## ROYAL METEOROLOGICAL SOCIETY.

THE opening meeting of this session of the Royal Meteorological Society was held on Wednesday evening, the 19th inst., at the Institution of Civil Engineers, when the president, Mr. Baldwin Latham, M.Inst.C.E., delivered an address on "The Relation of Ground Water to Disease." The pages of history show that, when the ground waters of our own or other countries have arrived at a considerable degree of lowness, as evidenced by the failure of springs and the drying up of rivers, such periods have always been accompanied or followed by epidemic disease. In all probability, ground water in itself, except under conditions where it is liable to pollution, has no material effect in producing or spreading disease. As a rule, it is only in those places in which there has been a considerable amount of impurity stored in the soil that diseases become manifest, and the most common modes by which diseases are, in all probability, disseminated, are by means of the water supplies drawn from the ground, or by the elimination of ground air into the habitations of the people. It is found that the periods of low and high water mark those epochs when certain organic changes are taking place in the impurities stored in the ground, which ultimately become the cause and lead to the spread of disease. Mr. Latham defines "ground water" as all water found in the surface soil of the earth's crust, except such as may be in combination with the materials forming the crust of the earth. It is usually derived from rainfall by percolation, and it is also produced by condensation. In dry countries ground water is principally supplied by the infiltration from rivers, as for example, in the Delta of the Nile. The absence of water passing into the ground for a long period naturally leads to the lowering of the free ground-water line, and may lead to the drying of the ground above the water line; and it is curious to note, with reference to small-pox, that the periods marking the epochs of this disease are those in which there has been a long absence of percolation, and a consequent drying of the ground preceding such epidemics. On the other hand, small-pox is unknown at such periods as when the ground has never been allowed to dry, or is receiving moisture by condensation or capillarity. The study of underground water shows that certain diseases are more rife when waters are high in the ground, and others when the water is low. The conditions that bring about and accompany low water, however, have by far the most potential influence on health, as all low water years are, without exception, unhealthy. As a rule, the years of high water are usually healthy, except, as often happens, when high water follows immediately upon marked low water, when on the rise of the water an unhealthy period invariably follows. Mr. Latham has found that those districts which draw their water supplies direct from the ground are usually more subject to epidemics and disease than those districts in which the water supply is drawn from rivers supplied from more extended areas, or from sources not liable to underground pollution. In the case of Croydon, one portion of the district (under three-fourths) is supplied with water taken direct from the ground, whilst the remaining portion is supplied with water from the river Thames. It is curious to note that even so recently as 1885, the zymotic death rate in the districts supplied with underground water was twice as great as in that part of the district supplied from the Thames; and in this particular year 41 deaths from small-pox occurred in the district, not one of which was recorded outside the district supplied by the underground water. Mr. Latham, in his address, dealt largely with zymotic diseases as affected by ground water, and showed that cholera ordinarily breaks out when there is the least ground water; a high air and ground temperature is also necessary for its development, and, as a rule, the low-lying districts are favourable to the production of these high temperatures. Smallpox is almost always preceded by a long period of dryness of the ground, as measured by the absence of percolation. Typhoid fever is most prevalent after a dry period, and the first wetting of the ground or percolation from any cause takes place. The condition essential to the development of diphtheria is a damp state of the ground marked by extreme sensitiveness to percolation of rain. Scarlet fever follows the state of the dryness of the ground, which is essential for its development, and it occurs in the percolation period. The conditions that precede small-pox are those favourable for the development of scarlet fever, and, like small-pox, the dampness of the ground for any considerable period in any particular locality may check its development, or render it less virulent, and it is most rife in low-water years. Measles are least prevalent at the low-water periods, and mostly rife at and near high-water periods. Whooping cough follows the percolation period in its incidence, increasing with percolation and diminishing as the waters in the ground subside. Diarrhœa is generally more prevalent in a low-water year than in other years—that is, with a very much colder temperature in a low-water year there is a very much higher death-rate from this disease. Mr. Latham finds that the general death-rate of a district is amenable to the state of the ground water, years of drought and low water being always the most unhealthy.

## QUEKETT MICROSCOPICAL CLUB.

THE 287th ordinary meeting of this club was held on November 21st at 20, Hanover-square, W., Dr. W. H. Dallinger, F.R.S., President, in the chair.

The minutes of the preceding meeting were read and confirmed.

Mr. Karop exhibited a simple adjustable frame to carry pieces of blue glass, fitted to the upright of an ordinary bullseye condenser, so that it might be used in conjunction with the latter if desired. Although an old accessory, having been introduced by Mr. Rainey some forty years ago, the so-called light modifier seemed insufficiently appreciated, judging by the almost blinding glare which exhibitors frequently made use of. He thought this was partly due to the want of some simple piece of apparatus to take glasses of several shades, which could be rapidly changed according to the nature of the exhibit, and not take up much space. The glass he had found most suitable was that from which blue spectacle-lenses were made, and which could be procured of various depths of tint. Flashed glass was no use.

Mr. Morland read a communication from Mr. Shrubsole, of Sheerness, on a new marine diatom *Streptotheca Thamesis*, recently discovered by him. It was so imperfectly silicified that it was destroyed by treatment with even very dilute acid. This is the case, however, with certain other undoubted diatoms, such as *Rhizosolenia*, sp. It had been submitted to Prof. Cleve, of Upsala, who considered it a true diatom from the arrangement of the endochrome, which was that of the order Coccochromatici.

Mr. Geo. Western made some remarks on the rotifer brought before the club at the last meeting.

ınsideration Dr. Hudson was of opinion that
enus must be founded to receive it, and he
ned it *Dinos longipes*, the generic title being
from a word in Sophocles, meaning
erful to behold," and the specific from the
f the foot.

ousselet also read a note on the same
ns, which he thought was identical with an
*hna* figured and described by the late Mr.
n the *Journal* of the Royal Microscopical
for 1887.

Nelson read a note on "Some Points of
e in the Human Spermatozoon."

course of some remarks on Mr. Nelson's
he President said that two points stood out
n investigations of this kind. One was the
of motion on the interpretation of struc-
is, although of the highest importance, had
een studied at all, and he thought it was
of the attention of the mathematician and
cian, who would probably be able to furnish
m their own standpoint of material value to
roscopical observer. The other related to
me caution with which inferences drawn
eserved and stained specimens should be
. He had been deeply impressed with the
of this caution on repeating observations
previous years; a reinvestigation had
im the unreliability of much which had been
rom such material, and, although staining
great value, if possible, some kind of stain
e made use of which did not destroy the
e organism, for instance, methyl green.

igpen gave an account of a microscopical
tion of a certain popular dentifrice. This
ınd to contain diatoms, and some of the
oted closely resembled those in the well-
"Cherryfield" deposit—viz., *Amphipleura*
*homboides*. He also described some of his
tions on mounting media of high refractive

of thanks were given to these gentlemen
respective communications, and the pro-
terminated. The next meeting will be held
y, December 19th.

## L AND SCIENTIFIC NOTES.

**st Tree in the World.**—The largest
he world has been discovered in Fresno
beating by all odds the wonder of Calaveras.
oomis, an old mountaineer, with a party,
ting bears in the Sierras east of Center-
l wounded a big fellow in the most rugged
of the range. In pursuing him they were
use axes and knives through the under-
d they unexpectedly came upon the king
rests. In spanning it a rope 143ft. 5in.
required, and its diameter was found to
The great tree was christened "Los
"

comotive superintendent of the Cincinnati,
y, and Cleveland Railway, Mr. J. S. Porter,
advocates painting with asphaltum all
rfaces in contact with the water—viz., the
the shell and the outside of the fire-box
e flues. He claims, judging by the appear-
he pit, that more scale becomes detached
e an engine is washed out than when the
allowed to attach itself directly to the
surfaces. The removal of flues is also
be greatly facilitated, as the vibration
y a few taps of a hammer on the end of
hen partly out, will shake off the greater
e attached scale. With a view to economy,
ter makes in separate parts the rubbing
between his engines and tenders, so that
dly worn they can be readily and cheaply
. He adopts a similar practice in connec-
h the wearing surfaces of Miller hooks,
ich couplers his passenger equipment is
l.

**ic Railways.**—The *Railroad Gazette* says
now in operation 260 miles of electric rail-
he United States, which is five miles more
t operated by cable, as shown by the recent
ulletin, No. 11, which covers street railroad
ation—a new field in national statistics—
gs forward information which can but be a
o those who have not been conversant with
ess of the electric motor in street railroad
With reference to the mileage of city rail-
is said that the returns from 286 roads give
ileage of 3,151 miles, which is an increase
miles since 1880, or at the rate of 146 miles
. Ten years ago the total mileage was
d it has nearly doubled since that time.
e miles are operated by steam on elevated
s, and 221 miles by steam on surface roads.
hia has the largest mileage, 283; Boston
0; then follow Chicago with 184, New
h 177, and Brooklyn with 164. Chicago
reatest length of double track, 176 miles;
k next, 161 miles. The total number of
lroads in independent operation at the first
ar was 807.

## SCIENTIFIC NEWS.

THE number of known planetoids now amounts to 300, that observed by Dr. Palisa on Oct. 6 being the latest, though it was really discovered by M. Charlois on Oct. 3. The rate of discovery of these small planets seems to be about one hundred in ten years—that is, in recent times, for No. 1 Ceres was discovered by Piazzi of Palermo so long ago as Jan. 1, 1801.

Prof. Ricco, of the Royal Observatory, Palermo, has been appointed director of the new observatory at Catania, which is to be specially devoted to the work of astronomical physics, celestial photography, and seismology. The usual meteorological records will also be kept.

Herr O. Stumpe, of Bonn, contributes to the *Ast. Nach.* a determination of the direction of the solar motion, made from the proper motions of 1,054 stars in four groups. The different values thus obtained show that the apex of the sun's way is either in Lyra, or near it in Cygnus.

Appendix II. of the Washington Observations contains an account of Prof. Asaph Hall's work on Saturn during 1875-89. From a series of observations of the white spot on the equator, he calculates the rotation period as 10h. 14m. 23·8s., more or less 2·30s., mean time, which agrees with his result obtained in 1876, but differs from Sir W. Herschel's estimation by some minutes, and very materially from Schröter's, whose highest figures were as much as 12h.

Although Pingré's notes of his expedition to Rodriguez to observe the transit of Venus of 1761 have been published in the *Phil. Trans.*, so far as astronomical details are concerned, his personal narrative with topographical and natural-history notes has never been published. Capt. Pasfield Oliver has, however, by the courtesy of M. Bouquet de la Grye, obtained an exact transcript of Pingré's manuscript, and will publish a translation shortly.

Circular No. 28 of the Wolsingham Observatory (Rev. T. E. Espin) reads as follows:—"Es.-Birm. 710a, D.M. + 53° 2684; R.A. 21h. 37m. 6sec.; Decl. + 53° 49′ (1890); on Nov. 15 was only 9th mag. It was observed in the spring as 7·5—8·0. The star is very red, with a magnificent III. type spectrum."

News from Cape Town contains an item stating that Mr. L. A. Eddie, F.R.A.S., of Grahamstown, observed a comet on the 27th of October from 7.45 p.m. until 8.32 p.m., when the last trace faded in the S.E.

The death is announced, in American papers, of Dr. Henry Jacob Bigelow, probably the most distinguished surgeon in the United States, at the age of seventy-two. Dr. Bigelow invented litholapaxy, a method of dealing with stone in the bladder which revolutionised that branch of surgery. From 1849 to 1882 he occupied the Chair of Surgery at Harvard, and on Nov. 1 the Faculty of Medicine of that university recorded its appreciation of his services, and paid a warm tribute to his character and talents.

At a meeting of the Court of Victoria University, Manchester, a "burning question" was decided by 18 votes to 14, the majority being against the proposal to grant theological degrees. When the university was founded, theological teaching and theological degrees were expressly excluded from its operations by the unanimous consent of the chief actors in the formation.

It is probable that Manchester will have a crematorium next year. The plans for the building have been prepared, and the movement is ripe for settlement.

In St. Louis, Mo., the names of the streets are painted on the glass globes surrounding the arc lights, and the shadows are thus thrown on the adjoining walls and pavements, so that the names can be easily read.

In New York the "infectious" wards of the City Hospital are placed in telephonic communication with the visitors' reception-rooms, so that friends can converse with the patients without risk.

The French Minister of Commerce has created at the Conservatoire des Arts, &c., a chair of industrial electricity, and the president, on the recommendation of the Paris Académie des Sciences, has nominated M. Marcel Deprez as professor.

Electric traction is to be tried on the tramway from Uxbridge-road station to Kew. The Lineff system will be used.

The City and Southwark underground railway was opened to the public on Wednesday, the 26th. Much interest attaches to its successful working, apart altogether from its financial results.

Prof. F. W. Putnam, in a note to the Boston Society of Natural History, gives fresh evidence leading to the belief that in America man was a contemporary of the mastodon and mammoth. A portion of a shell with a rude figure of a mammoth scratched upon it has been found under a peat-bed in Delaware in the company of human and animal bones, charcoal, and stone implements.

Mr. W. L. Calderwood has been appointed Director of the Laboratory of Marine Zoology at Portsmouth.

Prof. Elwin, F.R.S., succeeds Prof. Stuart in the chair of Mechanism and Applied Mathematics at Cambridge.

The car stove has almost disappeared from railway carriages in New York State, and will be discarded in Canada, and the New England States. Trains will in future be heated by steam from the boiler of the locomotives.

Amongst the materials used for making armour plates, none seems to have given better results than those known as "nickel" plates; but the Secretary of the U.S. navy believes in "hastening slowly," and is going to try two of the nickel plates before giving extensive orders. Large quantities of nickel can be procured at low prices now, and it seems to exercise a toughening effect on the iron.

The Royal Microscopical Society will hold their next Conversazione at 20, Hanover-square, on Monday, December the 1st, at 8 p.m.

AN old form of wood paving is being tried in Bristol. An area has been laid in Bridge-street, on what is called the Elli system. It consists of a number of oak pegs, varying from 2in. to 4in. in diameter, 4½in. deep, and laid on a bed of gravel 5in. deep, the latter having a small covering of sand. The spaces between the pegs are well filled in with sand, watered, and repeatedly rammed, until an even and solid surface is produced. It is claimed that it is less expensive, more durable, easier to remove for the purpose of laying pipes, as there is no bed of concrete, and that it is not so slippery as the blocks.

OWING to the increased duty of 40 per cent. imposed on English coal imported into the Black Sea, all English vessels, except those bringing a general cargo, now arriving at Odessa, come in water ballast instead of bringing coal. The consequence of this new impost will probably be that during the winter Odessa will have a coal famine similar to that which afflicted that city in 1887. The Russian coal brought from the Azoff and the Donetz basin is lying in huge heaps near the quays, but no one will purchase it. It is of a brown shaly substance, and its heating and combustible qualities are equal to about 10 per cent. of those of British coal.

**Siemens Steel.**—It is very common to speak of Siemens steel and Siemens-Martin steel as though they were the same thing. Mr. F. J. R. Canella has given the following clear distinctive explanation, which will be of use to many:—"In the earlier or Siemens-Martin process, malleable iron, wrought scrap, or scrap steel is melted in a bath of pig-iron, from which the impurities are eliminated solely by the action of the flame and the addition of spiegel or ferro-manganese. Wrought metal or scrap is an essential element of the process, and no ore is used. In the Siemens process, on the other hand, a much larger relative quantity of pig-iron is employed, and although scrap is also generally worked up, the process can very well do without it. Then, again, the impurities are driven out from the pig-iron by the addition to the bath of a properly selected iron ore, which becomes reduced while its oxygen carries away the carbon, and assists in the formation of a silicious slag. Both processes re[illegible] Mushet's addition of ferro-manganese at the e[illegible] a common need for steel-making processes. It will require very little further explanation to show that the Siemens process lends itself more readily than the Siemens-Martin to the production of large quantities of a high-class material of uniform nature, as pig-iron and iron ore of the necessary quality are always available in any required amounts, whereas wrought-iron scrap and scrap steel are very difficult to procure in quantity and of the required quality."

# LETTERS TO THE EDITOR.

◆

*[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]*

*All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

*All Cheques and Post-office Orders to be made payable to* J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

◆

## BEGINNING AT THE WRONG END—THE ROTATION-PERIOD OF VENUS—THE TIDES AT THE SOCIETY ISLANDS—DIAMETER OF MARS—MAKING DENSE GLASS—TELESCOPE FOR BOX SEXTANT.—LUNAR SNOW MOUNTAINS—THE WATCH AS A COMPASS—COMETARY ORBITS.

[31824.]—IN letter 31651, p. 120, I expressed a hope that a course of lectures then about to be delivered in Belfast by the Irish Astronomer-Royal would excite sufficient enthusiasm to render a suggested local astronomical society a conspicuous success. As far as the enthusiasm is concerned, my vaticinatory hope has, if I may judge from local newspaper correspondents, been entirely fulfilled; but I confess that Sir R. Ball seems to have imbued some of his listeners with a zeal which not according to knowledge. For more than one gentleman writes to the *Belfast News Letter* proposing to raise funds to buy telescopes! One of these correspondents modestly suggests that Sir Howard Grubb might supply instruments at a reduced rate, and the town council give a site for an observatory. Another one proposes that the initial equipment of the society should be "one good telescope at £200, and a few smaller ones at £20 to £30 each." If this be not "putting the cart before the horse," I am at a loss to know to what that expression is applicable.

"Terbyitus" (letter 31786, p. 248) invites my opinion as to the alleged determination of the period of rotation of Venus by Schiaparelli, and of its "confirmation" by Perrotin. Well, it is soon given: I have not the very slightest faith in the validity of the conclusions derived from the observations made at Milan and Nice respectively. Every practical observer is aware of two facts in connection with the planet referred to: the first being the extraordinary difficulty of detecting and holding any marking whatever on her surface; and the next, that such difficulty actually increases with the aperture of the telescope employed; so that if there were any stable markings on Venus akin to those on Mars visible in a small or moderate telescope, they would almost certainly disappear in a larger one. But, really, it is an idle solecism to talk about Perrotin "confirming" Schiaparelli's observations (or rather deductions from them), for the Milanese astronomer makes the periods of rotation and revolution identical, while the observer at Nice says that "The time of rotation of the planet does not differ from its sidereal period more than 30 days"! Nice kind of corroboration, certainly. For myself, I think that De Vico's period of 23h. 21m. 23·93s. is as likely to be correct as any, albeit I am constrained to admit that "that isn't saying much."

I can only say, in reply to query 72885, on p. 256, that I do not know. I presume that there is some scientific warrant for the assertion of the lady traveller whom "Leo" quotes? We know what cock-and-bull stories travellers relate in the most perfect good faith.

I do not quite understand what Mr. Tom Moore (query 72899) means when he alleges, on p. 257, that "every new work on astronomy gives 4,200 miles linear" as the diameter of Mars; because, if my querist will consult the elaborate table of the Solar System appended to Vol. I. of Chambers's "Handbook of Astronomy," published at the Clarendon Press in 1889, he will find such diameter given (p. 652) as 4,999 miles. I cannot now afford the time needed for a hunt for measures of the planet's diameter made during the opposition of 1887, but one set of Mr. Ellery's, executed on Sept. 6th of that year, gave him 26·806″ as the equatorial diameter of the planet. I would remind Mr. Moore that Le Verrier, in his tables of Mars, adopts 5·55″ as its equatorial semidiameter, and this would give a linear equatorial diameter exceeding 4,970 miles.

In reply to query 72916 (p. 257), I am ignorant whether the process of compression referred to by "A. S. L." has ever been adopted by glassmakers or not. They have all sorts of trade secrets, jealously guarded even from the pure amateur. There is a very dense flint glass in the market as it is; but I know nothing of the process of its manufacture.

"W. S. P." (query 72944, p. 258) cannot have a telescope fitted to his box-sextant with any advantage. I have one myself, with a sight-hole only, such as he describes: one of those made by Elliott expressly for the cadets at the Royal Military Academy at Woolwich. It is so good a one that I thought I should like a telescope fitted to it, and took it to Elliott's for that purpose; but their reply was that it would so constrict the field as to render the instrument useless.

May I assure Mr. Peal (letter 31806, p. 268) that the fact that gravitation on the moon is only ⅙th of terrestrial gravity by no means comes as a revelation to me? But he must know that in any compressible substance piled in strata the weight of each such stratum decreases in geometrical progression as the height above the surface increases in arithmetrical progression, and hence that, light as his "snow" indubitably would be at the summit of a lunar mountain 20,000ft. high, its compression at the moon's surface must be by no means so trivial as he would ask us to believe. Even assuming it to be there converted into "rigid" ice, there is a limit to the cohesion of that. I do not know whether Mr. Peal knows London well, or has ever seen the Queen Anne's Mansions between Victoria-street and Birdcage Walk; but, if so, he must have witnessed what I take to be something approaching the limit of safe compressibility of an ordinary brick, which is usually regarded as a fairly rigid material, and one far from being subject to flux. How long would a full-sized model of the Himalayas stand if constructed in calves'-foot jelly? Mr. Peal's argument from certain appearances on Mars appears to me, if I may say so without offence, to be the veriest *petitio principii.*

"A. J. S." is simply reiterating in letter 31812 (p. 269) what I myself said on p. 166 in letter 31705. To attempt to determine the meridian by the aid of the sun and a watch laid horizontally is precisely the same as though we were to try to get the time in, say, latitude 45° from a horizontal sundial divided into equal spaces of 15° each for hours. Take two of your correspondent's own examples: On December 11, in this year, the sun's declination being 23° 2′ south, in latitude 52°, at 9 a.m. *apparent* time, the sun will be not 45°, but 40° 48′ 28″ east of the meridian; and on June 29, his declination being 23° 14′, he was at 2h. 47m. 52s. p.m. apparent solar time, in latitude 30° N., actually on the prime vertical, due west, or had an azimuth of 90°. Now at this instant the hour-hand of a watch was on the 14th minute from 12, and half the interval between this and 12 o'clock is 7 minutes—i.e., $\frac{7}{15}$ths of 90°, or 42°. The sun, though, was not 42°, but 90° from the meridian *as measured on the horizon,* so that following the directions as given by *Truth* and reproduced in these columns, we should get our meridian 48° wrong by a watch lying flat on its back; or, in other words, our imaginary south point would be really the south west!

I would refer "J. G." (query 72978, p. 279) to pp. 59 and 71 of Vol. LI. of the ENGLISH MECHANIC.

**A Fellow of the Royal Astronomical Society.**

## BURNHAM 648.

[31825.]—IN answer to Mr. Gaudibert's letter in to-day's issue (let. 31804) I am unaware of any specific request for measures of this object, having apparently overlooked the letter. As a matter of fact, I examined the star some three years ago when the air was unfit for measures, and since then have not again referred to it. I will, however, place it on my working list when a favourable opportunity offers.

With regard to 71 Tauri, a star which has from time to time been reported as double, a communication recently received from Mount Hamilton may be deemed conclusive evidence of its non-duplicity; the great refractor giving no sign of elongation.

**Kenneth J. Tarrant.**

Bushey Heath, 21st Nov.

## D'ARREST'S COMET.

[31826.]—THIS comet has been observed here with the 10½in. equatoreal. On Nov. 5th it was in R.A. 21h. 13m. 20s. – 27° 31′. On Nov. 6th in R.A. 21h. 17m. 20s. – 27° 28′.

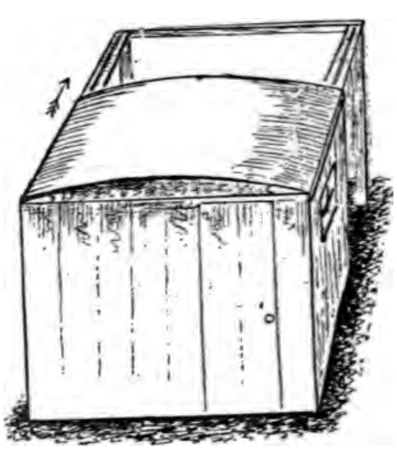
The comet is large and rather faint, but, very strangely, much brighter than at P.P. about two months ago. Its computed brightness at that time was more than twice as much as at present, but until recently was not visible in the 10in. refractor. I have swept very carefully for it several times during the past summer, but it could not be seen.

**William R. Brooks.**

Smith Observatory, Geneva, N.Y., Nov. 8.

## TELESCOPE-HOUSE—DAMPNESS—NEPTUNE.

[31827.]—As there has been some discussion in your columns lately on the subject of observatories, permit me to send you rough sketch of telescope-house built for me by a local contractor in the spring of this year. I had the idea from Rev. N. S. Godfrey's sketch, and description in Vol. XXX. of the ENGLISH MECHANIC; but my roof, instead of being peaked, is curved like that of a railway coach, which, indeed, the whole house very much resembles. The roof (of match-boarding, covered with canvas painted) slides off completely in the direction of the arrow, the telescope when roof is on being in a nearly horizontal position. The house is most comfortable, whether open or shut, and the roof perfectly safe in the windiest weather. I have shutters at the sides for protection, if necessary, from the draught and the "vulgar gaze," when observing near the zenith; but I scarcely ever require them. The house is about 10ft. square, and lodges my 8½in. Calver, with abundance of margin. Cost about £12, and so constructed as to be easily removable. I am thoroughly pleased and satisfied with it, except that the bright parts of instrument are so often covered with moisture in the morning. What will rid me of this nuisance, which keeps me polishing for hours every week?



Will some correspondent kindly give a sketch of Neptune's position, in respect to small stars in his immediate vicinity?

Llanelly. **Idris, F.R.A.S.**

## A BRIGHT METEOR.

[31828.]—THE meteor seen by Mr. A. E. Spencer at London, on the 16th inst., was also seen from Dublin. It started just below the bright star Betelgeuse, in Orion, and moved downwards towards the E. or S.E. horizon; but, owing to fog, I could not well trace its course among the stars. The end was like a rocket; but I did not notice any blue colour. The sky here was clear, except near the horizon, where fog interfered with the view.

Dublin, Nov. 21. **W. H. S. Monck.**

## SUBSTAGES FOR STUDENTS' MICROSCOPES.

[31829.]—"MICROSCOPIST" (31722) supposes that I now recognise the inferiority of my spiral focussing tube for a substage condenser. Allow me to state that he is quite mistaken, for I am more than ever convinced of its great utility. I brought it out as "a cheap form of condenser to meet the wants of students." ("E.M." Vol. XLI. No. 1042).

The microscope to which it was fitted, cost £3 12s., including two objectives, and two eyepieces, in a case. My *cheap* form of condenser and substage was never intended to rival those usually fitted to microscopes as expensive as Swift's New Student's, which we were told cost £8 15s. in a case, without lenses. Speaking for myself alone, if I had to choose between two of these microscopes, similar to one another in all respects with this exception, that one had the screw centring and push focussing as shown in the model exhibited at the R.M.S. and the Q.M.C., while the other had my spiral focussing without centring gear, I would choose the spiral focussing one. In a spiral focussing substage, if the maker carefully centres the outer tube in the first instance, the slight displacement due to the varying centres of different objectives is not of great significance. This is especially so when we consider the kind of condenser used with students' microscopes. Let Figs. 1, 2, 3 represent the front lenses of the condenser, the object being at the apex of the cone. In Fig. 1 the condenser is centred to the object, and the rays pass through it axially. In Fig. 2 the condenser is placed eccentrically with regard to the object, and the diaphragm is supposed to be

FIG. 3.

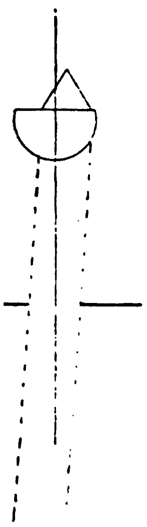


FIG. 2.

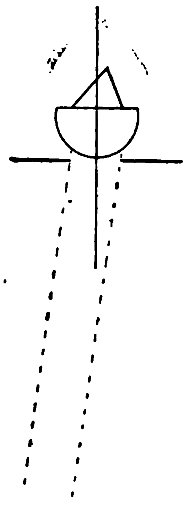
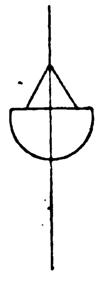


FIG. 1.



nd the front lens. In this case the lamp
to be placed to the left hand of the axis.
:e will be some obliquity in the cone; but
case not met with in practice. Fig. 3
example of what really takes place: the
n is behind the back combination, and
ittle distance from it. The result is that
passes eccentrically through the lens, and
becomes more nearly a *right* cone than in
I have tried the experiment critically with
hromatic objective, and a Pleurosigma
n, and was surprised to find how much
ty was required before much difference
in the character of the image. Not so,
with regard to the focus; here a slight
ade a considerable alteration in the image.
the student's microscope is intended for
al purposes, in other words, for objects
not a tithe as sensitive as P. angulatum, I
the urgent necessity for a mechanical cen-
tage at the expense of mechanical focussing,
when *cheapness* is of paramount import-
a slightly better class of instruments an
ent I exhibited at the R.M.S., Oct. 1889,
adopted—viz., two lugs are fitted to the
tube, and two straps are fixed below the

s slide smoothly in the straps, and they
nmed in any position by a screw. This is
inexpensive. I see no reason why a
microscope, with a Campbell fine adjust-
k work coarse adjustment, sliding stage
substage such as the above, plane and
irrors, and a bent claw foot, should not
or £5.
this I am certain—viz., that no student's
e should exceed that figure, and I much
f one student in ten has a microscope as
as that. I quite agree with "Micro-
that unless English opticians put their
foremost they will be out of the running,
with regard to students' microscopes.
be no doubt that the Germans are pro-
cellent work in this direction at a reason-
. It is in design that they err.
gard to students' microscopes, I have for
n a good deal of attention to them.
the first English "Hartnack" on a claw
d with a rackwork coarse adjustment,
to my order in April 1877, and subse-
n 1878 I had a rectangular mechanical
nd rackwork focussing substage added to
ibstage was transferred in 1883 to another
ether better class of microscope, which I
or a figure of which see R.M.S. *Journal*
It was also figured (incorrectly, however)
E.M." in 1884, Vol. XXXVIII. No. 982.

oduction of the spiral focussing was not the
mere passing thought, but was the out-
ong practical experience on that special

for a moment doubts that rectangular
nd rackwork focussing are far preferable;
g as 30s. are charged for the centring,
or the focussing movement, they are quite
rt for the student's microscope.
riting the above I have read with much
Microscopist's" further remarks on the
1801). I think his idea an excellent one;
no better "centre of action" could be
an the able secretary of the Q.M.C.,
. Karop. He is not only a first-rate
st, but also a worker in metal, who, if I
ich mistaken, has himself made a micro-
l.
suggest that the specification finally
by the committee should not be given to any one particular optician (which might savour of favouritism), but be communicated to the Q.M.C., where it would appear in their *Transactions*.

Any optician would be free to take it up, and the one that produced the most conscientiously-made instrument at a fair price would eventually carry the day. I advisedly say "fair price," because I do not believe in low-priced-cut-throat-competition shoddy.

The committee's recommendations should be absolutely limited to "students' microscopes," in the strict acceptance of that word, which, as I understand it, imposes a £5 limit.

**Edward M. Nelson.**

P.S.—There is nothing like "striking while the iron is hot." Might I therefore suggest that Mr. Karop should form a committee for the purpose of designing a student's microscope? I would propose that the committee's report be published in the ENGLISH MECHANIC, and that the microscope designed receive the name of the "ENGLISH MECHANIC model."

**E. M. N.**

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[31830.]—WE have observed your correspondent "Microscopist's" further letter on this subject, but fail to see that he has in any way improved his position. His remarks may be summed up in two points. Firstly, it is absolutely necessary that a substage, to be of use, must be rigid. Secondly, that any substage that is capable of being lifted aside cannot be firm, and therefore the substage fitted to our Edinburgh Student's Microscope is not steady.

On the first point we are perfectly agreed. On the second point we maintain that "Microscopist" cannot be aware of our method of attaching the substage, nor can he have had any practical acquaintance with our instrument by use; otherwise he would not speak as he does. His remarks are based on theories derived admittedly from the "low-class microscopes for toy-shops, &c.," instead of on facts concerning the instrument he is criticising. We are perfectly aware of the absolute necessity of the substage being as well made and fitted as the body of the instrument itself, and we have ever had this in view in the construction of our instruments. Of course, "Microscopist" is expressing his views only when he says the system of a shifting substage is wrong; but other people have opinions, and they exercise those opinions when purchasing an instrument, and a constant requirement among purchasers is a substage that can be lifted aside so as to leave the mirror free for occasional use alone. In meeting this requirement, we have done it in such a manner—which is quite possible—that the substage shall be, when in use, perfectly firm. The question of cost was never considered in the fitting of the substage, and, as a matter of fact, it would be easier, and would cost less to make the substage a fixture than it does for it to lift aside in our way.

With the concluding paragraph of "Microscopist's" letter we heartily agree. There has been enough of inferior construction of students' microscopes, and it is time to aim at something better; and this is what we have been doing, and contend that our microscope meets the requirements of the student in the highest degree.

**W. Watson and Son.**

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## MICROSCOPICAL SECTION CUTTING—MOUNTING, &c.—II.

[31831.]—HAVING briefly described the processes of preparing and imbedding, I propose giving a few directions for mounting the sections. First, those obtained by the gum and freezing method. The sections should be removed from the knife by a camel-hair brush and transferred to warm distilled water in a capsule, changing two or three times until all the gum is removed. Stain as desired, and put in equal parts methylated spirit and water for a few minutes, and then into the strongest and best methylated spirit obtainable, until thoroughly dehydrated. Now lift out the section *on the cover-glass*, drain off the surplus alcohol, and let fall a drop or two of oil of cloves at the edge of the section, so that it runs underneath and drives out the remaining alcohol, which evaporates. The section should now be quite clear and transparent; if any milkiness remains, it shows the section to be imperfectly dehydrated, and if this does not disappear on gently warming, the specimen is useless. Remove as much of the clove oil as possible by draining the cover and going round the section with snips of filter-paper, avoiding the section itself. Drop on a little balsam solution and turn over on to a clean slip, which has also a spot of balsam in the centre, and very gently press the cover on the slip to express the surplus mountant. This surplus must not be removed, as the balsam shrinks as it hardens, and if there is no excess air-bubbles form under the cover.

For sections in paraffin the following must be provided:—A solution of equal parts egg albumin and glycerin; four vessels large enough to take 3 by 1 slips containing respectively spirit of turpentine, methylated spirit strong, half spirit and half distilled water, a 10 per cent. solution of HCl in distilled water. The paraffin sections are affixed to the slip, slightly wetted with distilled water by the albumin and glycerin solution, going carefully over them with a wet brush to insure perfect contact. The slips are then placed in an oven heated to the melting-point of the paraffin and kept therein for about two hours. They are now put in spirit of turpentine and left until every trace of paraffin is removed. It is as well to give them a second wash in some fresh turpentine, as the smallest remainder of paraffin prevents staining. Next transfer to the methylated spirit; leave for ten minutes, and rinse well in the spirit-and-water mixture. Put into the acid solution, and leave until this lies evenly on the slip when removed from the vessel; tilt to drain, and pour over the specimen a few drops of Ehrlich's hæmatoxylin, which must remain for some time—say an hour. Now wash in the acid mixture until the colour of the specimen turns to orange or yellow, and place in a basin of hard water, when the yellow gradually changes to a bright blue. Dehydrate first in 50 per cent. spirit and then in absolute alcohol; drain, and pour on the oil of cloves, which will clear the specimen and render it transparent; remove as much of the oil as possible, drop on sufficient balsam solution, and finally cover.

This is, of course, a lengthy process, and requires care; but the results, especially with serial sections, are most brilliant and satisfactory. For celloidin sections, simply stain and mount in balsam as usual; but as the celloidin also stains, it is, in some cases, desirable to remove it. I find it generally sufficient to incline the slide, with specimen in place, in a porcelain tray, and pour over from time to time a few drops of the solvent—i.e., equal parts of ether and alcohol—with a pipette until the celloidin is dissolved and washed away. Treat then with absolute alcohol to remove the ether; follow with oil of cloves and balsam.

Ehrlich's hæmatoxylin stain, which I prefer to any other, is prepared as follows:—Hæmatoxylin crystal opt. (Hopkin and Williams's), 2 grams; absolute alcohol, 100c.c.; dissolve, and add distilled water and glycerine (aa), 100c.c., with as much powdered alum as it will dissolve, and 5c.c. strong acetic acid. When freshly made it is quite pale in colour and useless for staining; but it continues to improve and darken with age. It may be used undiluted, or mixed with any desirable quantity of water or alcohol.

**A Demonstrator of Physiology.**

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## DRY BATTERIES.

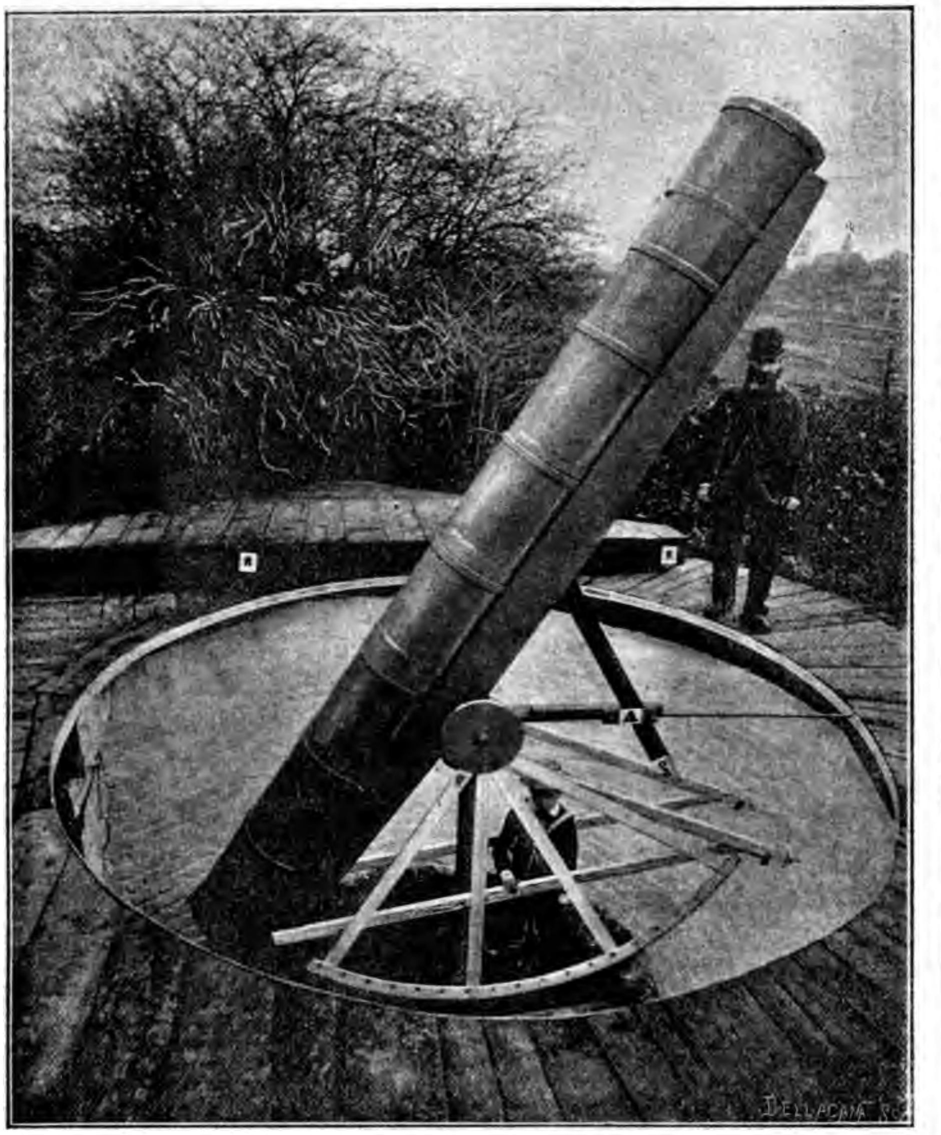
[31832.]—IN reply to Mr. A. Ball, my letter (31793) was forwarded previous to the publication of his reply to Mr. H. Leitner's letter (31768).

Mr. Ball says that there is nothing wonderful about the 3½ volts. given by his dry battery for one week after being regenerated by current. Mr. Leitner (31815) cleverly puts the accumulation of gas theory to the wind.

Therefore, I consider Mr. Ball's dry cell all the more wonderful, inasmuch as the high voltage is entirely due to the excitant or excitants employed.

My battery giving 2·40 volts, low internal resistance and absence of local action, consists of two plates 2¼in. by 4in., immersed into a weak solution of sulphuric acid. So is entirely free from creeping, fuming, &c.

I have had one in constant use for seventeen months, with an electric bell and intermittent light without attention. When it is exhausted it is recharged by current, and has a capacity of four ampère hours, thus forming a cheap and useful battery for the electric light. No, its voltage does



not rise, but remains the same, so is a long way from beating Mr. Ball's dry cell with 3½ volts.

Nov. 22. **J. R.**

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## A SILVER-ON-GLASS NEWTONIAN.

[31833.]—I HEREWITH send you a description of a silver-on-glass Newtonian reflecting telescope I have lately finished making for my own use, having purchased a disc of plate-glass in the rough, 16¼in. diameter and 1½in. thick, which I ground, polished, and worked to a parabolic curve of 15⅞in. diameter, and 13ft. 8in. focal length. The tube is 16⅜in. diameter and 14ft. 8in. in length, and is made of tin in eight lengths, and seamed and soldered to make it water-tight, the end of one length fitting over the other in the same manner as sheet-iron stove pipes. As I have mounted it somewhat differently to others I have seen, I thought it would be much easier to explain with the aid of a photograph I have inclosed. My reason for adopting this plan was to make it as light as I could, and yet to be free from tremor. To make the tube firm and rigid, I made a wooden girder with two boards 1¼in. thick and 9in. in depth, and of the same length as the tube—viz., 14ft. 8in., the ends being reduced in depth to 5in. Between these boards I let in to their sides some cross-pieces of wood 13in. in length, with their top edges hollowed out to the same curve as the tube, and screwed them all up tightly; this made a strong girder. One of the cross-pieces is much stronger than the others, to which is affixed the axis for moving the telescope in altitude, which can be easily moved from the horizon to the zenith, or around in any direction with a slight pressure of one finger, owing to it being well balanced. At the bottom end of the tube is fixed an iron hoop, with studs riveted on to hold the speculum and to regulate it for adjustment; all the other hoops are of wood for lightness. I have fixed the girder and tube on the top of the stand instead of the side, as is usual. The stand is in the middle of a circular pit 6ft. 3in. deep and 12ft. diameter at the top. Around this pit is a wooden platform, the inside edge of which is divided into 24 hours and minutes. Underneath the top of the stand is fixed a strong arm projecting out in the same direction as the tube towards the eyepiece end, to which is affixed a clamp (marked A), which can be tightened with two nuts and spiral springs. Between this clamp slides a steadying-bar (shown as S), and is coupled to the girder. When the telescope is elevated, a very slight pressure put on the steadying-bar, by screwing up the nuts, will cause the telescope to remain in any position it is placed. (The counterbalances are shown as B B). On the arm that carries the clamp a rod is fixed, which points to the hour circle as the telescope moves round, whilst on the declination axis is fixed a quadrant divided into degrees and parts, which shows to what elevation the telescope is moved. A movable platform (marked R R), on three rollers, which covers nearly half the pit when required, and can be moved around in any direction, and with the aid of a step-ladder on this platform the eyepieces are easily accessible at any altitude. The weight of tube and girder on which it rests is 190lb.; the speculum and cell in which it is placed is 42lb.; total, 232lb. At present it has altazimuth movements; but no doubt it would be more serviceable if it was mounted equatorially with a powerful clock to move it. I have an uninterrupted view from all sides except a small space on the north side, which is hidden by a large elder bush, and is rather an advantage in assisting to keep off the cold winds, and does not prevent me seeing the Polar Star. Since I have finished it I have spent some very pleasant hours with a friend (a member of the British Astronomical Association) who is very much interested in astronomy, and is the possessor of a magnificent silver-on-glass Newtonian reflecting telescope, of 8½in. aperture, mounted equatorially, and is doing all he can to impart instruction to others by giving lectures, &c. We have had some very good views of the moon, Saturn, Jupiter, Nebulæ, and star clusters with various powers. At present I have no covering whatever for it, except a tin cover over the mouth of the tube, and have to take the speculum, plane, and eyepieces out when I leave it, but do not, as a rule, experience much difficulty in adjusting them when I want to use it—especially if I put them in before dark.

Hereford. **J. Phillips.**

## ETHER AND ELECTRICITY.–

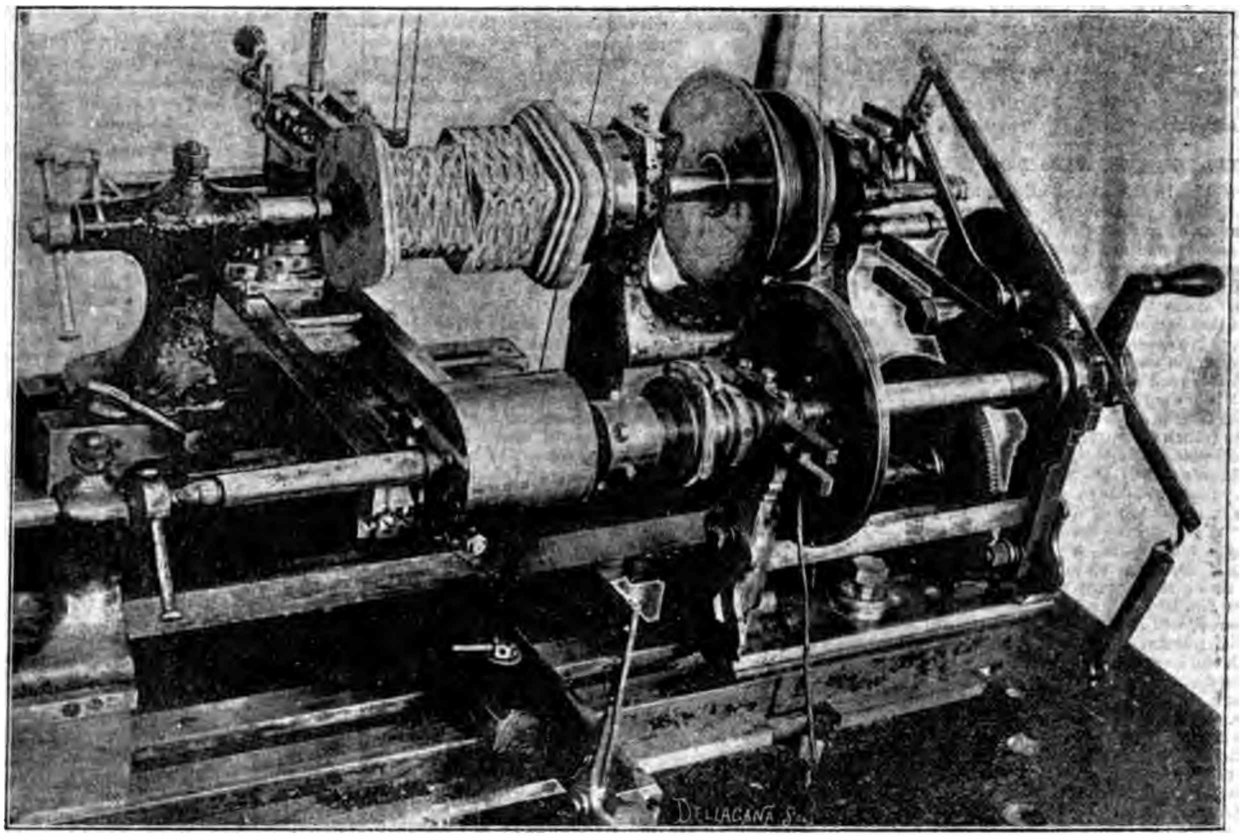
[31834.]—IN my letter 31799, p. 250, t
some misprints, which are not important.
one in my last quotation from Sir W. T
where he really confesses that he can only of
*impotent* (not important) conclusion that w
know nothing below the surface."

Now let us see what Dr. Oliver Lodge ha
In his papers on "Electrolysis," *Electricia*
p. 352, when examining some theories,
distinctly affirms the doctrine of two elec
and asserts "in certain cases an electric cu
*known* (his own italics) to consist of equal
streams of positive and negative electricity
not intend here to debate these ideas, or it
be easy to show that what he calls *kno*
merely the *assertion* of only a very few ou
mass of electricians, and equally easy to sh
the notion is utterly absurd. But all I wa
is to hold my opponents to these definite ass
He there discusses the relation of Ohm's
liquids, and says: "In Maxwell's theor
hardly be quite exact for any current; bec
optical transparency of electrolytes shows th
behave as di-electrics to very rapidly alte
E.M.F.'s" His object here appears to be t
tain the doctrine of the existence of fr
wandering about, and susceptible to electric
tions. For want of any real evidence he is
to use the indirect results of Maxwell's the
though they were real facts, in order to
another hypothesis inconsistent alike with w
know of chemical and electric actions.

He does the same in another place, when
ing the hypothetical electric charges of atom
says, "It is difficult to know whether they a
not, until it can be shown that absolute vacu
a specific inductive capacity. The transpar
stellar space and the velocity of radiatio
would seem respectively to answer the que
the affirmative, and to suggest unity as its
This suggestion is now boldly converted
doctrine, and almost asserted as a fact, and
a striking illustration of the mode in whic
assumptions grow into facts. The transpar
dielectrics is a deduction from the hypothesis
electro-magnetic nature of light. That hy
involves the possession by the ether of di
capacity; so, because the ether is transpa
must be a dielectric, &c. Can one conceive
example of what logicians call "workin
circle"? Here we have a closed chain o
ment, with neither beginning nor end, or i
each link serves for both at pleasure. Every
argument is at one time the result, and at
the starting-point, of all the others.

Turning now to the functions of the ether,
ing to Dr. Lodge in his "Modern Views o
tricity," we find him modifying Maxwell's
of geared and idle wheels, which would b
into a system which permits "slip" am
cogs (a sort of unlimited back-lash and
teeth probably, controlled by the special
ments of the theorist, to suit any particular
that in dielectrics the ether is rigid and lock
in conductors the same ether is flexibl
"slips" as much as is convenient. "The
of slip which we have depicted goes on in
ductors conveying a current, whether st
variable, and, in fact, *is* the current."
currents, the conductors conduct nothing, n
an impulse (I am quoting from the *Elect*
review, as I have not the book itself at hand
function of the wire [this is an extract f
book] is to dissipate the energy crowding
from the medium (that is, the ether), wh
would take up a static strain and cease to t
any more." "The wire dissipates energy—
mits none; all that enters it is lost. The d
alone, with its cogged gearing, transmits en
the distant station." I have the greatest
and admiration for Dr. Lodge; but I feel th
one word can adequately characterise all t
word I have applied to these ether n
"nonsense."

Why, what is to be done with all our
facts? We *know* that the one thing esse
current is the *wire*—the conductor. We *k*
the slightest break in that (*a break which*
*no way interfere with its power to dissipate*
would put an end to the current under
E.M.F., and under a powerful one would
make manifest the *energy it was transmit*
the well-known form of the arc light.
thing we *know* about the ether (that is th
thing we call ether) is that it transmits e
light, *without waste*. Now, if electricity a
are the same thing, as we are told, why
(exactly so, not in space) must the ether
waste-pipe or sink provided to enable it to t
electric energy? On this point of the ide
light and electricity, I may as well quote Dr
especially as his words forcibly illustrate t
chievous effect the habit of treating hypo
facts has upon even so clever, earnest, and
thinker as he is. "There are two obvious
explaining the transparency of a conductin
on the electric-magnet theory. One is t



he minute and rapidly reversed electro-motive which constitute light are incompetent, &c." t consider what this really means when sed. 1. Facts of nature, when inconvenient, be got rid of somehow. 2. We can *explain* any- whatever by *assuming* anything we like. is explanation has a right to be treated as a ubmitted (as "W.C.E." tells us, is the function higher mathematics) to mathematical calcu- s, and if the results will accord with the hesis—that is, guess—the assumption was ted to support, we must consider the guess reat extent proved. Finally, we have im- l into science the Jesuit's notion of "probable nes"; the setting forth of a notion by an nt man gives it a quasi-reality which renders e who doubts it liable to excommunication as etic; and further, we may have entirely ite and inconsistent notions equally endowed his probable validity.

ve now finished my examination of some of ding prophets of the ether-electric notions, own that they themselves admit that they are suggestive guesses, invented merely to satisfy lesire for some sort of conception of the nism of electric actions as to which g is really known. These suggestions, taken up by a lower order in the scientific , are transformed into more or less established nes; from *suggestions* they are elevated into s by professors and crammers, who find it to stuff students with cut-and-dried notions to cultivate their thinking faculties. As a , the less a man knows of the subject, the positive he becomes of the actual reality of otions he has been stuffed with, while the cal electrician cares nothing for the matter. y be all very well for the professor of the e attends to tell him the current passes by -electric and not by the wire, and when he to pass his examination he pays the professor with his own coin; but when he wants to te out a dynamo, he gives no single thought ether, except as an insulator, and devotes all nsideration to the iron and copper, their y and distribution. If he wants to fit up a or discover a leak, the only things he troubles is the conductor, and the agents which may it. I will now endeavour to show that the al electrician is right, and the ether notions h idle talk. **Sigma.**

## LATHE MATTERS.

35.]—I SEND the photograph of Mr. Massa's genious arrangement; it is so complicated, fear it will be impossible to render it clearly. ay a few words by way of explanation, and at Mr. Massa will himself clear up what is in my description.

lathe is seen from the back, the tool-board ing at the right-hand bottom corner. Upon the tool-board is fixed the short piece of lathe-bed intended to be used to lengthen the main lathe-bed. Upon this short piece of lathe-bed is mounted a headstock (which formerly belonged to a rose-engine) and a poppet, forming a complete secondary lathe having a mandrel, which we will call the back mandrel. This back mandrel has upon its nose a spiral chuck, and between this chuck and the poppet is a mandrel carrying a plain drum, which can be set more or less eccentric. Upon the tail-end of the back mandrel appears a handle by which it is turned. The back mandrel can be connected with the main mandrel of the lathe proper by change-wheels; thus, by turning the handle at the right of the drawing, both mandrels are set in motion at a relative speed depending on the change-wheels, which in this case is four turns of the back mandrel to one of main mandrel.

Under the main lathe slide-rest is seen a long cross slide; this is fully described p. 280, Vol. XLVI.; it is a double slide, at the end of which is fixed a rubber to bear upon the eccentric drum, the slide and rubber being kept in contact with the drum by a spring or weight from a bell-crank which appears at the bottom of the figure. It will now be understood that when the handle on the back mandrel is turned, the long cross slide will move endways, in and out, four times for each revolution of the work upon the main mandrel. A vertical cutter in the slide-rest on the long slide will then curve out the quasi-square shape of the column as seen in the figure.

Now for the ornamentation of the work. The reciprocator is mounted as seen, and the arm of the reciprocator on the main mandrel is connected with the handle of the back mandrel in such a way that the angular movement of the mandrels will still be four to one, the long bar to the right of the fig. being attached to a point on the main mandrel lever four times as far from the centre as the point to which it is attached upon the crank of the handle. Thus the movement of the reciprocator eccentric rocks both mandrels, but causes the back mandrel to revolve through four times the arc that the main mandrel does. After the first zig-zag cut has thus been made, it is necessary to count round both the work and the eccentric drum, but this must still be done in the same ratio; therefore, if one tooth be taken on the spiral chuck on the tail-end of the main mandrel, then four must be counted on the spiral chuck on the back mandrel. Then another cut can be taken.

I hope the fig. will come out clearly enough for the motion to be understood, and that it will give other lathe-men as much pleasure as it did to

25, Grange-road, Eastbourne. **F. A. M.**

## THE WATCH AS A COMPASS.

[31836.]—THERE is nothing novel in the use of a watch as a compass, and no one supposes (that is, no one who knows anything about its use for the purpose) that it could be so used for astronomical purposes; but even in such a diminutive forest as that known by the name of Epping the watch is useful—when the sun shines. It enables the rambler to define the north and south, consequently the east and west, and so with some little topographical knowledge he can easily find his way out, after losing his bearings by wandering about in search of mushrooms, blackberries, sloes, &c. It is well known that without any guide the rambler is apt to wander in circles, and the American who gave Mr. Labouchere the information is doubtless well acquainted with the use of a watch for finding approximately the north and south. **Nun. Dor.**

## RULES FOR BELL AND ALARM WIRING.

[31837.]—I HAVE already replied to Mr. Koerber's letter in the *Electrical Engineer*. His rule presumes that there must be a push for every "red wire" to be connected to, and a bell for every "blue wire," and therefore it does not apply to other than simple electric bell and push installations.

My rule (see "E. M." for Oct. 31) is so worded that it will apply in all cases of minor domestic electrical installation, such as bells, fire, frost, and burglar alarms, indicators, gas-lighting apparatus, telephones, electric clocks, etc. Mr. Koerber's reference to "line" and "return" wires is not at all clear. **W. Perren Maycock, A.M.Inst.E.E.**

## CO$_2$ GAS—PROBABILITIES.

[31838.]—"JACK OF ALL TRADES" and any other correspondent interested in the subject of letter 31822 are very welcome to the following data concerning carbon dioxide (not carbonic acid). One pound of chalk, $CaCO_3$, will give ·44lb. of the gas, which at atmospheric pressure will measure 100 litres almost exactly. There are 28·3 litres in a cubic foot, so that the above corresponds to 3·5c.ft. A cubic foot of the gas at standard conditions weighs about ·125lb. One pound of dry carbonate of soda will give almost exactly the same quantity of the gas as 1lb. of chalk. Soda crystals give less than half as much as the dry compound, because more than half their weight is due to the water of crystallisation which they contain.

It is quite possible to obtain an enormous pressure by the generation of the gas; but, on the other hand, the generation must be very rapid, or the pressure will at once go down.

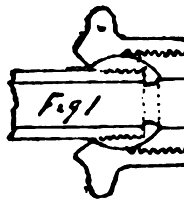
Is "W. G. P.," letter 31819, quite certain that he has got his facts correct about the Yarborough hand at whist? I have always understood that the earl, so far from offering odds which were "considerably in favour of his opponent," only laid £1,000 to £1, which is not much more than half the correct odds against a player holding a hand in which there is no card higher than a nine.

Is the aforesaid correspondent correct in his reference to "decimal places"? The number of hands, no matter of what sort, is necessarily an integer, and it is not easy to see how "decimal places" come in. There cannot be, say, 7,004·217 hands of any sort.

**Wm. John Grey, F.C.S.,**
Analytical Chemist, Newcastle-on-Tyne.

## AUXILIARY POWER FOR TRICYCLES.

[31839.]—In these small affairs, and owing to the vibrations, all joints for pipe connections would be best made upon the ball-and-socket principle. They are easiest made and easiest adjusted, and there is no special lineing out or keeping things lineable required, as they will adjust themselves to anything. As to the pipes, I shall have more to say about them anon. Fig. 1 is a sketch of the same joint. No special fitting or gauges are required, as any angle almost will suit, either in nut or seat. All that is required is for it to be true or smooth. Fig. 3 is the snifting valve that I have mentioned for the bottom of boiler, to act as a safety-valve and to return the surplus water to the tank. These are full-size. The best material to make them out of is Muntz metal, Delta metal, Prince's metal, or good yellow rod-brass, but it must be sound. A is the tube, the top of which is the valve-seat—flat seat, mind, no cones, no grinding. B is the spring-box, with a shoulder to catch the spring. D, the spring. This spring, if made with six or seven coils upon a bare ⅜in. mandrel, and of No. 18 B.W. gauge steel wire, hardened and tempered, will give us from 1lb. to 18lb. in compression; but we shall only want to adjust it to six, which can be weighed and marked off and adjusted by the spring box; and perhaps it would be as well to put a lock-nut upon the tube at F, to keep it there. The valve E is made out of a piece of hard brass rod, and the tube A is ¼ bore; and the best way to make them is to chuck a piece of brass, and turn the pin to fit the tube about ¼ up; then while this is in the lathe, file it three sides triangle, leaving the pins or angles almost to a knife-edge; then, with a very fine tool, undercut the edge, as shown; then chamfer the outside, as shown at G G; and then clean by taking off the knife-edge just as you can see it a bare $\frac{1}{32}$th, seeing that the inside is the gauge you require—viz., ¼, and you will find this A 1 when put together. This is the way I have made valves for hydraulic testing, from ⅛in. to 1in., and to stand from 120lb. to 6,000lb. per square inch.



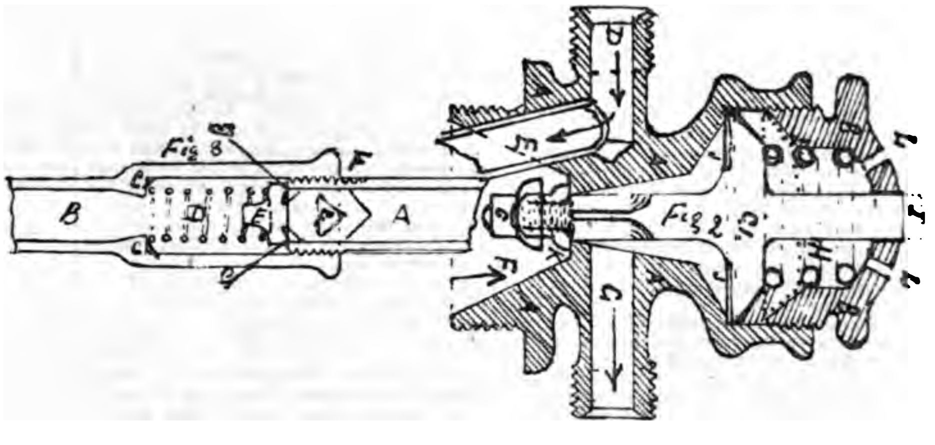


Fig. 2 is the reducing valve, the which is very necessary if using either gas or compressed air. This is full size, and made in this form to meet all our requirements. For instance, in the making our power—i.e., carbonic-acid gas—in the making this—a great quantity of free acid is carried over, and this is not only wasteful, but detrimental in other ways if it gets into the cylinder. So this is made to screw into a piece of brass tube 6in. long, with an egg end at bottom; this is not shown, as it is not necessary; its inside diameter is 1¼in., and thickness 10 B.W.G. Now, the bursting pressure of this will be perhaps 5,000lb. or 6,000lb. per square inch, and more than is wanted. 12 will be plenty, and will stand from 3,000lb. to 4,000lb. per square inch. The shell, or jacket, for these valves is good gun-metal, hard yellow brass, or Delta metal. A A A A is the shell, with the two seats for the valves J and K. B is a cap, with holes at L L, open to the atmosphere; it likewise acts partly as a spring-box and guide to valve spindle, as well as adjusting the spring. The spring H is made of three or four coils of No. 10 wire B.W.G. steel wound upon a $\frac{1}{16}$in. mandrel, hardened and tempered. This will give us from 1lb. to 90lb., or more if required. But I propose to work with smaller cylinders, with an inch more stroke—i.e, 1¼in. cylinders, 6in. stroke, and 90lb. per sq.in. Now C C are the valves; the dotted lines show when the pressure is on. When C I, the large valve is down, and no pressure on, the spindle I is flush, and the small valve is open; but when the pressure is on, it acts upon the large valve and closes the small one, and by passing your finger upon or over the hood L L, you will know what you have got in store. Of course, the communication between there and engines is closed to come at that, or it will not be found. The large valve is 1⅛in. and the small one ¼in. Now when the gas is making, it makes its entry at D, and passes down E, that is, the tube that reaches down to the wash-bottle—i.e., the 1¼in. tube 6in. deep. This is charged with 1oz. or 2oz. of bicarbonate of soda and water to about half fill it. Well, the gas passes down this tube through this bath, and up again at F, and through the valve and to the cylinders, thus freeing it from the free acid accumulating on its road without any waste. Now, if I was going to use this gas or compressed air, I should pass it through a serpentine heater—i.e., the same plan as the boiler heated with a lamp—in fact, the same without the fittings for water or steam, as they would not be required. I should do this to economise our power, as the atmosphere expands ⅛ of its bulk with 100 degrees of heat. If this gas will give that we shall be a gainer. I have no idea what carbonic-acid gas will expand at 2 or 300; but I daresay some of our friends will oblige us with a little information on the subject. I have had my considering-cap on for some time respecting the feeding of the water to the steam generator, and have come to the conclusion that I must fall back upon a plan I adopted some 50 years ago, when I made a model of a manual fire-engine not more than 3in. long—viz., a submerged pump for the job, as I am afraid that there will be no certainty in the gravity feed, as capilliary attraction will interfere with our apparatus, the quantity of water being so small; too much water means waste of power, and this will be the next on the board.

**Jack of All Trades.**

[31840.]—Could not liquid carbonic acid stored in strong flasks, and developing a gas which, at atmospheric pressure, occupies a space 450 times that of the liquid, be used for this purpose? It is obtained by compressing the gas exhaling from the earth or from other sources, and becomes liquid under a pressure of 35½ atmospheres, and being an article of commerce, is easily procurable at fixed prices.

**M.**

[31841.]—In reply to "Jack of All Trades," I beg to say that 1lb. of sodium bicarbonate will evolve about 4½c.ft. of gas at normal temperature and pressure.

**Sm.**

The saltest piece of water upon earth is, according to Consul General Stewart, the Lake of Urumia, in Persia, situated more than 4,000ft. above the sea level. It is much salter than the Dead Sea, the water being found on analysis to contain nearly 22 per cent. of salt. The lake is 84 miles long and 24 miles broad, and its northern coasts are encrusted with a border of salt glittering white in the sun. It is said that no living thing can survive in it, except a very small species of jelly fish. It is very shallow.

A Swedish engineer, Herr A. Frykman, claims to have invented a new machine for the manufacture of horseshoe nails, with which some successful trials have been made at the Langholm Warf, Stockholm. In a pressing machine the nails are cut out of iron rods, the machinery making 140 strokes a minute, each stroke producing two nails. The nails are then polished and pointed in a rolling machine, a skilled workman being able to turn out one a second. The construction of the machine has occupied the inventor eight years.

# REPLIES TO QUER

**** In their answers, Correspondents*
*fully requested to mention, in each instan*
*and number of the query asked.*

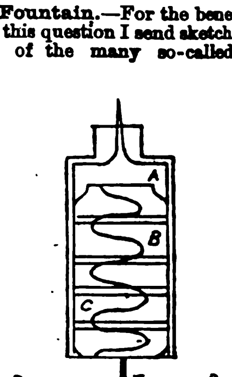
[72400.] — **Proportional Galvan**
Would S. Bottone kindly tell me if the p
galvanometer he describes in the "
26th September would be sufficiently
register a current set up by a small plat
and zinc, say, 1⅜in. square, with a piece
paper between them saturated with p
How is the needle fixed on the instr
mean how is the pivot on which the ne
fixed, and where? I amuse myself
galvanic plates for my rheumatism, and
to test the current first, so as to increa
in them. But I am very much of an an
as yet very ignorant of the laws of ga
electricity. Which is the best book
recommend containing the rudiments of
thorough but simple, plain, and not to
What is meant in your letter by "graded
E

[72549.]—**Analysis of KOH.**—Sut
Volumetric Analysis, does not mention t
matter. J. H.

[72584 & 72588.]—**Fountain.**—The q
find an excellent fountain on page 36
Vol. XVI. date Dec. 27, 1872, of mu
design than any figured lately. It much
an hour-glass, the water running from
to the lower bulb. They are then revers
action may be continued indefinitely.
J. H.

[72623.]—**Tramcar with Gas-Eng**
never know what you can do until you
why does "Engineer" ask for kindly ad
he should experiment, if he has any f
scheme? My opinion is not worth much
decidedly against the use of a gas-engin
pelling a tramcar. The very idea is abs
face of it, for what weight does "Engin
pose the gas-engine and "accessorie
amount to? I fancy an electro-motor
mulators would take the prize. I can
look on the face of the engineer of a t
whom such a proposition was put. Nu

[72584.]—**Fountain.**—For the benefit
interested in this question I send sketch a
tion of one of the many so-called



fountains, which I do not think has appea
"E. M." before. The fountain is repre
connection with an aquarium; but it mig
effort of a little ingenuity, be constructe
alone, or in the centre of a case of fern

y flowers and ornaments. The rockwork
uarium conceals a hollow case, A (see
). Inside the case A is fitted an india-
llows, B. The bellows contains a spiral
, and is wound down by a cord, E, passed
axle D D. When the bellows is brought
water enters the case A by a valve open-
rds, placed on the top. On the spring
ased, the bellows is gradually expanded,
ater is driven out through the jet to a
proportion to the force of the spring.

f this kind are to be bought capable of
lb. or even 15lb., which will be more than
for the purposes of ordinary indoor
. The principle of the fountain reminds
much of that of the ordinary carriage-
t is to be added, that a small tap may be
the jet-pipe to regulate the height, or to
erent kind of jet.
e. H. S. C.

]—**Brazing Iron.**—"Will any reader
te his experience in brazing sheet iron or
-that is the question. Experiences differ:
ke a mess of it; others, following direc-
n many times in "E. M.," do it at once.
surfaces to be joined; cover with a paste
mixed with spelter in filings; put some
lter round the edges, place in a clear fire,
spelter runs withdraw. Of course, I need
hat the parts must be held together with
t perhaps it is better to mention it. See
r directions. NUN. DOR.

]—**Goldbeater's Skin.**—This skin is
the peritoneal membrane of the cæcum
, dressed or merely cleaned and dried.
T. L.

]—**Engine Governors.**—Surely this
n find a suitable governor for his engines
umbers. What pressure does he run at?
M. T.

]—**Pianoforte Keys, Colouring.**—
-covered keys turn yellow mostly from
grease and perspiration. Scrape and rub
bit of felt holding whiting and ether.
ORGANON.

]—**Gas Blow-pipe.**—Why does not
" get one of Fletcher's catalogues? He
limit the conditions within dimensions that
uit. W. C. T.

]—**Propelling Boat.**—Query is amount
required to propel a boat 15ft. long by
eam, carrying load of 4cwt. at the rate of
n hour. Mr. Bottone (p. 193) says, in his
e, ½H.P. motor does it easily. How is
applied, and what is the motor, and does
include weight of motor?
TIDAL BASIN.

]—**Electric Gas-Lighter.**—What does
ay" mean? If his "gas-lighter" gives
sparks, or any sparks at all, it will
light coal-gas if it is held properly. M.

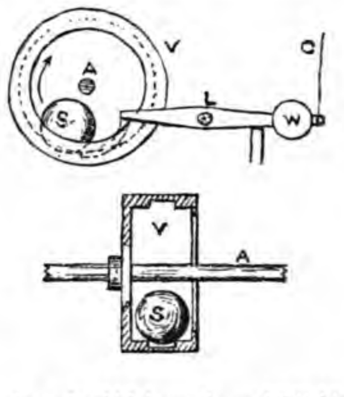
]—**Silent Steam-Jet.**—It will puzzle
to obtain a silent steam-jet worth having.
'jet," instead of circulating the steam
he heater? T. L.

]—**Pellets.**—Perhaps the querist will say
neans by pellets. If slugs, they are cast
. F. A.

]—**Indicating.**—To "W. S.," Liver-
ualising the work in both cylinders is only
by adjustment of the slide-valves. If
Engineman" will send me particulars of travel, lead, steam, and exhaust cover at each end for both slide-valves, also length of connecting rod, and possibly the original diagrams, as those small ones published may not be trustworthy, I shall do my very best with pleasure to advise him. My first reply would be correct if the two cylinders had been independent, one using high-pressure steam against a heavy back pressure, the other using low-pressure steam exhausting into a condenser, clearance being neglected in both cases, as I then explained.

Liverpool. W. S.

[72725.]—**Mechanical Motion Wanted.**—"Australian" does not state what force the lever or cord is required to overcome while the engine is working, or the extent of its motion. If the latter be but small, the following contrivance, which is simple and susceptible of modification, may suit his requirements, with a very slight expenditure of force. A metallic sphere, S, runs in a groove or between rails formed on the interior of a hollow vessel, V, keyed to the axle A. While the axle and vessel are rotating, as indicated by the arrow, in addition to the sphere receiving a rotation on its centre, it will be compelled to rise up the interior for a short distance in the same direction as shown in the upper figure. The lever L has a weight, W, at its outer end, which keeps the cord C tight while the axle is rotating, its range being limited by a stop. When the motion ceases, the sphere will fall to the lowest point, vertically under the axle, with a tendency to slightly exceed this before settling to rest, and will exert a part of its weight in depressing the inner end of the lever, which is bent so that it may be free of the groove, but so placed that the sphere may press upon it when in the position of rest. When this occurs, the opposite end, W, of the lever will be raised, and the tension of the cord released; the masses of the sphere and weight being so regulated as to admit of this. The groove, or what corresponds to it, should be much deeper than shown in the sketch, which simply illustrates the idea, so that the bent end of the lever may have more play and freedom of action. The vessel might be made in two halves, and bolted or screwed together. A. MARSON.



[72735.]—**Barometer.**—Question asked (p. 196) was, Why does water rise and fall in neck of flask before atmospheric change? In the device which it seems querist means the change in the atmospheric pressure is indicated by the water in neck of flask. This device was illustrated in Vol. XV. p. 69, and is there called "weather-glass" (barometer is inappropriate). That brought out from our friend, the late W. Tonkes, the remark that Squire Baxter's weather-glass was far more beautiful as well as equally simple. The device to which I referred was a half-gallon pickle-jar nearly full of water, an inverted Florence oil-flask full of water and supported by a ring of wire so that the neck dipped into the water in the jar. This arrangement was stuck out in full sunshine on the garden wall, where it was allowed to "form" (it took a lot of it), and the "old salts" used to be fairly successful in foretelling weather. NUN. DOR.

[72761.]—**Self-polishing Blacking.**—Referring to "Nun. Dor.'s" inquiry on p. 274, I should think no one but the veriest quack would speak of a recipe as reliable which he had not personally tested. I made up the article in quantity stated in recipe, and used it constantly, exhausted. By the way, one of my clients informs me that he finds ordinary black japan, thinned with turps or meth. spirit, to answer every purpose. I may also inform "Nun. Dor." (p. 274) that the patent for Woolf's "Acme" blacking, the specification for which (No. 1750, of 1877) was given on p. 253 by "Pharmacist," was quickly allowed to lapse.

P. W. STANLEY, Analytical Chemist.
Billson-street, London.

[72761.]—**Self-Polishing Blacking.**—I have referred to the specification mentioned by "Pharmacist" (p. 253), and find it to be an American's patent for black varnish and stain, the last two paragraphs giving modifications suitable for use on harness and boots—the latter being the one quoted by "Pharmacist." The specification is 1750, 1877, price 4d.; but in the fatal volume for 1877 patents there is the ominous word "Void" after the No. 1750. In fact, the second payment was never made. Readers can form their own conclusions, and those who like can make the so-called "self-polishing" blacking without let or hindrance.

NUN. DOR.

[72763.]—"**Girls" in the Bible.**—The statement of "F.R.A.S." that these occur only in Joel and Zechariah, is true of the English word; but there is one more occurrence of the Hebrew at Genesis xxxiv. 4, where it is translated "the damsel." "Boys" are, in the English, very nearly as rare, occurring only at Genesis xxv. 27, and the same two prophets; but the Hebrew word there is a quite common one, usually translated "lad," "youth," or "young man." E. L. G.

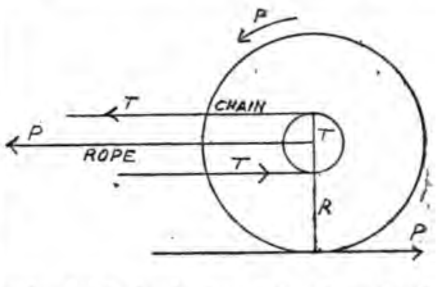
[72779.]—**Petroleum Furnace.**—S. Bray's patent hydrocarbon burner will answer all purposes where heat is required, providing steam or compressed air is obtainable for pulverising the oils. If inquirer will advertise his address in the "E. M.," I would post him address of the company in Russia exploiting this instrument, and who would give him all information he should require, and also where he could find the agent for the burner nearer to his residence. H. B.

[72816.]—**Analysis.**—"Abertify" is correct in saying that opium contains 10 per cent. of morphia. Opium (and its tincture), however, do not answer to the colour reactions of that alkaloid on account of the extractive matter. Diluted tincture of opium will give a red colouration with ferric chloride, owing to the presence of meconic acid, with which the morphia exists combined. The tests named are only applicable to the pure salts of morphia, the separation of which from organic matter being an operation which requires great analytical skill.

E. WIGHTMAN BELL, F.C.S.

[72852.]—**L. and S.W.R. Tank Locos.**—Nos. 457, 458, and 459 belong to the 445-459 class of four-coupled bogie express engines, built by R. Stephenson and Co., 1883. No. 446 has been converted into a Worsdell compound. Nos. 527—553 are, I believe, all of the "new mixed traffic" class. METEOR.

[72882.]—**Bicycle Power.**—Let R be radius of driving wheel, let $r$ be radius of chain-wheel, let P be force necessary to just move the machine; then, if the machine is pulled by the rope, the tension of the rope will be P. But if the machine is driven by the chain and driving wheel, the force P must be exerted as a backward pressure on the road at the point of contact of the driving wheel with the



road. Let T be tension of the chain, then by moments we have $Tr = PR$. Suppose $R = ur$—that is, that the radius R is $u$ times as long as the rod $r$. Then $Tr = Pur$, $\therefore T = uP$—that is, the tension of the chain is as many times that of the rope as the rod of driving wheel is that of the chain-wheel. We see that if the chain-wheel is increased, T becomes less until it equals P, when the chain-wheel is as big as the driving wheel, for in this case $u$ is unity, and $T = uP$ becomes $T = P$.

W. E. H.

[72885.]—**Tides of Society Islands.**—I have often heard of those purely solar tides in Pacific islands, and heard them explained as due only to the sea and land breezes, there being no real tides there. My notion is that there are none in Tropical places with establishments between one and six hours, or thereabouts, because the solar earth-tide has everywhere about two to four hours' establishment. E. L. G.

[72891.]—**Steam Power.**—The power required to operate a bucket or piston-pump is estimated by the formula—

$$N = x \times \frac{W \times H}{550}$$

in which $x$ is a coefficient = 1·5 for ordinary pumps of commerce. W = water in pounds which is lifted, H feet in height (including sectional height) per second. For deep-well pumps, with long connecting-rods and numerous guides, it would be safer to use as coefficient $x = 1{\cdot}65$. For single-acting pumps the quantity discharged per minute

$$= \frac{D^2 \times 3{\cdot}14}{4} \times \frac{v}{2} \times y,$$

in which $y$ is a coefficient which may be taken for ordinary pumps at 0·80; D the diameter of the piston in feet; and $v$ the piston speed in feet per minute. Assuming 10in. stroke, and a piston speed of 65ft. per minute, we have, for actual discharge of the three pumps:

$$\frac{{\cdot}333^2 \times 3{\cdot}14}{4} \times \frac{65}{2} \times 3 \times 0{\cdot}80 = 6{\cdot}8562\text{cu.ft.},$$

and $6{\cdot}8562 \times 62{\cdot}5 = 428{\cdot}5$lb. per minute, or $\frac{428{\cdot}5}{60} = 7{\cdot}162$lb. per second. Then, for power required, $\frac{1{\cdot}65 \times 7{\cdot}162 \times (90 \times 3)}{550} = 5{\cdot}798$ H.P.

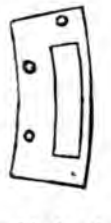
B. B. Clay can, of course, apply the rules to the actual circumstances of piston speed; but it would seem, from those assumed, that his engine should develop clear off the flywheel-shaft about 6H.P. I fail to see any just reason for objecting to the "engineering books." If instead of 7·162lb. he were lifting 5·50lb. of water per second (33,000lb. per minute), every foot of lift would represent, theoretically, 1H.P., and that, if the well were 100ft. deep, 100H.P. would be represented in the water lifted, for $\frac{550 \times 100}{550} = 100$H.P. (probably 150 to 165H.P. actually in work done in so lifting it), whereas, even with the pump described, 100H.P. would, theoretically, be used up with a well depth of $\frac{550 \times 100}{7{\cdot}162} = 7{,}679$ft., if such a condition of things could be imagined. MARIENBERG.

[72893.]—**Noisy Piano.**—How thankful I should have been if, at certain periods of my existence, my near neighbour had written to ask how the strains of the "Maiden's Prayer" or "Warblings at Eve" could be so modified as not to become a nuisance! It will be the easiest thing for "Crochet" to procure some soft cloth or baize and lay it on the strings of the grand piano. By the addition of weights, if necessary, the tone can be so softened as to be barely audible outside the room.

W. H. DAVIES.

[72894.]—**Model Traction Engine.**—Make safety-valve $\frac{5}{16}$in. diam.; firebox will only burn methylated spirits. Sorry I forgot to answer all your questions. J. A.

[72894.]—**Model Traction Engine.**—I inclose a full-size sketch of the slot-link. This is cut out of a piece of sheet brass. The radius of link is struck from centre of fly-wheel shaft when valve is at half-travel or equally covering both steam-ports.



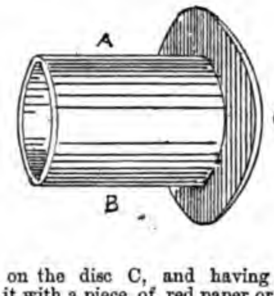
The hole shown at end is for pin from suspension-link. The other two are for the eccentric-rods. Of course we are obliged to alter the shape a little in order to make it strong. Length, 1in.; breadth, $\frac{3}{8}$in.; slot, $1\frac{1}{8}$in. by $\frac{3}{16}$in. This link slides up and down on die-block, and is raised by a double lifting-link which, through a bell-crank, connects with reversing-lever on foot-plate. J. A.

[72895.]—**Spectacle Lenses.**—You do not state if you mean convergent or divergent meniscus lenses. A convergent meniscus is used, like a double convex, for shortening the focus of the rays, and corrects presbytism or long sight. A divergent meniscus acts like a double concave, lengthening the focus, and is used to correct myopy or short-sight. The concave side of each lens being placed next the eye, it covers the eye better than double-convex or concave, and, as you say, receives the side rays, and therefore gives a larger field of vision. If there is any difference in the thickness of the glass, it is insignificant. CALDEMONE.

[72911.]—**Brighton Engines.**—I inclose the following:—No. 19, July 1875; 42, 1877; 76, 1880; 97, Oct. 1874; 103, Sept. 1876; 104, Oct. 1876; 105, Sept. 1876; 106, Oct. 1876; 112, 1877; 113, May 1877; 114, 1877; 115, July 1877; 130, Nov. 1878; 142, March 1879; 143, March 1879; 144, April 1879; 155, March 1881; 183, Dec. 1889; 268, May 1880; 269, May 1880; 296, Oct. 1877; 358, Nov. 1886; 402, March 1873; 404, May 1873; 411, 1873; 413, 1873; 422 to 426, 1882; 427 to 429, 1884; 430 to 432, 1887; 481, broken up 1867. Cylinders of No. 157, $18\frac{1}{4}$in. by 26in. Old Nos. 401—408. They used to run from 96 backwards. No. 201, Nov. 1872; 202, July 1872; 203, April 1871; 204, Jan. 1872; 205, July 1872; 206, Oct. 1875; 207, Jan. 1876. L.B. and S.C.R.

[72913.]—**Photographing the Moon.**—I used a small quarter-plate camera closed up, having an adapter to take the lens screw and the astro. thread of my telescope; focussed the moon on the ground glass, and gave an instantaneous exposure. The image produced at the focus of a $2\frac{1}{2}$ o.g. will be very small. I used a 5in. o.g., putting the plate, say, $\frac{1}{10}$in. inside the visual focus. H. A.

[72913.]—**Photographing the Moon.**—I think it hardly worth while attaching a camera to such a small telescope for this purpose. The following is a simple and more economical plan, and answers well both for telescope and microscope:—Turn a piece of wood similar in shape to that shown in the diagram, so that the cylindrical portion A B slides home into the eyepiece tube without any shake. To use it, place your dry plate in position on the disc C, and having previously covered it with a piece of red paper or cloth, fix it to the disc by means of a couple of paper-clips or patent clothes-pins. I need hardly mention that, in order to focus, a piece of ground-glass the size of one of your plates should be clipped to the disc, and the moon carefully focussed thereon.



T. D.

[72915.]—**Canal Boat.**—Both the querist and "Latris" are mistaken in supposing that it is necessary to jump in the direction of A. Quite the contrary. While you are on A you travel at the rate of three miles an hour. If you jump in the direction of A on to B, your head will retain this motion, but your feet will be stopped by friction on alighting, and carried the opposite way, so that you will have a worse fall than ever. But if you jump in the direction of B you will cease to move in the direction of A, and your motion coinciding with that of B, you will alight safely. If B were passing A in the same direction, then you would jump in the direction of A and B; but since they move in opposite directions, you must reverse your former motion to prevent a fall. If the bargee was not hypothetical, he was probably trying a practical joke. CALDEMONE.

[72916.]—**Dissolved Bones.**—Advertise your address, and I will write to you. I know what is the matter. SM.

[72928.]—**Pump.**—Without seeing boiler one cannot give a correct reply, but should think that boiler is dirty, or the tubes too close, as the water is really foaming, and the introduction of the cool feed reduces that, and water falls in glass. You should examine, and in any case not work water so low in glass, or you will have a mishap.

Bristol. T. C.

[72928.]—**Pump.**—I should imagine you start pumping a lot of cold water in boiler; the water in boiler then partly leaves off boiling, and the space occupied with bubbles of steam no longer exists. Have you not noticed the water falls when steam is down and before water begins to cool much? (I am not now speaking of the difference of expansion between hot and cold water.) It would be better for the boiler if you could warm the feed with waste steam from engines (not allowing any grease from cylinders to get in), and pump in at the same rate as boiler evaporates. CAMBRIDGE.

[72939.]—**Star-finder.**—You will find instructions as to making and fixing finder in Proctor's "Half-hours with the Telescope." A finder, however, is hardly necessary for such a small aperture as 2in., especially so as your telescope appears to be without a stand. T. D.

[72939.]—**Star-finder.**—You will find a description of a very simple star-finder in the "E. M." for May 27, 1887, with which the designer has often picked up the planet Venus when she was visible to the unaided eye in broad daylight. The baseboard must be level, the angle $x$ equal to the co-latitude of the place. Set pointer to the declination of star to be found on the circle, and put the hour pointer to its proper place by means of a watch put to sidereal time. H. A.

[72942.]—**Governor.**—It all depends on what speed you run, but as that is perhaps not of much importance to you, you can make balls $\frac{3}{4}$in. diam., and arms 3in. long of $\frac{5}{16}$in. iron, with a coiled spring on the spindle to push down sleeve and spindle of say $\frac{7}{16}$in. or $\frac{1}{2}$in. Governor can be placed horizontal or vertical, and spring chosen according to speed adopted.

Bristol. T. C.

[72945.]—**Compound Engine.**—Proportions correct. Cut-off in h.p. cylinder, say, at $\frac{5}{8}$ stroke will give you, say, 12 to 15H.P., indicated roughly.

Bristol. T. C.

[72953.]—**Boring Taper Holes.**—To "JACK OF ALL TRADES" AND "SNOWBALL."—The holes are $1\frac{1}{2}$in. long, and required to be dead true. Will "Snowball" kindly describe a taper D bit? as those spoken of in books, as far as I can find, are all for parallel work, and cut on the end; but I presume the cutting-edge of the taper D bit is on its side. If so, please say how the clearance is obtained to get a cutting-edge. Any hints will oblige. X. Y. Z.

[72954.]—**Brazing by Electricity.**—Although you might be able to perform the operation under the conditions named, with a current of 800 ampères, I do not think you could depend on the result with less than 1,000 ampères, in consequence of the comparatively large surfaces exposed, which of course prevent the heat being confined to one spot.

S. BOTTONE.

[72956.]—**Turning True Cylinder in Steel.**—To "JACK OF ALL TRADES."—My centres are cones of 60°. Will you kindly describe a barrel centre, and oblige? X. Y. Z.

[72956.]—**Turning True Cylinder in Steel.**—See that your lathe centre runs dead true before starting, as it is impossible to turn work dead true unless it does; also have both lathe centres the same cone. Should hardly think carrier has any effect. TURNER.

[72956.]—**Turning True Cylinder in Steel.**—Look to your running centre; possibly the hole in your mandrel is not perfectly true, and you may find a place where it (the centre) will run true. If you cannot true the centre up, see that both centres are of same angle, and that your work is square on ends. Drill the centres in work a little way up, and your difficulty will disappear.

Cambridge. A. J. DEW.

[72956.]—**Turning True.**—Ends of cylinder may not be square, and centre, therefore, not bearing centrally. But more likely the running centre is out of truth the least bit.

Bristol. T. C.

[72960.]—**Equation.**—

$$A = \frac{74{\cdot}41}{39{\cdot}04}x + \frac{58{\cdot}36}{22{\cdot}99}y$$

$$B = \frac{173{\cdot}9}{78{\cdot}08}x + \frac{141{\cdot}8}{45{\cdot}98}y$$

Let—

$$A = ax + by$$
$$B = cx + dy$$

to simplify working, then—

$$\begin{array}{c} Ac = acx + bcy \\ \underline{Ba = acx + ady} \\ Ac - Ba = bcy - ady \\ \therefore \dfrac{Ac - Ba}{bc - ad} = y \end{array}$$

Also—

$$\begin{array}{c} Ad = adx + bdy \\ \underline{Bb = bcx + bdy} \\ Ad - Bb = adx - bcx \\ \dfrac{Ad - Bb}{ad - bc} = x. \end{array}$$

On filling in and working out the numbers which I have done by logarithms—

$$x = \frac{3{\cdot}084\,A - 2{\cdot}538\,B}{{\cdot}225}$$

$$y = -\frac{2{\cdot}227\,A - 1{\cdot}906\,B}{{\cdot}225}$$

ASSOC.N.S.S.

[72960.]—**Equation.**—

$$A = \frac{74{\cdot}41}{39{\cdot}04}x + \frac{58{\cdot}36}{22{\cdot}99}y$$

$$B = \frac{173{\cdot}9}{78{\cdot}08}x + \frac{141{\cdot}8}{45{\cdot}98}y = \frac{86{\cdot}95}{39{\cdot}04}x + \frac{70{\cdot}9}{22{\cdot}99}y$$

Take $x + y$ from each side of the equation—

$$A - x - y = \frac{35{\cdot}37}{39{\cdot}04}x + \frac{35{\cdot}37}{22{\cdot}99}y$$

$$B - x - y = \frac{47{\cdot}91}{39{\cdot}04}x + \frac{47{\cdot}91}{22{\cdot}99}y$$

And

$$B - A = \frac{12{\cdot}54}{39{\cdot}04}x + \frac{12{\cdot}54}{22{\cdot}99}y$$

$\therefore (A - x - y) : (B - x - y) : (B - A) :: 35{\cdot}37 . 47{\cdot}91 : 12{\cdot}54$, or $12{\cdot}54\,(A - x - y) = 47{\cdot}91\,(B - x - y) = 35{\cdot}37\,(B - A)$.

From this we obtain—

(1) $47{\cdot}91\,B - 12{\cdot}54\,A = 35{\cdot}37\,(x + y)$
(2) $12{\cdot}54\,B + 35{\cdot}37\,A = 47{\cdot}91\,(x + y)$

and $47{\cdot}91\,(47{\cdot}91\,B - 12{\cdot}54\,A) = 35{\cdot}37\,(12{\cdot}54\,B + 35{\cdot}37\,A)$, whence $A = B$.

$$+ \frac{58\cdot36}{22\cdot99} y = \frac{173\cdot90}{78\cdot08} x + \frac{141\cdot80}{45\cdot98} y$$

$$\frac{12\cdot54}{39\cdot04} x = \frac{12\cdot54}{22\cdot99} y \text{; or } x = -\frac{39\cdot04}{22\cdot99} y$$

$$y = -\frac{22\cdot99}{39\cdot04} x$$

$$\times -\frac{39\cdot04}{22\cdot99} y\Big) + \frac{58\cdot36}{22\cdot99} y = -\frac{16\cdot05}{22\cdot99} y$$

$$+ \left(\frac{58\cdot36}{22\cdot99} \times -\frac{22\cdot99}{39\cdot04}\right) x = \frac{16\cdot05}{39\cdot04} x$$

$$= \frac{39\cdot04}{16\cdot05} \text{A; and } y = -\frac{22\cdot99}{16\cdot05} \text{A.}$$

way we obtain—

$$= \frac{39\cdot04}{16\cdot05} \text{B, and } y = -\frac{22\cdot99}{16\cdot05} \text{B.}$$

W. C. JOCELYN.

**Muslin Stamping.**—This is the old
ham block-printing. If you advertise
and what you want, I have not the
ut what you will get an answer. If
with any patterns you require, I
equal parts of fine pumice-stone
some finely-washed pipeclay would do
your patterns of sheet brass in strips
design, and drive them into a piece of
or sycamore endways the grain. I
some samples about that my sons
ne from Mitcham when on a visit to
engaged in block-making, and I was
sed to hear that anyone was engaged
there now. It is a very old sort of
ng business.

JACK OF ALL TRADES.

**Atmospheric Pressure.**—The pres-
ured by the difference in level between
mns of mercury. If it is 760m.m., the
ormal, and no correction is required;
ise, the volume must be calculated into
d be at 760.

SM.

**Transparent Unbreakable Ma-**
et gelatin, xylonite. Thin horn.

SM.

**Transparent Unbreakable Ma-**
luloid answers your requirements.

B.Sc.

**Transparent Unbreakable Ma-**
some of the transparent horn used
instead of glass.

JACK OF ALL TRADES

**Transparent Unbreakable Ma-**
w will mica do? This is rather brittle,
to very thin plates.

ASSOC. N.S.S.

**Transparent Unbreakable Ma-**
Sheets of gelatine containing $\frac{1}{500}$ of
f potash. These, on exposure to light,
h and insoluble in water, while they
transparency. 2. White celluloid, the
now used for pianoforte keys. This
n on with pencil, and the writing easily
washing with a damp rag.

S. BOTTONE.

**Unbreakable Material.**—For the
this query transparent sheet horn, such
horn lanthorns, will do well. Pro-
other scales are made from it, and can
mathematical instrument makers. As
d part, there is, or was, a material
skin," which was frequently bound
diaries. What it was made of I do
but if now procurable, would com-
er our querist's wants as to pencil, but
as to ink.

F. G. LL.

**Telephone.** — Speaking-tubes will
asily. They may be conveniently con-
rown paper rolled into tubes of ¾in. to

ASSOC. N.S.S.

**Telephone.**—Use a ¾in. compo. gas
aking-tube. I have three in use regu-
r such a short distance as you require
any advantages over any kind of tele-

HALL.

**Telephone.**—"Ulsterman" can com-
tween the two parts of his house by
Bell telephones. These require no
l to call attention he might use magneto
atent right of the Bell telephone ex-
, on the 12th of next month. After
one can make up, use, or sell the Bell
th impunity. A mechanical telephone
ed. Many different sorts have been
the ENGLISH MECHANIC; but if there
ners to turn in the line, I should re-
ll telephones.

ACOLYTE.

**Lighting.**—To MR. BOTTONE.—There
hing as mercuric acid, so you may be
at the brown deposit is not that. But it appears to me that, instead of using plain water, or dilute sulphuric acid along with the zinc, you have got some strong bichromate or chromic-acid solution, either put in intentionally, or oozed through the too porous cell. The brownish-red deposit is chromate of mercury. To prevent the too rapid transfusion of bichromate (or chromic acid), it is well to make the porous pot quite dry and hot, and then paint it all over, except one narrow strip about ½in. wide from top to bottom, with hot, melted paraffin. The cells must be coupled in series for lighting. Every cell gives about two volts.

S. BOTTONE.

[72968.]—**Darts.**—Treat it as an ┌ bracket, the corner of the ┌ being A in your sketch. Then breaking weights in cwts. at end of each bracket would be for wrought-iron $= \frac{320 \times r^2}{L}$, $r$ being radius of iron, and L length of arm—both in inches. If W = 10 tons, and L = 60in., then

$$r = \sqrt{\frac{60 \times 10 \times 20}{320}}$$
$$= \tfrac{1}{2}\sqrt{15} = \text{say 2in.}$$

The strain on strap A may be taken at 1½ times the load, and section of same to give a strain of three ton per square inch actual load.

T. C.

Bristol.

[72969.]—**Indicator for Medical Coil.**—To MR. BOTTONE.—These indicators do not indicate the strength of the current, but only the extent to which the regulator has been pulled out. Make a dial with any desired number of degrees on it, from 0° say to 360°. Arrange in front of this a pointer on a poised spindle, passing through to the back of the dial. Now coil some catgut or a fine chain round the spindle, and attach one end of the chain or gut to the brass regulator. When this is pulled out it will cause the pointer to travel over the dial. If a counter-poise be hanged on the other end of the chain or gut, the pointer will return when the regulator is pushed in again.

S. BOTTONE.

[72970.]—**Magic Lantern Screen.**—Is a roller blind not feasible?

SM.

[72971.]—**Magic Lantern.**—Do not turn the light full on until the glass has got warm. One would have thought the reason was obvious.

SM.

[72971.]—**Magic Lantern.**—The cause of glass breaking will be that it is too tight in its fitting. Use the thinnest glass you can get, and have it loose all round, and it will very rarely break.

R. B. S.

[72972.]—**Model Boiler.**—Coal is out of the question; methylated spirits will do, and possibly charcoal—but neither with tubes of ⅜in. diameter. To talk of 100lb. pressure in a model is absurd; remove one of the noughts from your figures, and you will be nearer the mark.

J. A.

[72973.]—**Manufactured Jewels.**—If any of "Ours" know how to make sapphires, &c., from silicate of alumina, it is not likely they will tell you; neither will the Sèvres people. Your only chance is to experiment till you get the "trick of the trade."

Plymouth. B.Sc.

[72975.]—**North-Western Engines.**—Of the engines of the "Lady of the Lake" class between 76—167, there are fourteen, as follows:—No. 1 Saracen, 28 Prometheus, Nov. 1861; 33 Erebus, Feb. 1860; 44 Harlequin, 60 Tantalus, March 1860; 61 Phosphorus, Feb. 1860; 77 Mersey, 97 Atlanta, 111 Russel, May 1860; 117 Tiger, Nov. 1860; 127 Peel, March 1862; 134 Owl, May 1860; 139 Cygnet, Nov. 1861; 165 Star, Nov. 1860. Of the 821, or "Diomed" class, there are about 60 in all on the N.W.R., and between 76—167 there are four:—No. 35 Talisman, 36 Thalaba, 124 Marquis Douro, Feb. 1865; 90 Luck of Edenhall, Oct. '74. There are no 6ft. compounds on the N.W.R., and of the "Dreadnought" class there are about 42. No. 2 City of Carlisle ("Dreadnought"), March 1886; 285 Phalaris (821), Sept. 1873; No. 373 is Clank; 805 Caliban (formerly Cyclops), March 1864 (821 class).

NORTH-WESTERN.

[72977.]—**Pulvermacher Chain.**—I did not see the former inquiry, but from the following description, copied from page 405 of "Electricity in the Service of Man," recently published in monthly parts by Messrs. Cassell and Co., I should imagine you would not have much difficulty in making a belt for your own use. "Each element of this battery consists of a piece of wood, about which a copper wire and a zinc wire are wound, but insulated from each other. The four wire ends of each part are bent so as to form loops, by means of which the copper wire of the one pair is connected with the zinc wire of the next, and so on. Vinegar is used as the fluid, the girdle being immersed in it; the wood retains the vinegar, and the battery remains charged even when taken out of the liquid. If magnesium be substituted for zinc, the current is considerably increased, and water may be used instead of vinegar.

H. BROCKLEHURST.

[72979.]—**Dissolving Amber.**—I am afraid you have not got real amber to work on, or you would find it dissolve in chloroform, benzol, or camphorated alcohol. If it is amber colophonium (amber refuse after dry distillation) you have got you will find it soluble in oil of turpentine and fatty oils. This is used to make the amber varnish.

Plymouth. B.Sc.

[72979.] — **Dissolving Amber.** — Powdered amber, especially if partially roasted previous to pounding, dissolves easily in chloroform and good benzole. Crushed glass should be mixed with the amber to prevent adhesion, and expose a large surface. In the old collodion days I made many a pint of amber varnish in this way.

S. BOTTONE.

[72980.]—**Tower Roof Ridging.**—The slates are cut to mitre, and pieces of lead, called "steps," are nailed under every course of slates. If "A. B. T." will fix two boards so as to make an accurate model of one angle of his roof, and set out upon them the depth of each course and the width of each slate, the adjoining slates in each course, taken together, will give the shape of the steps.

HALL.

[72980.]—**Tower Roof Ridging.**—I do not quite understand "A. B. T.," but of course with such a steep pitch, ordinary ridge tiles, or rather hip tiles could not be used. You could use strips of slate about 3in. wide, copper nailed, and bedded and pointed in cement down the corners A, as you call them; but if I had it to do, I should most certainly put "lead rolls"—i.e., round pieces of wood nailed to rafters, and then, when slates are on, lead dressed over these rolls to lap over slates on each side. Any plumber will show you how it is done.

INKPOT.

[72982.]—**Dynamo.**—You will have some difficulty in getting 50 volts 40 ampères from so small an armature at only 800 revs. per minute. However, if you can get 15lb. No. 12 on the armature, and 50lb. No. 18 on the fields, and connect up in shunt, you may possibly get the result you desire. The difficulty lies in the fact that it is rather difficult to get a cast-iron field-magnet, shunt-wound, to magnetise itself until the speed (and consequent E.M.F. and current) reaches a certain point.

S. BOTTONE.

[72983.]—**Noisy Piano.**—Put thick felt below the feet.

Plymouth. B.Sc.

[72983.]—**Noisy Piano.**—Something might be done by putting rubber buffers under the feet of piano.

SM.

[72983.]—**Noisy Piano.**—You cannot get rid of the noise, that is, if your neighbours have ears; but you can mitigate it by letting the piano legs and pedal-bar stand on thick indiarubber discs, at least 1in. thick. Please note that the piano must not touch the wall, or any article in the room, otherwise the sound vibrations will be conducted by them.

S. BOTTONE.

[72983.]—**Noisy Piano.**—Stand the legs of the piano on thick slabs of indiarubber, or perhaps better still, in little boxes full of sawdust. The latter can be covered up, and made even ornamental. If the sawdust boxes are used, especially if glass receptacles for the legs of the piano are also employed, there ought to be no inconvenience in the rooms below. But possibly the house is so built that it is resonant: there is no remedy for that.

ORGANON.

[72984.]—**Railway Bridges.** — Why should "Bon" have the foundations for his bridge in the water as the stream is only 7ft. wide? If I were doing this work, and I have done a good deal in this line, I should put my foundation on each side of the stream, and lay the bricks on a good thickness of concrete if there was not a rock foundation (and this is very unlikely in the neighbourhood of a brickfield). The arch might have a span of about 12ft., and a rise of about 4ft. to 4ft. 6in. The arch, if built five half-bricks thick, would be of ample strength.

R. S. S.

[72986.]—**Pure Dissolved Bones.**—Probably "Foreman" used too much sulphuric acid. Sulphuric acid is the only acid that can be used.

W. H. S.

[72987.]—**Gravity Electric Clock.**—If I were "Mem." I should not alter the Bain's electric clock to be worked by gravity-arms, as he proposes. I should keep the clock as it is, with the exception of taking off the contact breaker, and drive it with a current sent every second from some good clock with a one-second pendulum. If the selenoid on the pendulum is properly wound, he can do this with a water battery. I have one thus working, and it is a great success. I had it going for seven months without any attention whatever. At the end of that time I merely changed the water in the battery and put in a handful of common salt.

ACOLYTE.

[72990.]—**Telephone.**—Join the first and fourth studs of switch together, and connect them to line C, and join the second and third studs together and connect to independent bell, and see that the bar that connects the two levers of switch is made from some non-conductor of electricity; then you will not be confused by the wrong bell ringing.

F. W. Bernard.

[72991.]—**Dynamo Winding**—Your armature is small to get an output of 26 ampères at 60 volts pressure. Try 12lb. No. 12 on the armature, 5lb. No. 12 on each leg of the F.M.'s. connected in parallel for the series coils, and 40lb. No. 18 on the F.M.'s in one length for the shunt coil. It is hardly worth compounding the machine for so small an output as ten ampères; still, if you are inclined to try, use 6lb. No. 16 on the armature, 6lb. No. 16 in two sets in parallel for the series coils, and 20lb. No. 18 for the shunt coils. S. Bottone.

[72992.]—**Purifying Vitriol.**—If you will advertise your address, I will write to you. I have the necessary technical knowledge. Sm.

[72994.]—**Sewing Machine.**—To Mr. Bottone.—Power required, between a half and one man-power; speed of hand-wheel about 4 revs. per second; of needle bar and shuttle shafts about 24 revs. per second. S. Bottone.

[72995.]—**Fluid for Zinc Labels.**—If you will advertise your address, I will send you specimens of different inks, and you can take your choice.

Sm.

[72996.]—**Vacuum Tubes.**—It is *possible*; but it would require a great many tubes and a considerable amount of battery power. The length of spark required depends on resistance of vacuum tubes. The shock from a 2in. spark coil would be decidedly unpleasant. The tubes are called Geissler's tubes. They are made in a multitude of designs.

Sm.

[72996.] — **Vacuum Tubes.** — Vacuum tubes containing a carbonic-acid-gas vacuum (this not a bull) give a fairly white light, but hardly enough to light a room well, about sufficient to see by, and that is all. A coil giving a 2in. spark is not to be played with, the shock from it would probably seriously injure, if not kill. Such a coil would work a tube 24in. long brilliantly. S. Bottone.

[72997.]—**Battery and Lightning.**—It is just possible that during a storm lightning may find its way through the battery. No great injury would accrue, except, perhaps, melting the wires. It would be no use connecting the negative wire to a water-pipe. It would be better to protect by a properly constructed lightning conductor quite independent of battery. S. Bottone.

[73000.]—**Electric Light.**—A coil is no use for lighting incandescent lamps. S. Bottone.

[73001.]—**Flue Gases.**—The chimney being the draught producer (as an exhaust fan would be on the upcast shaft of a mine), the w.g. is necessarily highest (from accumulated frictional resistances) the nearer you approach it, and less all along the track to ashpit, where it may be almost *nil*. Thus the boiler nearest the chimney shows the highest w.g. The high w.g. in the main flue indicates a high velocity consequent upon insufficient area, whilst the chimney area was probably correct. The temperature of the gases entering at the base of the chimney should not exceed 400° Fahr. for ordinary working steam pressures of from 45lb. to 60lb. per square inch. Marienberg.

[73003.] — **Accumulator.** — You can charge these by placing them across the main circuit, with sufficient resistance in circuit to bring them up to nearly the same resistance as the lamps; this would be about 25 ohms. S. Bottone.

[73006.]—**Heat.**—By Charles's Law—

$$V_t = V_{t'} \times \frac{273 + t}{273 + t'}$$

[$V_t = V_o(1 + d\,t)$ $V_{t'} = V_o(1 + d\,t')$, and divide one equation by the other to get rid of $V_o$].

$$\therefore 1 = \tfrac{1}{2} \times \frac{273 + 40}{273 + t'}$$

$$\therefore 2(273 + t') = 313$$

$$t' = \frac{313 - 546}{2} = -\frac{233}{2} = -116{\cdot}5^\circ$$

or 156·5° absolute temperature. No Sig.

[73005.]—**Conic Sections.**—The words "in acceptance" almost seem to imply that "A. M." imagines a contradiction between the definitions. A conic may be defined from (1) one or other of its properties, (2) its mechanical construction, (3) the section of a cone. The usual way of explaining the names given to the conic sections by Apollonius (not Appollonius) is as follows:—The parabola is so-called because $y^2 = px$; the ellipse, because $y^2 < px$; the hyperbola, because $y^2 \mathrel{7} px$, $p$ being the perimeter. Apollonius first called the curves sections of the right-angled, acute-angled, and obtuse-angled cones respectively. Analysis being in most hands a much more powerful weapon than geometry, the latter of "A. M.'s" two definitions is possibly more common than the former. Strictly speaking, however, (1) occurs in works on geometrical, and (2) in works on analytical conics.

No Sig.

[73009.]—**Leclanche Batteries: Proportions.**—The exact amount of manganese dioxide is not material; anything between 30 and 50 per cent. works well. Fuse coarsely-crushed carbon, 60 parts; needle manganese, 40 parts. Be careful not to use dust, either in the carbon or in the manganese. They must be granular. S. Bottone.

[73010.]—**Electric-Bell Magnets.**—You seem to be using too much of too fine a wire. Four layers of No. 20 silk-wound over paper would give good results with a single quart Leclanché cell. See my book, "Electric Bells and All about Them," for table of sizes of wire, &c., required for bell magnets. S. Bottone.

[73011.]—**Milk.**—There is no instrument that would be of any use to you. The way to analyse milk is to determine the total solids, the fat, and the ash, and compare the amounts with those obtained from pure milk. Sm.

[73011.]—**Milk.**—For 1s. you can get a test-tube, by which you can approximately ascertain the percentage of cream in milk. The milk should be set up in the tube either fresh from the cow, or warmed to 100° Fahr., and the tube then placed in cold water. The percentages of different samples should be read off at definite periods—say, six hours, or 12 hours. For another shilling you can obtain a lactometer, which is a specific-gravity bottle, graduated so as to indicate approximately whether water has or has not been added to the sample. Another device, procurable for 2s. 6d., indicates the purity of milk by an ingenious colour test. None of these tests can, however, be relied upon for accuracy. If accuracy is required, the quantity of fat on a given sample must be estimated by the lactobutyrometer, the butter-fat being extracted with ether. It is a somewhat tedious process, unless a number of samples have to be examined. To ascertain the amount of solids other than fat, the residue, after the extraction of the fat, is evaporated to dryness and weighed. If the percentage of solids is found to fall below a certain arbitrary and very low standard, the milk is considered to be adulterated with water—indeed, the standard is so low that it leaves room for a pretty free dilution of ordinary cow's milk before its level is reached. Refrigerated milk I consider quite as wholesome as new milk—indeed, rather more so, as the process involves a good deal of aëration, which dissipates certain odorous gases. These may or may not be injurious; but milk so aërated and cooled keeps sweet, when in milk not so treated B. lactis and other germs grow quickly. The cream can be made to rise on refrigerated milk by heating it to 100° Fahr., or even 120° Fahr., and then plunging the containing vessel in the coldest water obtainable. The watery part of the milk, being a better conductor of cold than the fat, contracts more quickly. The fat becomes thus relatively lighter, and rises to the surface. It is a fact for which I am unable to account that milk thus reheated sours much more quickly than fresh milk. It follows, from what I have stated, that refrigerated milk can be tested for purity the same as new milk. I may add, respecting the addition of boric-acid preparations to milk to preserve it—for doing which I see a man was fined in London the other day—I am of opinion, from an extended experience, both using them in my own family as a food preservative and prescribing the salts of boric acid medicinally, that they are no more injurious to the human economy than chloride of sodium; indeed, I know that what would be a poisonous dose of the latter would produce no particular effect were the former taken. But some people, who are never easy unless they are engaged in the discovery of dietetic mares'-nests, have found out boric acid is poisonous; but then I think they have also ascertained, to their own satisfaction and the discomfort of nervous people, that everything we eat or wear is also more or less impregnated with morbific agencies—and yet we live on. Doctor Med.

[73013.] — **Electric Lighting.** — To Mr. Bottone.—Sixty cells giving 2 volts each and 20 ampères on the short circuit would light well from 20 to 25 lamps of 110 volts, taking about 0·8 to 1 ampère each, or 30 to 33 if they took only 0·6 of an ampère. The statement that a current of 110 volts can light up "any number" of incandescent lamps is totally erroneous. First, because volts is not a current at all; and, secondly, because a battery has always a resistance, and this has to be reckoned with. In your case, the resistance of each cell must be about 0·80 of an ohm, since the current given is only 20 ampères; 30 of your cells would light a good arc lamp. So that the 60, in two separate lots, would light two such lamps. I can recommend the Brockie-Pell lamp. The cells should be arranged in series. S. Bottone.

[73014.] — **40C.P. Shunt Dynamo.**—To Mr. Bottone.—Wind the armature with about ¾lb. No. 20. Wind the field magnets with about 9lb. No. 20 for the shunt circuit. Have a switch arrangement, by means of which you can connect the two limbs of the field magnets in parallel, so as to be able to reduce the resistance to ¼ when you want to use the machine as a series dynamo; otherwise the resistance of the F.M. coils will be too high. You will also require another switch in connection with the F.M. wires to open the passage for the series circuit. A ring armature takes nearly double (not quite) the amount of wire required by a shuttle armature to give the same output, since all the wire that lies inside the ring is dead wire. When the field magnets of a dynamo are wound with too little wire, so that they do not get fairly magnetised, the effect of increasing the amount of wire is to increase the magnetism; this, of course, increases the E.M.F. in volts, and consequently the current is also increased. S. Bottone.

[73016.]—**Boiler.**—This boiler should work safely at 20lb. pressure per square inch; for 70lb. it would require to be made of iron, and stand a water pressure of at least 210lb. per square inch—i.e., to be pressed to three times the working pressure.

J. A.

[73016.]—**Boiler.**—It will be safe at 70lb., but not higher. I should put two or three hoops round it. I am supposing the ends are not flat or else stayed; if neither. it would not be safe. T. C.

Bristol.

[73017.]—**Brighton Railway Locomotives.**—"A" class: 6 coupled tank-wheels, 4ft. diameter; from rails to top of chimney, 11ft. 3in.; from rails to centre of boiler, 5ft. 8¾in.; from rails to foot-plate, 3ft. 6½in. "B" class: 4 front-coupled wheels, 6ft. 6in.; trailing-wheels, 4ft. 6in.; from rails to top of chimney, 13ft. 2in.; from rails to centre of boiler, 7ft. 5in.; cylinders, 18¼ by [illegible]; rails to foot-plate, 4ft. D. Leitch.

[73018.]—**Dynamo, Gramme Type.**—To Mr. Bottone.—Armature 4⅛in. diameter, 3in. wide, wound with 8lb. No. 18. Field-magnet cores, each 4in. long, 2in. diameter, wound with 10lb. No. 18. No. 18 runs 45 yards to the pound. Ten sections on the armature will be sufficient.

S. Bottone.

[73020.]—**What Battery is This?**—To Mr. Bottone.—A battery with a silver strip, surrounded by chloride-of-silver paste, and separated from the zinc by a pad of blotting-paper is one of Gaiffe's chloride-of-silver batteries. These batteries soon run down if used on the closed circuit. They are of no use except for working small pocket-coils; and not much good for those. S. Bottone.

[73022.]—**Broken Wrest-Pin.**—The best way to remove a broken wrest-pin that cannot be gripped and twisted out is to drill it out, and replace with one a larger size, or plug the hole and rebore. As to the buzzing-string, that must be examined to find the cause of the buzzing. Perhaps the covering is loose; perhaps the string does not bear fairly on the bridge; or perhaps the string has gone. Querist does not say whether it is up to pitch and retains [illegible]

Organist.

[73022.] — **Broken Wrest-Pin.** — I am afraid you will not be able to extract that pin, as you say it is flush with the plank. In that case it must be bored out or driven right in, sufficiently to make room for another pin. If you will advertise your address, I will send you three different sizes of pins to select from so as to fit properly (no charge). Take the noisy string off, and send it to Messrs. Goddard, Tottenham-court-road, W., or to [illegible] Rew, Little Camden-street, Camden Town, N.W. They will make a new one—that is the only remedy for it. J. H. Schucht.

[73022.]—**Broken Wrest-Pin.**—Mr. Foster has got in a fix, from which, I am afraid, all the advice in these columns will not relieve him. Many a stringer, who, in the hurry of his piecework [illegible] has knocked the pin too deep before turning it, has asked the same question in despair. A "broken pin extractor" may be obtained from Mr. H[illegible], 37, Drury-lane; but I fear from the description that he will have to treat it on the homœopathic principle, and punch it clean through the plank.

W. H. Da[illegible]

[73023.]—**Piano Dampers.**—To Mr. Da[illegible] or Mr. Schucht.—Under dampers are a very [illegible] invention, and are not generally favoured by English makers. They exercise a quicker control over the vibration, because they act nearer the middle of the string. It is, however, possible to have too much of even a presumably good thing; for, when in good order—which, by the way, is not always the case—they are apt to produce a [illegible] effect that is anything but pleasant, and though the monotomy may be relieved by the judicious use of the loud pedal, I think the "advantage" is questionable, and should, on the whole, prefer a good top damper for general use. W. H. Da[illegible]

[73023.] — **Piano Dampers.**—The price of a pianoforte action with under dampers is the same as for one with upper dampers; but the pianos which you have seen may be a superior class of instruments, and on that account more expensive. S[illegible]

rs prefer the one, and some the other
imply a matter of taste. I do not use
under dampers for the following
The under dampers certainly stop the
the strings more effectively than the
rs; but there is usually a break in the
the dampers leave off and the two
e treble part begin, in which there are
2. In order to get room for the under
ween the action and the strings, the
e hammer is about 1in., and in some
away from the strings; consequently,
ammer has struck the strings it will
, because its centre of gravity is now
strings and its own centre or fulcrum.
s, a spring is required to force it back
-place. 3. The under dampers require
orce them against the strings in order
vibration. Now, if we press the key
its course by playing *pianissimo*, these
resist more when the hammer comes
he dampers away from, the strings.
ve overpowered the two springs; but
low and no sound, hence we are com-
amp the key. The action with upper
s not damp so well; but there is no
sound where they leave off. Neither
or the hammer requires a spring—they
k by their own gravity. We can play
ith such an action, and *forte* as well,
ave no springs to overcome.

J. H. SCHUCHT.

**L. and Y.R. Locos.**—(1.) Six-coupled
1in. diam., trailing wheels 3ft. 8in.;
in. diam., 26in. stroke; heating sur-
935·5sq.ft., firebox 85·5sq.ft., total
area of fire-grate 19·7sq.ft.; boiler—
rel 10ft. 3in., diam. outside 4ft. 4in.;
bes (iron) 192; 1¾in. diam. by 10ft. 7⅝in.
-plates; capacity of tanks 1,200gals.;
-leading to driving 7ft. 3in., driving to
in., middle to trailing 6ft. The trailing-
Webb's radial axle boxes. Weight of
eading wheels 13tons 3cwt., on driving
s 3cwt., on middle wheels 12tons 1cwt.,
heels 9tons 6cwt., total 48tons 13cwt.
is fitted with the automatic vacuum
-iron block acting on each of the six
els.

METEOR.

**L. and Y. Railway Locos.**—The
ne for the passenger traffic which you
our query as having 5ft. 8in. coupled
ng, the wheels being 6ft. in diameter,
in. by 26in. The tractive force exerted
nd of steam-pressure in the cylinders
$\frac{17\frac{1}{2} \times 26\frac{1}{2}}{72} = 110\cdot5$; the weight avail-
esion being 28 tons 17cwt., and the
force is very useful. The principal
re:—length of boiler-barrel, 10ft. 3in.;
boiler outside, 4ft. 4in.; number of
liameter of tubes outside, 1¾in.; dia-
e-wheels, 3ft. 7¾in.; thickness of tires
ls, 3in. Heating surface:—firebox,
ubes, 935·00sq.ft.; total 1028·25sq.ft.;
19·25sq.ft.; valves placed between
nk motion is of the ordinary type.
ngines of this class have Joy's valve-
lves being above cylinders. Total
1ft. 0½in.; weight of engine in work-
eing as follows: on bogie-wheels,
.; on driving-wheels, 14 tons 13cwt.
iling-wheels, 14 tons 4cwt.—total,
. 2qr. Axles are of best mild crucible
oiler is of Yorkshire iron, the inside
per. The tender is fitted with the
. Railway water scoop.

AQUA FORTIS.

**leate of Lead.**—It may possibly
dry. You might also try crystallisa-
cohol. SM.

**Leclanche Battery: Corroded**
are probably right about the sul-
being at the bottom of the mischief.
harm in washing the cells out with
d; but the cells should afterwards
er, to which a few drops of liquor
e been added, for several hours. Be
algamate your zincs. S. BOTTONE.

**Precipitation of Silver and**
precipitation at all. Reduce the
rrent of hydrogen. The nitrates will
rcoal without flux. SM.

**Precipitation of Silver and**
rod of zinc immersed in a slightly
ution of sulphate of copper will give a
finely-divided copper. If immersed
f nitrate of silver, metallic silver will
d. Nitrate of silver is easily reduced
lver on charcoal under the reducing
blowpipe. Copper salts yield with
lty. S. BOTTONE.

# UNANSWERED QUERIES.

***The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.***

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# QUERIES.

[73029.]—**Noise on Cello.**—Can anyone inform me as to the probable cause and its remedy of the following? When I took out my cello one day last week to practise, I noticed a nasal sort of twang after every note that was played at all loud. It sounded upon all the strings, but more particularly upon the third and fourth. I found out the soundpost was out of upright, so I put that right, and have also altered the bridge. I have thus succeeded in considerably improving and strengthening the tone of the instrument, but cannot get rid of the twang, which sounds as if a knitting needle was resting upon the cello. It has been like it once before, but righted itself again on shaking some shavings, &c., out of the interior; but I can find nothing in it now, nor can I see any sign of anything sprung that might cause the mischief. It sounds worst on F natural, third finger, first position, and in some places is quite unnoticeable. I may mention that the cello was rebuilt about six months ago, and up to the present has been in very good order. I keep it in a case which stands in a dry and warm atmosphere, and am quite at a loss to account for the very disagreeable noise that is produced, the notes themselves being pure. Any information as to above will oblige.—CELLIST.

[73030.]—**Telescope.**—I have a 2in. achromatic lens, 16in. focal. Would this be any use for astro. telescope. If so, what eyepiece could I construct for it, and what power should I get?—Q.

[73031.]—**Gas Tire Furnace.**—Can any reader give me any information respecting above? Should like to use gas instead of wood for heating cart and carriage tires if practicable and economical?—CONSTANT SUBSCRIBER.

[73032.]—**Telegraph Line.**—In a telegraphic line wire having an earth for return the resistance is counted as *nil*. Now supposing the wire resistance was measured before erection and after only having the earth for return, would it measure the same as wire alone or higher?—GALVO.

[73033.]—**Swollen Wrist.**—For about twelve months my left wrist has been swollen very much. The doctor says it is the enlargement of the muscle through over work, and advises me to wear a strap, and as long as as there is no pain it won't be any harm. I should be glad if any reader would give me advice.—TURNER.

[73034.]—**Tablets.**—I have a number of cast-iron tablets to make, 9in. square and ⅜ thick. Each tablet contains several lines of letters and figures, and each is different. How can I fix these small letters to the wrought-iron pattern without pins, so that they will not shake off with the taps of the moulder's hammer. What cement is suitable for this purpose?—C.

[73035.]—**Tree Calf.**—To "PRACTICAL BOOKBINDER."—Have read with pleasure and profit your interesting articles, and should be much obliged for some information and descriptive account of the production of what is known as tree calf. I mean for the very best bindings, not for trade purposes.—POMOSHNIK.

[73036.]—**Accumulators.**—Will one of your experienced correspondents tell me what size dynamo would be required to charge accumulators for lighting 50 lamps of 16c.p. for five hours, and the horse-power needed to drive same for seven hours?—ALABASTER.

[73037.]—**Wood to Slice.**—Wanted a simple plan for cutting thin shavings of various woods across the grain? Must be thin, clean cut, the cell-walls unbroken, and in pieces about 1in. square.—XYLEM.

[73038.]—**Lithanode.**—To MR. BOTTONE.—Please say if these cells can be charged with salammoniac or zinc chloride in place of sulphuric acid, and without much loss of E.M.F., so as to avoid the necessity of amalgamating the zinc plates, or of removing them when not in use.—NOVICE.

[73039.]—**Regulator Clock.**—I will feel extremely obliged if any practical man will inform me what is the best train for a regulator clock? Britten gives a description in his book of one of these clocks, with all pinions of 12 leaves, but I am led to believe that pinions of seven or eight are better. Will some one kindly help me with correct sizes, and also size of cutter for cutting the wheels? Is pinion wire or cut-pinions best? Any other hint will be gratefully received.—AMATEUR ALL OVER.

[73040.]—**Telephones.**—To MR. F. C. ALLSOP.—I wish to make a complete telephone with bells, &c., to connect two business premises about 200yds. distant from each other. 1. I thought of making the receivers of the "E. M." type, and if I made the transmitters of the same type fixed in front of the switch-board, do you think it would give good results? 3. Is the electro-magnet of the receiver in Chapter I. on "Telephones" drawn full size, or would it be any advantage to make it larger, and how many cells shall I want at each end? 3. Please give the quantity and size of wire the four bobbins should be wound with. 4. Can I use an iron ferrotype plate for the transmitter and receiver after Dec. 31st next, without any danger of an infringement of any patent? 5. Will ordinary electric bells do for the signals, wound with 26 B.W.G. silk-covered, or must they be wound with special wire?—AMATEUR FITTER.

[73041.]—**Detector Galvanometer.**—I wish to make a lineman's detector galvanometer. How much wire must I use for the intensity coils, and how much for the quantity coils? Also what size wire is best for the quantity coils, and what for the intensity?—R. S. S.

[73042.]—**Electro-Magnet.**—I wish to make an electro-magnet to lift ¾ ton. I must not exceed the following sizes:—Length 6ft., thickness 3in., breadth 10in. It has to be flat, not curved. Kindly say how many cells giving 1·4 volts will drive it? I have about 6½lb. No. 18 B.W.G. wire, covered. Would this be of any use? Also could I have core cast of ordinary iron, and what would be the probable cost of the whole?—H. C.

[73043.]—**American Organ.**—To "ORGANON."—I should esteem it a favour if you could kindly lend me your valuable aid as follows:—I am about constructing an American organ with six full sets reeds on Swell and four or five on Great. Each manual to have reeds from 16ft. tone up. The pedals I am thinking of putting two sets also 16ft. if I can get any variety of tone in each set. Can that be done? I don't think it would be worth while to put a set of 8ft. when there would be 16ft. on manuals. I have tried to set out the action on paper; but as I do not know what size the bellows would be required, I am done at once. Further, I cannot see where to fix the pedal reed board without getting the trackers in the way of the action for couplers pedal to Great and pedal to Swell. If it would not be troubling our friend "Organon" too much, I should like a plan (end view) of the action. I can spare a space of 6ft. high, 4½ft. wide, and 3ft. deep, taking out about an inch each way for case. I thank him for his courteous reply sent in response to a letter addressed direct to him, and if he would like to send me a plan of the action direct (he has my address) I should be glad, as it would save our Mr. Editor the expense of a block. Plan about an inch to a foot would be best, I think—that is what I tried to set it out. I saw his articles on American organ building in our reference library, and I see he there recommends Munro's reeds. Would he kindly say if all reeds are made of a uniform size, so that they would fit any reed-board purchased, and what is Munro's address? Also what is the difference between broad and narrow reeds, and brass and steel tongued? Any further hints he can give me I should be glad of.—J. H. S.

[73044.]—**Dynamo.**—I have a small Gramme dynamo, shunt-wound, the poles of which heat very much after an hour's running. F.M.'s wound with 13lb. No. 18, and armature (laminated) with 3¾lb. No. 18. It runs at 1,780 revolutions. Conductor wires are No. 16. Four lamps in parallel 16c.p. Should I put more lamps on? How long should such a dynamo run without heating? Any information will be thankfully received.—NOVICE.

[73045.]—**Shocks from Dynamo.**—In a book that I have been reading on the management of dynamos it stated that it "was impossible to get a dangerous, or even unpleasant, shock from an incandescent dynamo, as the voltage never exceeded 100." Am I to understand from this that the number of ampères passing is of no consequence?—R. S. S.

[73046.]—**Petroleum as Fuel.**—Is petroleum used successfully at present time as a fuel in England? If so, is it suitable for heating brewing coppers, and does it compare favourably with steam-heating as regards economy and efficiency? What is the temperature of steam at a pressure of 20lb. per inch?—COUNTRY BUNG.

[73047.]—**Coils.**—Mr. Bottone, in one of his replies (see 31823), says, "In these latter, however, owing to the space taken up by the series coils (which should be laid on first) the shunt cores, &c." Now, what is Mr. Bottone's reason for putting on the series coils first? I believe most of our leading makers do the reverse, and put the series on the outside of the coil. What depth would Mr. Bottone advise the F.M. coils to be wound in a 2,000 watt and a 4,000 watt machine, compound wound? I believe his outer coils are not so effective as those nearer the F.M.—NO SIG.

[73048.]—**Pulleys.**—Can any of our engineering contributors inform me how the iron pulleys with wrought-iron arms and rims and cast-iron bosses are made? The one I have has round arms with a shoulder forged near the extremity of each arm, which passes through the band and is then riveted over. Are the arms secured to the band before the boss is cast or *vice versâ*? Are there any special appliances for moulding these kind of pulleys, so as to secure great accuracy and prevent the boss being eccentric with the rim? Mine is somewhat of an offender in this respect, although the hole is bored fairly central.—SCARLET TOWN.

[73049.]—**Armour.**—Can anyone recommend a good book on arms and armour, with illustrations? A series of papers on the "Knights of the Middle Ages" appeared in the *Art Journal* some years ago. Have these been republished in book form?—SCARLET TOWN.

[73050.]—**Gassner Battery.**—I have made a Gassner battery according to the recipe of Mr. Bottone—½lb. chloride of zinc, ½lb. oxide of zinc, 1lb. plaster of Paris, 1½ pint of water. Would he kindly state further, especially in answer to No. 1? 1. Whether salammoniac is used in the composition, and what quantity? 2. If the carbon plates should be in duplicate, so as to approach closely to the zinc lining and so prevent resistance? 3. If the zinc would do in the form of a rod amalgamated, as in the Leclanché battery. I have lined an earthenware pot with 1-16 sheet zinc. 4. If a rod of zinc would do, would it not be better to place it close to the carbon plate, or close between two carbon plates?—A. B.

[73051.]—**Magnum Bonum Pens.**—Would some one be kind enough to describe the kind of machine used to make the above into cylinder form, and also how they are hardened without changing their form?—J. W.

[73052.]—**Yorkshire Coalfields.**—I will be very much obliged to any of your correspondents giving me particulars of what they know of the coal seams in the district between Scarborough and Whitby? Also title of any geological book or map relating specially to the district named?—Miner.

[73053.]—**Banjo.**—Would some of your readers aid me to make a first-class banjo? What wood to use, and how much? Could anyone give illustrations of banjo, showing working dimensions?—K. C. B.

[73054.]—**Walton's 200c.p. Dynamo.**—How many layers of wire should there be on the field-magnets? Should right-hand pole be finished before the wire is taken over to the left side? Should a piece of wood be let into the top recess, and fixed down by four screws? What is the use of the wire being bent like a spiral spring where it goes to a terminal? What is the cause of wires becoming brittle where attached to batteries or dynamo? Should the punchings be turned true in back-gear lathe after fixed on spindle before wire is wound on armature? Should the wire be first wound on one side of the spindle, and then on the other, and crossed each time? Can field-magnets be magnetised any time after the dynamo is completed (if the armature is taken out) by connecting the terminals to a battery? I propose winding one limb of the F.M. till the wire remaining weighs 22½lb. Then cross over to the left side, and wind on till the coil weighs 15lb. Then cut off the wire, and then wind on to the other casting till the coil only weighs 7½lb., and pass over to the other side and finish off. Should recesses in lathe castings be filled in with wood level with the iron, and have a groove for wire to pass through?—D.

[73055.]—**Mosaic.**—Can any reader advise me as to books, tools, cements, &c., for use in making Derbyshire mosaic—i.e., inlaying marble with designs in marble or like material?—Carrara.

[73056.]—**Scaling.**—When visiting a sawmill in Wales, I saw that the boiler joints were leaking in several places, and the water escaping was as black as ink. On inquiring the reason, the engineer said that the water they used contained lime, and caused scaling which they prevented by putting oak chips in the water when in the boiler. I shall be glad to know if this is not injurious to the boiler plates?—Traveller.

[73057.]—**Condensing Engine.**—The water that supplies an engine falls from the height of 20ft. to the air-pumps, the exhaust being forced up again to a tank 15ft. high. Formerly, the air-pump had to pull the water up about 7 or 8ft., the exhaust falling away again. What I want to know is, does the water falling to the air-pump interfere with the formation of a good vacuum, or in any way act differently than when being lifted up?—W. H. H.

[73058.]—**Gas.**—Will some reader kindly answer the following:—1. The cost of generating pure hydrogen gas per foot? 2. Does it give far better results than house gas? 3. Does it require more oxygen for the mixed jet and the etho-oxy jet, than for the safety jet? I am aware they give double light. Does it require double quantity of oxygen?—Sudbury.

[73059.]—**Accumulators.**—Will Mr. Bottone please tell me what material is used in conjunction with lithanode for an accumulator, and what would be the capacity of plates measuring 4in. by 1½in.? Also state the capacity of a zinc plate measuring 4in. by 3in., with a lead plate same size.—J. R.

[73060.]—**Boat Engine.**—I have a boat 13ft. by 3ft. 4in., fitted with engine 2in. bore, 3½in. stroke, flywheel 12lb. What size boiler should I require, and propeller? Also what speed should I get? An answer would greatly oblige.—E. Dollin.

[73061.]—**Names on Pencils.**—Would any of your kind readers inform me of the process employed by pencil makers to impress their name, &c., and how gilded? I have a steel roller and bronze powder, but it is not successful. The wood I use is beech.—Stick.

[73062.]—**Sand-papering.**—Can any of your readers tell me how to make a cheap machine for sand-papering wood up to about 6ft. 6in. long by 4in. square, to be driven by steam? How fast ought it to run, &c.?—J. V. Gibbons.

[73063.]—**Motor.**—To Mr. Bottone.—I have constructed an electro-motor, as described by you in No. 1322 of this paper, but it will not work. I have wound the magnets with six layers of No. 23 silk-covered wire. Does it matter in which direction the wire is wound? Could you also inform me how to make a commutator, as I am not sure if I have made mine correctly? I could not understand how the wires were to be connected, as the lettering of the diagram was indistinct. So I should be glad if you would kindly explain again how this is to be done. You would greatly oblige me by answering the above.—No Name.

[73064.]—**Allowances for Turning.**—Will someone give a scale of allowances for turning, stating how much traverse to leave in gauges for working fits; also for tight fits—such as cylinders, liners, &c., say, from 3ft. to 6ft. in diameter?—A. E. D.

[73065.]—**Gas-Engine.**—Two 16H.P. nominal Otto gas-engines driving two 110-volt dynamos in parellel, each dynamo giving 180 ampères, consumption of gas per each engine hour 800ft., water supplied direct from main to both engines through one meter, which shows 500gals. per hour. I wish to know if by setting down tanks, would the water circulate quick enough to keep engines cold enough?—if so, what capacity would be required, and what size pipe to and from engines, and any other information bearing on the above will be received with thanks?—Water Jacket.

[73066.]—**Electro-Plating.**—Does the process of plating affect the tempering of steel—such as bicycle hubs, springs, &c.?—Amateur Plating.

[73067.]—**Electric Light.**—Will some of your electrical readers kindly answer the following:—1. How many cells shall I require to light a 5c.p. incandescent lamp for about three hours at a stretch? The carbons 5½in. by 1¾in., arranged in form of a square with the zincs in the centre, using 4 carbons and 2 zincs for each cell. The zincs would be 5½in. by 1½in., and ¼in. thick, and how to arrange them for best result. Presuming, I double the lamps, I double the battery-power, and so on. Also how many volts could I expect from each cell with chromic-acid solution?—M. G. Einner.

[73068.]—**Telephone.**—In fitting a telephone up with two Bell receivers, one to be used as transmitter, and the other as receiver, will it speak as loud without a battery as the "E. M." receiver does with a battery? And would the Bell receivers be improved by using a battery in circuit?—Bernard.

[73069.]—**Safe Pressure of Boiler.**—Could one of "ours" kindly inform me the safe pressure of boiler of the following dimensions:—3ft. high, diameter 10in., internal firebox 15in. high, 9in. diameter, substance of foundation ring ⅜in. by 1½in., ⅛in. plate all over boiler?—Constant Reader.

[73070.]—**Musical Scales.**—Is there at the present time, or was there ever any nation that used a scale in which intervals were not integral multiples of a semitone? Is the semi-tone founded on a law of nature, or merely a conventional development? Is there any scale that differs in its intervals from those we use—i.e., major, minor, and Gregorian?—Charles Robinson.

[73071.]—**Marine Boilers.**—Having a pair of ¾in. by 1½in. slide-valve cylinder engines for a 4ft. boat, I wish to make a boiler to steam fast, in order to drive the engines at 7 0 to 1,000 revs. per minute. I propose making boiler of brass, copper riveted, 12in. long, 6in. wide, 6in. deep, slightly rounded at bottom to fit boat, and well stayed. Firebox right through 4in. high, 5¼in. wide, which will leave ⅜in. space for water at sides and bottom. Can vertical tubes be recommended, as I think of putting four ½in. from top to bottom of flue, and six ⅜in. Field tubes coming from crown and half-way down near end of fire-grate 5in. long? Will any experienced reader state if I may rely on this style of boiler as fast generator at 50lb. pressure?—Billy Hooks.

[73072.]—**Gold Line.**—Will some brother-contributor state the proper or best way to draw a gold line on card-mounts, various sizes and shapes—oval, round, and cushion? I cannot succeed with pen. Please state what kind of pen apparatus, &c, is needed, and name a work, if any, on the above?—Golden.

[73073.]—**Phonograph Cylinders.**—Can anyone tell me the proportions of beeswax and paraffin used in making these, and other ingredients, if any? I cannot get them so hard and dark-looking as the Edison ones. Also the arrangement by which the style or recording point is made to impinge against the diaphragm. Any hints will oblige.—Puzzled One.

[73074.]—**Chromic Cells.**—What effect does the amount of solution in a single-fluid chromic cell have on the duration of current—e.g., would a cell holding one quart and giving a certain current for a certain time give the same current for twice the time if it held two quarts, and how long might I expect a cell holding half-gallon to give 20 ampères of current: Also how can I tell when the solution is used up without testing the current, and is the addition of more sulphuric acid when the current begins to fail of much use?—Ursa Minor.

[73075.]—**Wheatstone Bridge.**—Would a circular form of mètre bridge be any improvement on the long form by reducing R. of standing connections, as the ends of the wire would be brought close to each other?—Ursa Minor.

[73076.]—**Black for Tools.**—How can I black some home-made tools similar to black Lancashire tools, the black on which seems to stand wear and resist rust?—Ursa Minor.

[73077.]—**Fountain.**—I have a ½-horse Otto gas-engine which runs a dynamo to light my house. I have also one of Joseph Evans's rotary pumps, which brings water out of a well 11ft. deep (sunk for the purpose) in my engine house, and carries it through about 135ft. of ¾ iron gaspipe and rubber hose to water my garden. Now, it occurred to me that this engine would work a fountain in my garden, about 100ft. from engine, if carried through ¾in. gaspipe, with a drain for outlet when basin was full. Will some one kindly instruct me as to how I should plan and carry it out?—Inquirer.

[73078.]—**Wimshurst Machine.**—To "J. W."—Many thanks for your reply to query 72910. Would you advise me to fix new sectors? You might say what is effect of having them rather larger than you name, ½ by ¼ by 3½. The Leyden jars I now have are about half-pint. What is effect? I will try new small ones as soon as I can get the glass necessary. When working this machine and charging Leyden jars by connecting terminals to inner and outer coatings, the current is often reversed after allowing to stand a few minutes, and occasionally it refuses to start without a little coaxing. Shall be glad of that advice you so kindly give.—Puzzled One.

[73079.]—**Magneto Machine.**—Will some electrician kindly help me out of a great dilemma? I have a magnetic machine, and after cleaning it, cannot get any current through it. When out of the box I can get a brilliant spark from under the commutator spring, but when fixed in the box the current does not flow. There is no short circuit in the handles. Ought I to have a platinum contact on the end of the spring which receives the spindle commutator? There is plenty of magnetism in the magnet. How close ought the bobbins be to the magnet?—Constant Reader.

[73080.]—**Bell Telephones.**—Will anyone please state the actual resistance and the size of wire used by the National Telephone Co. in their Bell receivers? I have read the valuable papers written by Mr. Allsop, and he says about 70 ohms is the resistance, and in Preece and Main's "Telephone" it is stated to be 40 ohms, so I am undecided which to follow. I intend using two receivers at each end joined in parallel. Should they be wound to a higher resistance than if only one receiver is used at each end, as there are two paths open for the current, which would lower the resistance?—F. W. B.

[73081.]—**Ancient Clock.**—Will some reader kindly help me out in the following? I have an ancient one-hand clock, which is all complete except the small wheel which fits on square of driving wheel arbor (outside of plate) and drives hour-wheel. Required to know number of teeth this wheel will contain. Number of teeth in hour-wheel 48, driving wheel 60, next wheel 60, with pinion of six; escapement 36, with pinion of six. I also require length of pendulum and weight of bob, and weight for driving, going, and ticking trains combined.—W. S. H.

[73082.]—**Engine for Dynamo.**—I would like some one to tell me what c.p. dynamo my engine
diameter, 3½ stroke, 50 pressure in boiler, an
—S. G.

[73083.]—**Split Organ Pipes.**—Will s
obiige by informing me the best way to sol
are split through over-tuning?—F. W.

[73084.]—**Bennett's Iron Battery**
please tell me whether Bennett's iron batte
for lighting 6-volt lamp? Do you have to
in outer cell with iron turnings when charg
much caustic potash do you have to put
along with the zinc?—Ona Igsa.

[73085.]—**Formula Wanted.**—Will
kindly show me how to solve the following
pitch of an engine whistle be a note pr
vibrations a second, and it appears to soun
duced by 330 vibrations a second, find how
is moving, supposing the velocity of soun
1,120ft. per second.—B.

[73086.]—**Fire-Bars.**—Will any firema
ironfounder please say if there is any advant
having fire-bars (ordinary) cast face dow
cast on iron plates and chilling the face of b
last longer or clinker adhere less? Have
several patents taken out for chilling cert
bars, but are they not defunct?—Fireman.

[73087.]—**American Laundry-wo**
lately been in some of the New York hotel
some fine linen shirts got up at same, I a
the different appearance of these from our
They have quite an enamel-like appearance
to know if any of "ours" could tell me wha
are got up? They are simply perfection.—S

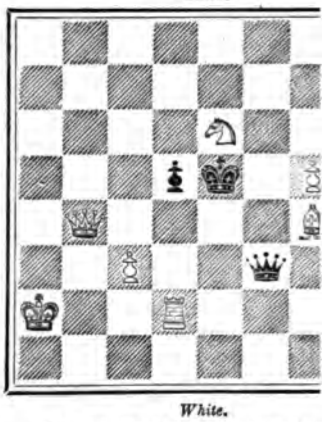
[73088.]—**Resistance.**—How can I
several ohm coils up to, say, 300 without a br
an ohm coil and astatic galvanometer.—Ga

## CHESS.

All communications for this departm
addressed to "J. Pierce, Knollside, Yawl,
Dorset."

### PROBLEM MCCXXX.

*Black.*



*White.*

**White to play and mate in two m**

Solution to 1228.

*White.* *Black*

1. B-Q B 8. 1. An
2. Mates.

### NOTICES TO CORRESPONDEN

Correct solutions to 1228 by E. Perrin, W
Biene, W. Gleave (pure and pleasing, but
C. P. P., J. H. Eastwood, Fr. Fernando,
G. W. Middleton, A. Fellows, junr., J. Ki
Rogers, W. A. Clark, D. Mackay; to 12
Middleton, J. H. Eastwood, J. H. Rogers, D.

W. Gleave and W. A. Clark draw our att
similarity between 1228 and Problem No. 6
*master* current Tourney: White, K-K R 8;
R-Q sq; Bs-Q 8 and Q R 2; Kt-K B 2; P-
K-K 4; B-K B 4; Ps-Q 4 and K B 6. Two-
Q-B 8.

An amateur would like to play a game by co
with any of our readers. We will forwa
address on application.

C. M. and E. Perrin.—In 1227, if 1. $\frac{\text{K-K}}{\text{B-Q}}$
is no mate next move.

Some time ago we noticed a useful little w
in the "Club" series entitled "Chess," by
We took occasion to remark that its one d
lack of a chapter or two on chess problems.
been met by the publication of another work
series entitled "The Two-Move Chess Proble
Laws. Mr. Laws is well known as one of
posers, and joint-author of the "Chess Pr
book." We need hardly say, therefore, that
is treated in an interesting, lucid, and system
which, subject to the limits at his disposal,
to be desired. We are pleased to come
old friends again in the selected problems,

Gems
That on the fore-finger of old T
Sparkle for ever.

The remarks on construction and merit o
well worth the attention of the young comp

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*unications should be addressed to the* EDITOR
MECHANIC, 332, *Strand, W.C.*

### TS TO CORRESPONDENTS.

ne side of the paper only, and put drawings
s on separate pieces of paper. 2. Put titles
when answering queries put the numbers
titles of the queries to which the replies
harge is made for inserting letters, queries,
Letters or queries asking for addresses of
or correspondents, or where tools or other
purchased, or replies giving such informa-
inserted except as advertisements. 5. No
for educational or scientific information
rough the post. 6. Letters sent to corre-
er cover to the Editor, are not forwarded,
s of correspondents are not given to in-

n is especially drawn to Hint No. 4. The
to letters, queries, and replies is meant for
d, and it is not fair to occupy it with ques-
e indicated above, which are only of indi-
and which, if not advertisements in them-
replies which are. The "Sixpenny Sale
s a cheap means of obtaining such informa-
rust our readers will avail themselves of it.

are the initials, &c., of letters to hand up
y evening, Nov. 26, and unacknowledged

ARMES.—C. Birchall.—Quaero.—J. P.—
—An Old Subscriber.—W. W.—C. F. Rat-
J. M. Russell.—A. Harris.—Dunedin.—
addle-wheel.—Model Steamer.—Angulus.
nager.—Jas. More, jun.—Glasshouse.—
—Chisel Wellborer.—Jack of All Trades.
ton—C. C. Ellison.—E. L. G.—Horo.—
shall.

(If you mean the pulley illustrated on
ldress of the makers is there given; if, as
as an an advertisement, the address is sure
given with that. About what time ago?)
The usual mounting medium for photo-
rch paste; but there are many suggestions
mes.)—AN OLD SUBSCRIBER, Folkestone.
nderstand what you mean by "melting"
It is fluid at any temperature ever found
ds, for its melting point is – 38° Fahr.,
below freezing point. Its boiling point is
2. Tinfoil forms an amalgam with quick-
is what you mean by "melting.")—DEB.
makers and ask them if it is worth while
our ivory rule. If no name on it, forward
Mander, Old Compton-street, Soho, W.)—
ou have the dies, you want a fly-press, and
operly annealed. But what do you mean
medal stamping? You will find full par-
t die-sinking in back volumes, also as to
er and gold; but for the latter you can
itchell's Manual of Practical Assaying,"
. Crookes, and published by Longmans.)—
See p. 100 last volume, and the indices of
s. It is the vapour of the acid that gives
lass appearance; but nowadays most are
ns of the sand-blast, a stencil protecting the
equired to be eroded. There are also
riting on glass.)—L. SPENCER. (For
ee Nos. 935, 1007, 1009, 1075, 1195.)—
NE. (See indices. A bichromate or a
cell is suitable for use with coils. At a
nt cells. You should have stated amount
e coil, not merely the external dimensions
ork. 2. You can buy the tire cement as
can make it; but if you must make, melt
f pitch and guttapercha together, stirring
n the fluid state.)—SOLDER. (Tinman's
rally made of one part tin to two parts of
(What size equatorial stand do you want?
you understand that it requires consider-
a good lathe to make one. Try No. 1283,
the latter giving Mr. E. Crossley's device.
ny plans in back volumes.)—J. T. B. (We
ld not think there was much demand for
But in what way was the poor patent
sible, or we for advising you to employ
patent agent's business to patent anything
gs him—not to give opinions of the merit
on. Your agent seems to have done his
y—at least, you make no charge against
core—he is surely not to blame because the
have protected will not sell!)—R. N.,
have not the information required, nor do
thing of the patentee—not even his ad-
that it is Greenwich. You might pos-
n the address by reference to the Patent
ecification is No. 10,968 of 1890.)—C. A. T.
man will advise; but ask Dr. Allinson
*Veekly Times and Echo.* It is not a serious
d a Turkish bath and gruel going to bed
relieve the more unpleasant symptoms.)
. (You must really give some definite
ou want—lenses being a wide term. Do
ctacle lenses, photographic lenses, or tele-
or what? Please see indices of back
you will probably find the information
umbers already issued.)—B. A. LONDON.
es are advertised occasionally in some of
They are supposed to improve the shape of
y of the warehouses keeping surgical ap-
o doubt, supply you.)—G. H. (There is
opinion" in the matter. The query was
ther, and the force of the "possible" has
ed, for it is possible to take all the
y lowering the bend of the siphon,
words, keeping the highest part
ft. of the surface of the water. The text-
ly say that the height of the short leg
than that of a column of liquid which
es the atmospheric pressure. Obviously
ight varies with the altitude of the spot
e atmospheric pressure as shown by a
atmospheric pressure is not always the
same. As the query was put it appeared as if there were a doubt whether the water would run along the horizontal pipe.)—CERO. (Full particulars can be obtained from the Civil Service Commissi n, Cannon-row, Westminster, or from the respective departments when competitive examinations are not held, but merely examinations to test the suitability of the candidates for the certificate.)—ELEKTRON. (For information in connection with harmonium and organ building, see the indices of back volumes. What is meant by a "lot of pipes"? Have they been in an organ and are in complete sets? Wicks's book on "Organ Building," Ward, Lock, and Co., is a useful one for amateurs.)—R. B. S. (Practice varies, but at the R.M.S. they generally put the accent on the "cros" in mi-cros′-copist. Custom mostly settles such matters.)—P. P. (See indices. Spelter for brazing is usually brass, the proportion of zinc determining its softness. Procure a list from Mr. Fletcher, Warrington, of his blowpipe apparatus.)—J. P. H. ("Practical Electric-Bell Fitting," commenced in No. 1185. The numbers containing Articles III., VI., VII., VIII. are out of print. The other five can be had for 1s. 0½d.)—H. HYDE. (See "Hints" above. Surely you cannot have seen the many-articles we have published on the practical work of electric-bell construction and fitting, and on electric lighting.)—GAS-FITTER. (The little dial evidently reads "tens." If indices are correctly placed, the dials read 127,340, as given in first line. You can easily test the reading of the top dial by noting what effect a revolution has on the hand or index of the "hundreds" dial. If the little dial reads "tens," one revolution will carry the "hundreds" hand one division forward.)—A. CAPLATZI. (Too long. Replies marked "To be continued" frighten us!)—E. PERRIN. (You had better see a surgeon. A broken knee-cap is much too serious a matter to take amateur advice about. 2. Some people bear chloroform better than others. 3. The glasses have water in them, and the man's hands are rendered rough with some astringent. It is easy enough to produce sound from an ordinary goblet with the wetted hand with practice. See back volumes for more information.)—AMATEUR ELECTRICIAN. (Such questions must either be asked privately, or sizes must be given in words. We cannot engrave sketches of all sorts and sizes of electrical appliances simply to elicit directions of value merely to the individual querist.) W. G, GREY, SCHLOSS SCHWERIN, G. POSTON, G. J. B. (In type).

**Electricity v. Medicine.**—The following is a list of some of the ailments that we know have been effectually cured by simply wearing one of Harness' Electropathic Belt appliances: Nervous Exhaustion, Neuralgia, Sleeplessness, Melancholia, Loss of Appetite, Indigestion, Constipation, Spasms, Flatulence, Torpid Liver, Nervous and Bilious Headaches, Rheumatism, Gout, Sciatica, Lumbago, "Weak Back," Kidney Complaints, hysteria, internal weakness, poorness of blood, feeble circulation, heartburn, &c. This is not a rash statement, but an actual fact, which can be verified by referring to the book of testimonials published at 52, Oxford-street, London, W., by the proprietors, the Medical Battery Company, Limited. A copy will be sent free by post on application, with descriptive pamphlet, to all those who are unable to call at the Company's Establishment, which, by the way, is the largest and only complete Electro-Medical Institute in the world.

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## OUR EXCHANGE COLUMN.

*The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.*

**Astro. Telescope,** 6½in O.G., Cooke, six eyepieces, finder, equatorial mounted, no circles. Exchange. 4in. wanted.—BASSETT, 82, High-street, Stoke Newington.

**Telescope Equatorial,** 12½in. With reflector, slow motion R.A., 2in. finder, 6 eyepieces, Barlow's lens, diagonal set of stops. Photo 12 stamps.—Below.

**Transit Instrument,** 2⅜ o.g., silver circles, striding level, collimating eyepieces; photo 6 stamps. Photometer by Hilger, micrometer by Grubb, astronomical books and instruments.—Below.

**Barometers,** 2 aneroid, Patterns for Equatorial stands, dynamos, tricycle, Cromartie lamp, new ebonite Wimshurst machine, 9in. spark; lantern photos. List stamp.—Box 20, Liversedge.

American **Organ** wanted, with several rows reeds, would do out of repair. Good exchange given.—SCHOFIELD 292, Stubbins, near Manchester.

Wanted, **Autograph Letters** of Celebrities, or picture books, or anything relating to coaching. Exchange MAGIC LANTERN, &c.—COLLECTOR, 18, Lowbaxter, Bury, Suffolk.

**Village Cart,** 12 hands, light running, sound. What offers in exchange?—FORD, 72, Queen's-road, Bowes-park London, N.

**Safety,** hollow rims, tangent spokes, balls throughout; Tricycle, Cripper, balls throughout. Exchange Lathe or ½H.P. Otto Engine.—ENCORE CYCLE DEPOT, Kirkwood-road, Nunhead, London.

Wanted, small **Launch Boiler,** with about 20 square feet of heating surface; working pressure not less than 100lb.; horizontal preferred. Good exchange.—W. H. BROWN, Pyle-hill, Newbury.

For **Bicycle** or Camera, Magic Lantern, 3in. double condensers, 80 slides; particulars.—R. NORRIS, 5, Dean-street, Islington, N.

Wanted, small **Gas Engine,** in exchange for 3H.P. Vertical Engine, four-horse boiler, combined, on water tank foundation, by Hindley, little used, been driving dynamo, or 400c.p. Gramme dynamo by the British Electric Light Co.—HELLYAR, 144, Dalling-road, Hammersmith.

Very powerful **Shocking Coil,** velvet covered, with regulator; and 5c.p. Electric Light Battery set, with Lamp. Exchange for Gem Air Gun.—JAMES SHARP, Sanquhar.

2½in. **Bench Lathe,** good as new, four chucks, bench, driving wheel. Wanted, Singer's Hand Sewing Machine, or offers.—BYATT, 61, Oakfield, Stroud-green, N.

Wanted, Harmonium for learner. Will give **Printing Press** and TYPE for same.—*Time Table* Office, Daventry.

10c.p. **Dynamo,** finished for wire, complete, steel shaft, oak base. Exchange Sounders, Keys, Relays, &c.—H. COLLIN, Castle-street, Leicester.

**Cylindrical Electrical Machine,** 10in., complete, rubber, prime conductor, and handle. Exchange anything useful.—H. COLLIN, Castle-street, Leicester.

Special **Facile,** ball bearings, for Piano, good Lathe with slide-rest, small planing machine, gold watch and albert. Offers.—JAGGS, Boones-road, Lee, Kent.

**Dynamo,** Manchester shunt, 3in. armature, eight sections, 12 volts, eight ampères, speed 2,000. Exchange Tools to value £3.—E. MOY, 20, Loraine-road, Holloway, London.

Reform **Safety Bicycle,** good condition, balls, including pedals, geared 60in., lamp, wallet, and tools. Exchange lathe to value £6.—MOY, 20, Loraine-road, Holloway, London.

A pair of **Telephones,** in splendid working order. Will exchange for Zither or other musical instrument to 18s. value.—C. L. FORD, Stalybridge, Lancashire.

Wanted, a good **Fountain** for garden, with about 100 feet of ½in. iron gas-pipe. Good exchange to offer.—D. G. HARRIS, Heckington, Sleaford, Lincolnshire.

Wanted, few **Platinotype Photographs** of L. and N. W. Locomotives. Exchange other PHOTOS.—F. W. BREWER, 90, Cloudesley-road, London, N.

Wanted, good **Insulated Wire,** 250 yards, for electric lighting, to carry 100c.p. Good exchange.—D. G. HARRIS, Heckington, Sleaford, Lincolnshire.

Strong set of **Stocks,** without dies, for fan; or the stocks and oval turning chuck, all iron, for good bench drilling machine.—W. G. WATSON, Eastfield Side, Mansfield.

**Gas Engine,** half-man-power. Exchange, Mechanical, Electrical, Lathe Chucks, or Apparatus suitable for 3½ S.C. lathe, or Planing Machine.—DIBLEY, Blandford, Dorset.

Splendid set new gunmetal **Boiler Fittings,** water gauge, with packed taps, improved steam gauge, and safety-valve. Wanted, good 4in. Slide-rest, Bench Drills, or offers.—WM. POATE, Havant.

Powerful 4H.P. Vertical **Boiler and Engine,** on frame, complete, all fittings; will take 1H.P., or Gas Engine.—WM. POATE, Havant.

Tower **Rifle,** 6-chambered Revolver, old patterns, Water Motor; preferred, 4 or 6-volt lamps; 16 G.C.C. Wire.—LEA, 28, Paget-street, Wolverhampton.

**Microscope Slides,** good pocket Telescope, exchanged for Slides; also a good dividing ¼in. Objective, Society thread, for exchange.—Rev. SAUL, Millom.

"**English Mechanic,**" from 1162, Vol. XLV., to date, two numbers missing; "Work," No. 1 to date, unbound, slightly soiled. Exchange Mechanic's Text-books. Offers.—F. DAVISWORTH, 60, Ellerby-lane, Leeds.

**Night or Watch Lamp** (electric), battery, lamp, watch-holder, push; no toy; useful article; what offers? Exchange.—DOUGLAS, 1, Brunswick-street, Edinburgh.

Clock Movement wanted, in exchange for **Microscope** and Revolver, or part cash; an eight-day Movement, striking hours.—HICKTON, 14, Holt's-hill, Walsall.

Pair of stout **Elastic Stockings,** new, large size. Will exchange for Coil, Tools, or anything useful.—N. E. B., 83, Patshul-road, Kentish Town, N.W.

Fletcher's **Gas Bath-Heater,** copper, cost 55s., requires practical cleaning. Exchange for what offers useful.—GREEN, 2, Boundary-road, Norland-road, Notting-hill.

**Vertical Engine,** 3½ stroke, copper boiler, 18 by 9, internal firebox, worth £12. Exchange for a Safety Bicycle or Violin.—H. C., 16, Myrtle-street, Hoxton.

**Engineer's Bench** (portable), 12s.; Lathe carriers, ½in., 10d. each. Drills and Turning Tools. Set Steel Figures, 3s. 6d. Exchange Jewellery value.—29, Queen's-road, Battersea.

Wanted **Upholsterer's Carding Machine**, new or good second-hand. Exchange.—C. Cornwell, 157, Church-road, West Brighton, Sussex.

Will exchange **Browning's 12 by 10 Rapid Rectilinear Lens**, good as new, for full-compass bass English Concertina. Approval.—Harmer, Littlehampton.

**"Allen's Commercial Organic Analysis"** wanted, second volume; will take both if necessary. "Cameron's Oils and Varnishes" wanted. Offers.—J. W. S., 4, Brunswick-place, Leeds.

**Wanted, Model Boiler, about 10in. by 6in. Will exchange** Jubilee Camera, accessories, with part cash.—A. H. Hatton, Point Park, Uddingston, near Glasgow.

Exchange a quantity of Lathe and other **Tools**, also a few Carpenter's Tools; small Printing Press; also 12 Gauge Glasses. Stamp reply.—Below.

**Set of Castings** of a 3½ back-gear slide-rest Lathe, 3ft. gap bed, and a set of Castings for 4in. back-gear Heads.—Below.

**Set of Castings** of 5in. back-gear Head, also two sets of 4½ and 5in. Compound Slide-rest Castings; a 3in. Leg Vice. Stamp reply.—Below.

Quantity of **Slide-rest Tools**, lot of Drills, lot of Plummer Blocks, two sets of screwing tackle, ⅝ to inch; one set of Gas Tackle, screw ⅛ to ½in.

Wanted, for above, a quantity of 3in. Leather Belting, or good Lathe Patterns, or offers. Stamp for reply.—Sedgley, Witton-lane, West Bromwich.

Six quart Leclanché and three Bichro. **Batteries.** Henley's Dischargers and Insulating Stands, and other Apparatus. What offers for part or whole.—W. Young, Aylesbury.

Wanted, Treadle Turning Lathe, in exchange parts of Model Beam Engine, on iron planed bed, and cash.—Tapscott, Melbourne-street, Tiverton, Devon.

Wanted, Tools, Planes. Exchange handsome male Cockatiel in cage; also Orchestrionette, with 17 tunes, cost £3. Exchange for Lathe, &c.—Baker, Colborne Ho, Dartmouth.

**Dynamos**, 100c.p. and 40c.p., ½H.P. Vertical Engine, Spark Coil, 1½in., all new. Lathe or Gas Engine wanted, or offers.—Penrow, Truro.

Job lot of **Round Carbons**, 8, 11, 13, 16, 18, 24 Millimètre Carbons, suitable for electric light or battery work. What offers?—Huddleston. Below.

520 **Corrugated Carbons**, 3 Leclanché sizes, Mercury Vacuum Gauge, two Steam Gauges, 40c.p. Dynamo. What offers?—Huddleston, 21, Upham Park-road, Chiswick.

2 **Morse Sounders**, S.N. Instrument, 7 S.N. Keys, Medical Coil in case; small Engine and Boiler, Lineman's Galvanometer. What offers?—Percy Huddleston. Below.

Two **Dynamos**, 500 yards of Cable, quantity of Incandescent Lamps; three Indicators, and four Sun Ammeters. What offers?—Huddleston, 21, Upham Park-road, Chiswick.

A Wilson **Stylographic Pen**, cost 5s. 6d., writes 5,000 words, in perfect order. Will exchange for set of Dynamo Castings.—Hope, 8, Catherine-terrace, Tottenham.

1-1 or larger Camera wanted. Will exchange to value of £3. Including Stirn's Nickel Patent Detective and Lantern Slide Making Camera.—Address as above.

34in. **Facile**, genuine ball bearings, and on crank, saddle, lamp. Exchange Shares, or what offers?—Turner, 26, Gainsborough Cottages, South Hackney.

**Mahogany Dining-room Suite**, solid leather, nearly new. Exchange for lighter. London district. Stamp for reply.—Yabsley, 3, Kemble-road, Forest-hill, Kent.

**Ratchet Braces**, new, 10 and 18in. long, wrought-iron blocks, treble, double, and snatch, 5in. brass sheaves. Useful exchange. Stamp for reply.—Yabsley.

Horizontal **Pumping Engine**, cylinder 3in. diam., 5in. stroke, brass pump and valve box. Model Horizontal Engine, cylinder 2¼ dia., 4in. stroke. Useful exchange.—Yabsley.

**Locomotive Boiler**, 9in. long, steam dome, one tube, value 10s. Horizontal Slide-valve Cylinder, ½in. bore, 1in. stroke, value 6s. 6d. Exchange.—Lamont, 43, Thompson-street, Govan.

8in. **Fan**, with gear; six-chambered Revolver and holster; two Horizontal Engines, ¾in. and 1in.; pair Oscillating Marine Engines, ⅝in. by 1½in. Offers in exchange.—Gale, Seend, Melksham.

**Astronomical Telescope**, length 5ft., O.G. 2⅝, brass body, rack to eyepiece, on stand. Exchange good Photo Apparatus.—S. Clarke, Wormwood-hill, Kirton Lindsey.

**Printing Press**, prints 9in. by 15in., cost £12. Exchange breech-loading Gun or offers.—R. Gornall, Damside, Pilling, Garstang.

**Overcoat**, Undercoat, Concertina, Limelight Burner, and two-gallon bottle best Black Ink. Will be exchanged for anything useful.—Walton, 6, Goldsmith-road, Peckham.

**Typewriter.** — A perfect and really serviceable machine, complete with instructions, easily used immediately. Useful exchange value 12s. accepted.—J. Walton, 6, Goldsmith-road, Peckham.

Model Steam Locomotive wanted. Will exchange Books, Conjuring Tricks, Flute, Jewellery, Oil Paintings, &c.—R., 66, Lowden-road, Herne-hill, S.E.

**Brazing Forge**, bellows Blowpipe, and Drilling Machine, £4 5s. Exchange small Lathe and cash.—Press, 30, Middleton-road, Kingsland-road, N.E.

6in. **Lathe**, with iron bed, planed for saddle, and flat pulleys on mandrel. Exchange for 4½in. Lathe, good, and cash.—1, Abyssinia-road, Wandsworth, S.W.

## THE SIXPENNY SALE COLUMN.

*Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.*

New Illustrated Price List of **Screws, Bolts and Nuts** for Model Work, drawn to actual size, sent on receipt of stamp.—Morris Cohen, 132, Kirkgate, Leeds.

**Millar's Electric Depot, 14**, Deansgate, Manchester.—Best of everything electrical. Large stock. Low prices. Catalogues 3d.

**Tam o' Shanter Hones.**—Fine, medium, sharp qualities—razor, knife, joiner's—1s. 3d., 1s. 6d., and 2s., according to size, post free. Try these famous hones.—Tam o' Shanter Hone Co. Dalmore, Stair, Ayrshire.

**Wheel-cutting and Dividing** to 12 inches diameter, in brass only.—Gledd, Belinda-street, Hunslet, Leeds.

**Manchester Electrical Stores.** — For Bells, Cells, Wires, Chemicals; Medical Coils, Magnetos. Best terms.—Bentley, Newton-street.

**Fretwork, Carving, Repousse, and Leather Work.** Catalogue of all requisites, six stamps.—Harger Bros. Settle, Yorks.

**Fretwork Parcels**, 10ft., assorted, 4s. Fretwork Outfit, 2s. 6d. Fretsaws, 1s. 6d. gross, carriage paid.—Below.

**Turning Woods.**—Ebony, Box, Lignum Vitæ, Rosewood, parcels 5s. and 10s. each. Good value.—Harger Bros., Settle.

**Practical Dynamo Building for Amateurs.** How to wind for any output, by F. Walker, illustrated, post free 2s. 1½d.—Iliffe, 3, St. Bride street, E.C.

**Nicotine Difficulty Solved.** — All users of "Roll Call" Pipes say so. Splendid briars. Healthful, clean luxurious.

**"Roll Call" Pipes**, post free 1s. 2d. and 1s. 8d.—Dewsnap, 268, Upper Brook-street, C. on M., Manchester.

**Brass Name Plate**, 9in. by 4½in., 4s. 6d. Lists free.—Gilkes, Engraving Works, Reading.

**Machine Engraving and Dividing** on brass, ivory, and ebonite. Style and price unsurpassed.—Gilkes, Engraving Works, Reading.

**Brass Window Plates**, engraved, for shop-fronts, any style or shape.—Gilkes, Engraving Works, Reading.

**Zinc Stencil Plates** for sack, box, and ticket marking. All lists free.—Gilkes' Engraving Works, Reading.

**Electric Light.**—Complete Installations, arc or incandescent. Catalogue three stamps.—J. Sunderland and Co. Electrical Engineers, Halifax.

Self-centring **Lathe Chuck**, takes ⅛ wire to ⅜ drill, 4s. 3d. post free. Marvel of cheapness.—Below.

**Copper Bit**, with patent locking joint, several solder-irons in one, from 3s.—Below.

**Economic By-pass Workshop Gas Tap and Burner**, save its cost in one week, 1s. 3d. post free.—Below.

**Spindles** for grindstones, emery wheels, &c.; Screw flanges, anti-friction rollers, hand and treadle, from 4s. 6d.—Below.

**Telephones**, guaranteed clear articulation any distance, free from infringement, unaffected by atmospheric changes, from 12s.—Below.

**Agglomerate Blocks and Bands**, No. 2, 8s. doz. sets. Send stamp and card for list, bells, indicators, &c.—Baughan and Co., Charlbury.

**Dynamo**, 200 candles, improved armature, price £8. List and testimonials, one stamp.—D. Walton, Engineer, Hebden Bridge.

**Dynamo**, 120 candles, improved armature, price £4 10s. List and testimonials, one stamp.

**Dynamo**, 60 candles, improved armature, 45s.; 30-candle, 28s.; 10-candle, 20s.; 5-candle, 14s. List and testimonials, one stamp.

**Dynamo Castings**, from 2s. 6d. per set. Wire, from 1s. per lb.; Punchings from 4s. 6d. per gross; Lamps from 3s. List, one stamp.

**Gas Engines**, from ¼H.P. (Butterworth's patent) List and testimonials, one stamp.—D. Walton, Engineer, Hebden Bridge.

**Microscopic Mounting Materials** of all kinds. List on application.—Norman, 178, City-road, E.C. Estab. 1846.

**On Hard Soldering.**—A useful work issued by Charles E. Rose, Jeweller, Bolton. With sample of solder, 1s. 6d.

**On Hard Soldering.** — A sample of easy running hard solder inclosed, with practical instructions.—Rose, Jeweller, Bolton. 1s. 6d.

Write for **King, Mendham, and Co.'s** (Bristol) new Illustrated Catalogue, 4½d. Acknowledged to be invaluable to amateurs.

**"The Wimshurst Machine,"** by W. P. Mendham, gives theory of action and many experiments. Post free, 13d.—King, Mendham, and Co.

**Tables and Memoranda** for Electric Engineers. In pocket-book form, containing useful formulæ, tables, and information in daily requisition respecting electrical circuits, traction, marine propulsion, lighting, prime motors, estimation of power, testing, &c., &c. By F. Walker. Illustrated. Post free, 2s. 1d.—Iliffe, 3, St Bride-street, Ludgate-circus.

**Glaziers' Diamonds**, 6s. 6d., upwards. Resetting and postage, 2s. 8d. Circular and Tube-cutting Diamonds.—Below.

**Diamond Points** for all kinds of engraving, writing, ruling, and scratching, from 2s. 6d.—Below.

**Diamond Turning Tools** for truing emery wheels and turning hard steel, &c., from 6s.—Below.

**Diamond Drills** from 1s. Drill Stock and postage, 1s. 3d.; Bob ditto., 1s. 10½d., and 2s. 10½d.—Below.

**Diamond** for lapidaries, Diamond Sparks for china riveters.—Woods and Toussaint, 54, Spencer-street, Clerkenwell, London.

**Chime Clocks**, all parts, finished or rough. Chime Barrels pricked.—Every, 102, Barnsbury-road, London, N.

**Trains of Wheels**, for automatic, telegraphic, and other purposes. Spring Motors, all sizes.—Every, London, N.

**Wheels**, Racks, Pinions, Worms, Screws, all sizes, all numbers; all complicated Clocks to order.—Every.

Every's Patent **Musical Bars**, softer and purer tone than bells or gongs for long-case clocks.

**Castings.**—New Illustrated Catalogue of perfect Launch, Horizontal, and Vertical Engine Castings, Lathe and Drilling Machine Castings, 1 stamp. — Tomlin, Queen's-road, Barnsley, Yorkshire.

**French Polishing**, Ebonising, Staining, Varnishing.—A new Book. Contains 225 Recipes or Trade Secrets, with instructions and details. Free, 1s. 3d.—Tomlin, Queen's-road, Barnsley, Yorkshire.

**Five Hundred Trade Secrets.**—A new book. Contains 500 workshop recipes, with full instructions. Valuable and useful to every reader. Post free, 1s. 6d.—J. Tomlin, Queen's-road, Barnsley, Yorkshire.

**Mixing Paints.**—A new book, containing trade recipes and instructions for mixing, making, and using all kinds of paints, colours, oils, &c. Free, 1s. 3d.—J. Tomlin, Queen's-road, Barnsley, Yorkshire.

**Brass Lacquering, Bronzing, &c.**—50 Trade Recipes, with instructions for various colours of lacquering, bronzing, &c. Free, 1s. 3d.—J. Tomlin, Queen's-road, Barnsley, Yorkshire.

**Unpublished Manufacturing Recipes.**—Profits simply enormous. 6,000 enthusiastic testimonials. Particulars free.—Stanley, Box 1, Billson-street, Poplar.

Cheap lots of **Designs**, 100 Fretwork (speciality), 100 ditto (last season's), 100 Carving, 100 Repousse (full size).

**For Amateurs and Mechanics.**—100 Cake-icing, 300 Turning, 400 Stencils, 500 Shields, &c. 1s. each packet.

**Published by F. Coulthard**, Terrace-road, Bournemouth. Postage free. Lists sent free. Fretwork catalogue 3 stamps.

**S. Bottone, Wallington, Surrey**, supplies the following Electrical Books and Apparatus. Invaluable to Electrical Amateurs and Engineers.

**"Electro-Motors: How Made and How Used."** A handbook for amateurs and practical men. Post free, 3s.

**"The Dynamo: how Made and how Used."** All amateurs should read this book. Price 2s. 6d. post free.

**"The Dynamo,"** Sixth Edition, contains directions for making the best forms of Dynamos. 2s. 6d. post free.

**"The Dynamo"** contains tables for calculating the proper winding to use for any output. 2s. 6d. post free.

**"Electric Bells and All About Them."** Second edition, post free, 3s. Indispensable to bell fitters.

**Motor Castings and Fittings** of all patterns. Siemens, Simplex, Manchester, and others. Armatures, solid and laminated.

A beautiful little **Dynamo** that lights easily two six-volt lamps, post free in box, 13s. 9d.

**Dynamos of the Highest Efficiency**, from 15s. to £20; for lighting, plating, cauterising, and experimental work.

**Dynamo Castings.**—Beautiful sets for 5c.p. Dynamos, finished ready for wire, 10s. each; warranted efficient.

**Ammeters, Voltmeters, Galvanometers**, 5s. each. Tangents, 10s. Standard Ohms, 2s. 6d. Bridges, 5s. List, 1½d.—S. Bottone, Wallington, Surrey.

**Sign-writing Made Easy.**—Illustrated instructions and diagrams for marking eight alphabets, 1s.—Coulthard, Terrace-road, Bournemouth.

**Brass Model Engine Castings.**—Locomotive, Horizontal, Vertical, Beam, Marine. List 2d.—Wood, Dalley-street, Broughton, Manchester.

**Mesmerism.**—How to Mesmerise and Demesmerise successfully. Written directions, 9 stamps.—Magrath, 37, Divis-street, Belfast.

**Silvered Glass Specula** and Flats, any size, first-class work; moderate prices.—May, Hadleigh, Suffolk.

**Whooping Cough. — Asthma.** — Sample of remedy gratis for 6 stamps, which has a marvellous effect in subduing paroxysms and curing above.—Chambers, Chemist, Brighton.

**Screws! Screws!!** Terminals, and Turned parts, special low quotations to large buyers. Send trade card.—Butler.

**Screws**, brass, iron, and steel, for electrical, optical, and all kinds of small mechanical work.—Butler.

**Screws**, Bolts, and Nuts, for model work. New illustrated list, 88 illustrations, 2,500 prices, 3d.—Butler.

**Screws! Screws!! Screws!!!**—Buy of the manufacturers.—Butler Bros., Bentham-road, South Hackney, London.

New high-pressure vertical **Launch Boilers**, ready for delivery, 18in. by 2ft. 6in., £11, without mountings.

**2ft. by 2ft. 8in., £16, without mountings**; 18ft. by 3ft., £12, without mountings.

**To Steam Users.**—These Boilers are guaranteed by —Messrs. Noy, Launch Boiler Makers, Hythe, Colchester.

**Portable Forge**, pair double-actioned bellows, fan for forge; 2-horse engine and boiler.—Mac, 4, Vine-street, Lambeth.

**Patterns and Models** made to order; castings and forgings supplied. Estimates free. Address above.

**Immisch Motor**, Cuttriss Dynamo, Instruments, Batteries, &c. See advt. 14th November.—Rd. Allbright, South Vale, Norwood.

Lot of **Carbons**, Porous Cells, Batteries, Lamps, Sundries. Stamp for list.—Kindall, 119, Hill-street, Walworth.

**Microscopic**, ½in. adjustment, a Ross, 25s.: 2in. and 4in. E. Swift, 20s.; 1½ and 3in. Wray, 20s.—Geo. Wild, Devizes, Wilts.

**Soapmaking**, without costly apparatus. Bleaching tallow, fats, oils, washing-powders, solution, soda, 1s. 6d.—Garforth, Chemist, Sheffield.

**Water-Motors**, 10s., 15s., and 20s. each.—Walton, 9, Queen Anne-street, Stoke-on-Trent.

Four-cell **Bichromate Battery**, lamp, &c., 15s. 6d., cost £2, particulars stamp.—De Lasaux, 163, Mayall-road, Herne Hill.

High-class 3H.P. **Vertical Engine** and tubular boiler on feed tank, in splendid order, £25.—Samuel Pinkney, William-street, Sunderland.

Bourdon's **Patent Pressure Gauge**, 5in. dial, value 36s., bargain 22s., perfectly new.—Taylor, Wakefield-street, Warrington.

Upright **Steel Boiler**, 4ft. by 2ft., all fittings, splendid condition, value £20, sacrifice £9.—As above.

Several **Engines and Boilers** at half usual prices, all good working order.—Taylor, Wakefield-street, Warrington.

**Prize Medals**, London, Edinburgh, Australia, Holland, for Lathes and Engineers' Tools, awarded to Britannia Co., Colchester.

We are constantly Designing and Making **Tools** for the British Government. Several departments.—Britannia Co. Colchester.

**Technical Schools**, Workshops, and Factories fitted complete with Engines, Shafting, Tools. Plans and estimates submitted.

**Heavy Department.**—Tools up to 12 tons in Shapers, Boring Tables, Planers. New designs.

See the patent **Shaper** designed for Davy Paxman. American Patent for sale.—Britannia Co.

**Lathes**, from 35s. to £350. Milling Machines for Electricians and Brassfinishers.

Send six stamps for **New Catalogue**, with list of second-hand Engines, Tools, Machinery.

**Notice.**—We are buyers of Engineers and Woodworkers' Tools (good second-hand) for export.—Below.

Our Monthly Catalogue of second-hand **Engines**, gas or steam, sent on receipt of six stamps.

Entries of **Machinery and Tools** for sale and wanted. Terms as per catalogue.—Britannia Co.

**We Sell for Cash** or on hire-purchase. Largest stock in London.—100, Houndsditch.

**Call at London Depot.** All letters to—Britannia Works, Colchester.

**Twist Drills**, any size, at wholesale price. Lists post free.—Address, J. Lee, Gladstone-street, Kettering.

Keep your fireplace tidy, save coal, by using **Patent Coal Savers**, 1s. each.—Bradbent, Stretford, Lancashire.

**Bicycle Parts**, any stage of finish, and complete safety sets.—Encore Cycle Depot, Kirkwood-road, Nunhead.

English Mechanic
ORLD OF SCIENCE AND ART.
FRIDAY, DECEMBER 5, 1890.

## TO CONSTRUCT A QUARTER CHIMING CLOCK.—VI.

### .—The Chiming-Train Barrel.

only difference between this and the ier barrels is that it measures $2\frac{3}{4}$in. r, and is made of rather stouter brass. nd pivots are the same size as in ınd striking barrels. The main- though it makes only the same of turns in the barrel, is much :, the chiming train requiring about much power again to drive it as the : striking trains.

### 20.—The Fusee.

ılso is only a difference in size, as far ody of the fusee is concerned. It ıs $1\frac{5}{8}$in. long, $\frac{3}{4}$in. diameter at small l $2\frac{1}{8}$in. at large end. It consists of turns, as do the others. The extra gth allows a slightly larger-sized gut ı to be used. The great wheel is ameter, and rather over $\frac{3}{16}$in. thick. ins 100 teeth. The extra four teeth ɔ "going" fusee are to insure that ıing train does not run down before k stops, which would upset the order ıing. The ratchet measures $1\frac{1}{8}$in., going-train fusee. Click, spring, are of same dimensions also (No. 3). well, if it is desired to produce a : the best quality, to provide this ith *two* clicks and click-springs—one side of the ratchet. The winding is means made smoother, there being rop" on to the clicks, and conse- less strain, besides dividing the ıtween two clicks. Altogether it is rth while to provide this fusee with ɔ set of clickwork.

rbor is $\frac{3}{8}$in. in diameter, and pivots a ver $\frac{1}{4}$in.

### 21.—The Second Wheel.

47 shows the second wheel. It ıs 2in. diameter, $\frac{3}{32}$in. thick, and has eeth. Its pinion has eight leaves. eted directly on to the pinion head, e centre wheel of going train (4). rangements and measurements are n the figure. The pivots are both size and of good thickness, as there lerable pressure upon them.

### -The Chiming Drum and Wheel.

himing wheel is 1in. in diameter and ck. It contains forty teeth, and is direct by the second wheel. The hickness is to allow of its being ogether with the chiming drum or o change the chimes from four to ells. The arrangements for doing be afterwards described. The wheel ınted direct upon a steel spindle, ılso carries the drum, as shown in The drum is made from sheet brass tube, in the same manner as a spring ɔnly the ends are both soldered in. n. in diameter, and $1\frac{7}{8}$in. long, and tight on the arbor and soft soldered. ning of this barrel will be left till The shoulders of the pivots must ı. apart, instead of $2\frac{1}{2}$in., so as to n. for shifting. Accordingly, the back which should be of fair thickness, ., must be $\frac{1}{8}$in. longer than thickness , as shown in the figure. The front mes right through the plate. It is of e thickness as the back pivot, and from the shoulder to the end. The f is finished off to a fine point, as and nicely polished. The arbor is all over. The barrel is carried to

Fig 47

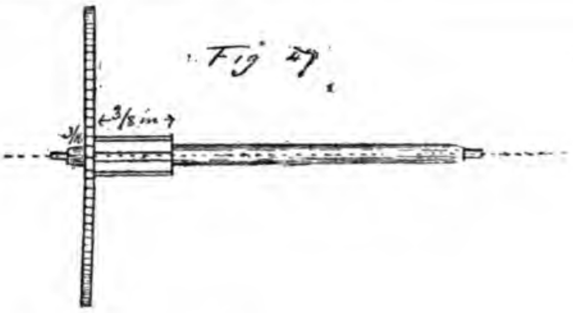
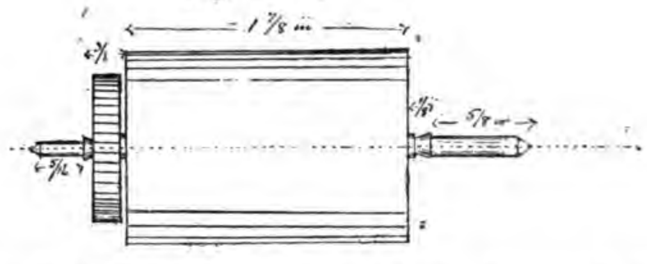


Fig 48



within $\frac{1}{8}$in. from the shoulder of front pivot. Both pivots are back-cut to retain the oil, as shown in Fig. 48.

### 23.—The Pallet-Wheel.

After the second wheel, the next in the chiming train is the pallet-wheel. It is $1\frac{1}{2}$in. in diameter, $\frac{3}{32}$in. thick, and contains 63 teeth. It is mounted on the pinion head in same manner as striking-train pallet-wheel (15). A reference to Fig. 40 will show the arrangement. The front pivot is formed in exactly the same way, and is of the same dimensions. The wheel and pinion are a little nearer the plate.

### 24.—The Warning Wheel.

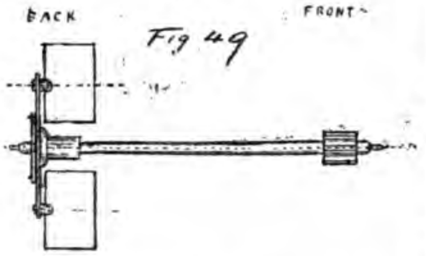
This measures $1\frac{5}{8}$in. diameter, $\frac{3}{32}$in. thick, and contains 56 teeth. It is mounted on a brass collet, and is similar in every respect to the striking-train warning wheel (No. 16), except that the pinion is a trifle nearer the plate.

### 24.—The Fly.

Till recently, the chiming-train fly was made in exactly the same way as an ordinary striking fly, only rather narrower. If this kind of fly is adopted, $\frac{3}{4}$in. will be found a suitable width.

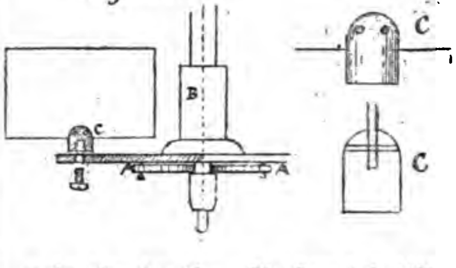
By far the better way is to carry the fly *outside* the back plate, and have a pair of regulating fans upon it. This allows of a perfect adjustment of the speed of chiming, but entails more labour. Fig. 49 shows such a fly. Some clocks have a fly of this kind fitted to the striking train as well, which is a great improvement, especially when striking the hours on a gong, when a slow beat is usually preferred. Those readers who desire to fit regulating flys to both trains will find Fig. 49 apply equally to both.

Fig 49



Lightness must be considered in its construction. Let it be remembered that it is the resistance of the air, and *not* the weight, which acts as a regulator. Fig. 50 shows details of construction. The cross-arm A is riveted on to a brass pipe, B, which revolves freely on the arbor. The pivots upon which the fans turn are fitted to the arm as shown, and secured by a small screw at the back of each, by means of which they can be set at any angle and screwed up tight. The fans themselves are made of very thin brass, and may be $\frac{1}{2}$in. by $\frac{3}{4}$in. The bar A is $1\frac{1}{4}$in. from centre to centre of fans.

Fig 50



The whole fly is held friction-tight to the arbor by a narrow steel spring resting upon two pins in the arm A and working in a groove on the arbor in the same manner as in the striking-train fly.

In large clocks, instead of friction springs, the flys are fitted with ratchets and pawls, which allow them to run forward when the arbors are stopped.

The back pivot of fly is held by a brass cock screwed to the plate.

## MODEL LOCOMOTIVE-MAKING.—XII.

FIG. 59 gives a plan view of the engines, Fig. 60 a longitudinal sectional elevation of the complete loco., Fig. 61 an external plan view, Fig. 62 an external longitudinal elevation.

Most of the reference letters are identical with those given in the last article, p. 178. There are some parts noted in that article whose complete elucidation was reserved for these views. From these views also judgment may be formed of the relations and proportions of the several parts.

Taking those parts seriatim, to which reference was made in the last article, we have A the fire-door, with its latch *b*; C the steam, and D the water tap; the wind-guard F in elevation, section, and plan, screwed to the front of the fire-box sheet. The side guards C are shown curved round and fastened to the fire-box and foot-plate; *h h* are the angles alluded to in our last, by which the guards are fastened to the foot-plate; and the half-round wire *g* is shown screwed to the fire-box in Figs. 61 and 62 at *g g*. The fire bars O are shown in side view, and their pivoted supports at P. The dished smoke-box door Q noticed in the last article is shown in plan in Fig. 61, in

FIG 59

PLAN OF ENGINES.

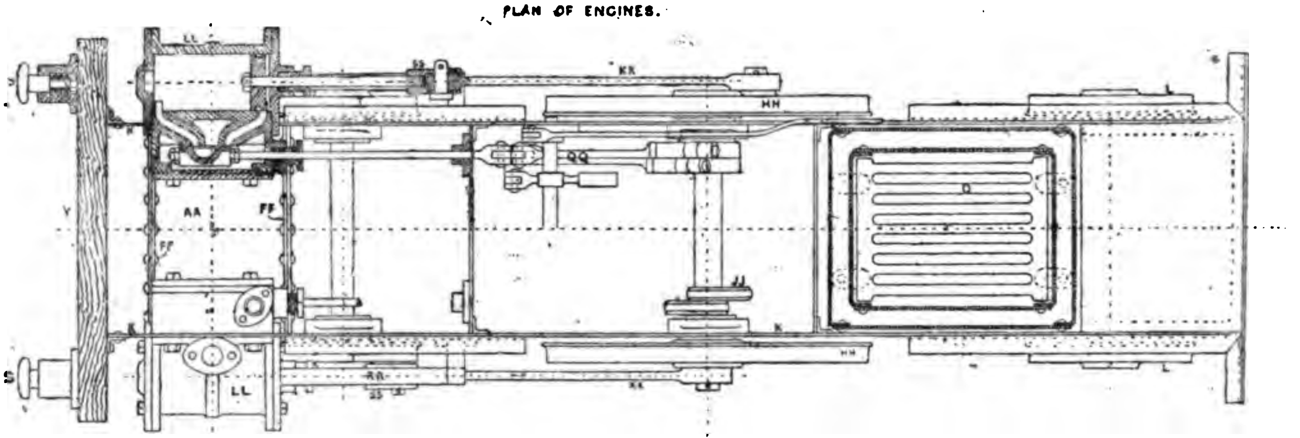
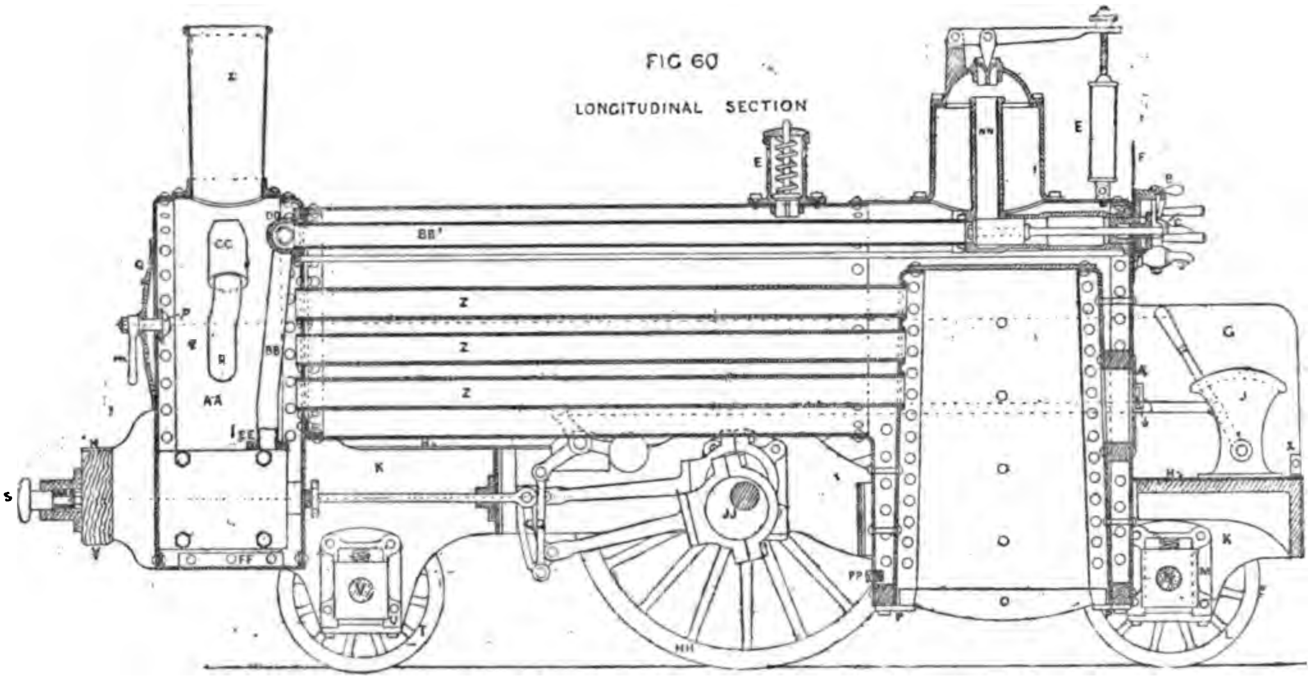
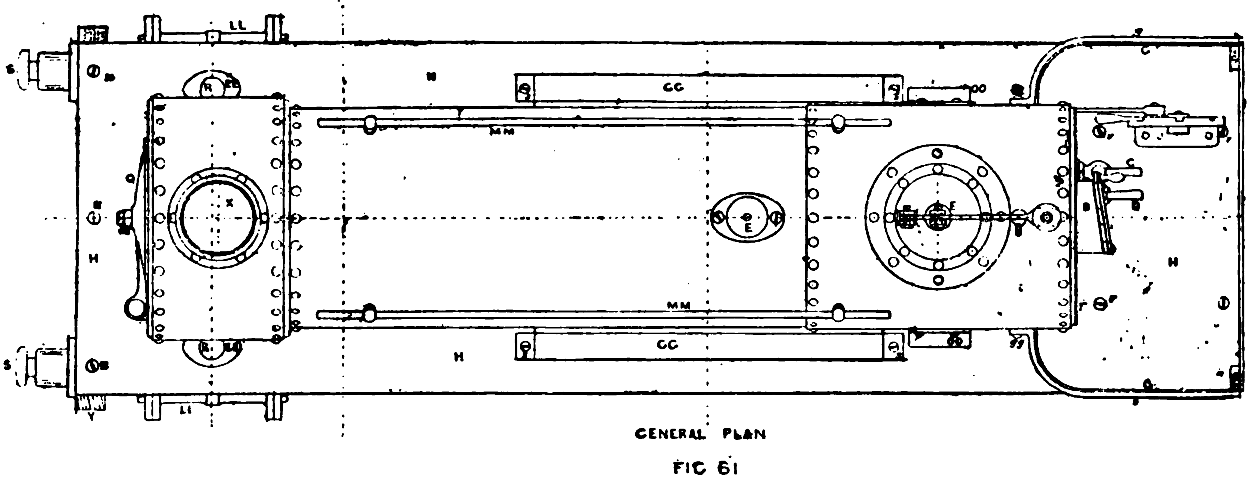


FIG 60

LONGITUDINAL SECTION





GENERAL PLAN

FIG 61

elevation in Fig. 62, and in section in Fig. 60, together with the apparatus for fastening it; *m* is the handle fitting with a square hole over one end of the T-headed bolt *p*, fitting into a slot in the cross-bar *q*. The cross-bar is placed over the inside of the opening in the front smoke-box plate, and riveted at the ends. When the T-headed bolt is in the position shown in section in Fig. 60, the door is held securely against the smoke-box plate. When it is turned quarter-round by means of the handle *m*, the T-head will be parallel with the slot in the cross-bar, and, on being drawn out through the slot, will permit of the door being opened.

The longitudinal positions of the steam-pipes B B and the exhaust pipes R are shown in the longitudinal section Fig. 60. D D is a sectional view of the union casting (see p. 180), and C C is the blast nozzle casting whose other views were given in Fig. 57.

The reversing quadrant B is seen in section, and in plan in Figs. 60 and 61. In Fig. 60 the connection between the reversing quadrant, the regulator N N, the main steam-pipe B B¹, and the casting D D is made clear.

In Fig. 67, p. 180, the bottom plate F F of the smoke-box was shown. The longitudinal view of the same plate in Fig. 60 shows that plate with its side flanges. These are cut out at the corners to make their flanging an easy matter. The rivets uniting the plate F F to the front sm box plate and to the tube-plate are se Fig. 59.

At O O, Figs. 61 and 62, are shown the a irons, riveted to the fire-box, which rest upo foot-plate, and support the boiler at that end

By comparing the plan view of the foot-p H in Fig. 61, and its elevation in Fig. 62, the small figure 63, with the sectional view the engine in the last article, its shape, dir sions, and positions can be readily seen. made of sheet-iron, or of brass, the latter ha of course, the better appearance. It may single sheet, cut out to clear boiler and driv wheels, or it may be made in strips, cut

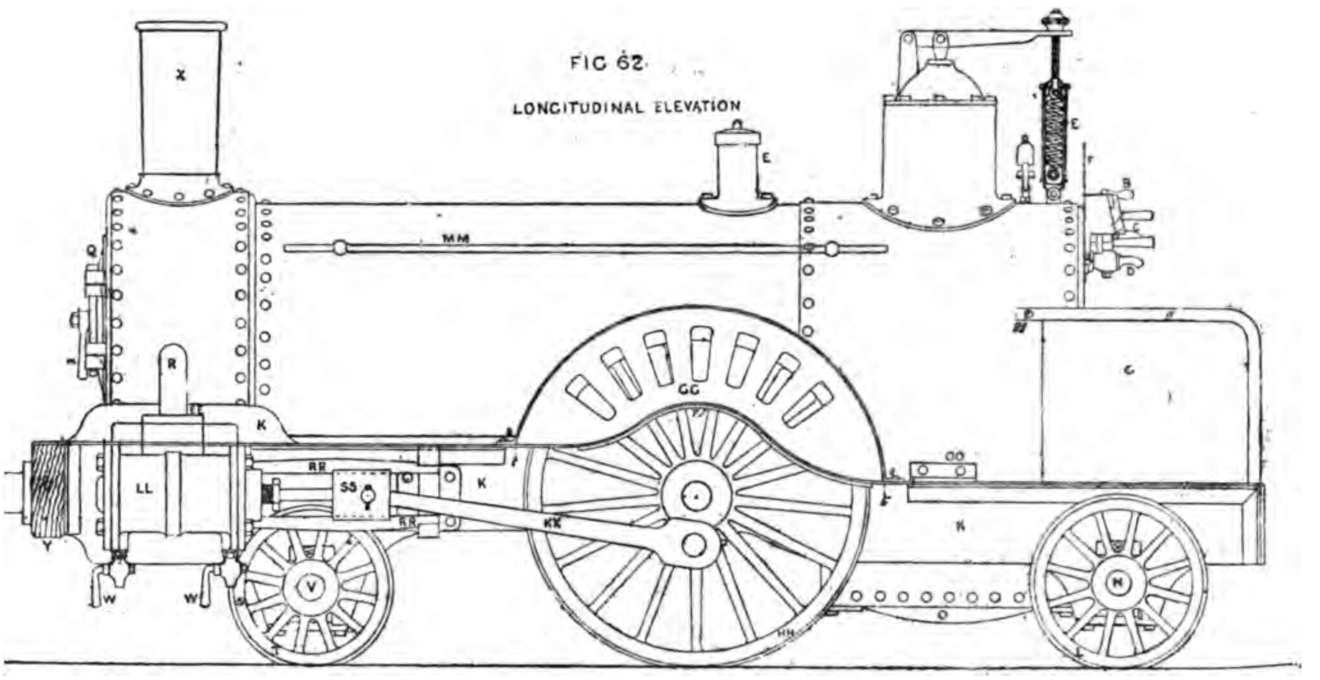


FIG 62.
LONGCITUDINAL ELEVATION

ound. In this case I should cut it from a
heet, as shown in Fig. 63. The plate is
at A in that figure to clear the smoke-box
nder flanges that bolt to the smoke-box; at
open space beneath the boiler-barrel; at C C
recesses to clear the driving-wheels, and
the space for the fire-box. The plate is
at E E to clear the big end of the con-
-rod (see Fig. 62.) The length of the
lft. 10⅜in.—given in Fig. 63, is in excess
ngth of the frame, in order to allow for
ving. The lengths, 3⅜in. and 3⅝in., also
d on each side of the centre line of the
-wheel axle, will make the openings for
els C C in Fig. 63, *t t* in Fig. 62, coin-
h the internal curve of the splashers G G
same figure. To give support to those
portions E E, and to form a handsome
er the driving-wheels, I suggest making
splashers G G as light castings in gun-
and casting flanges upon them to give
to the foot-plate. These splashers G G
own in section in the last article (Fig. 58,
and are seen in plan in Fig. 61, and in
n in Fig. 62.)

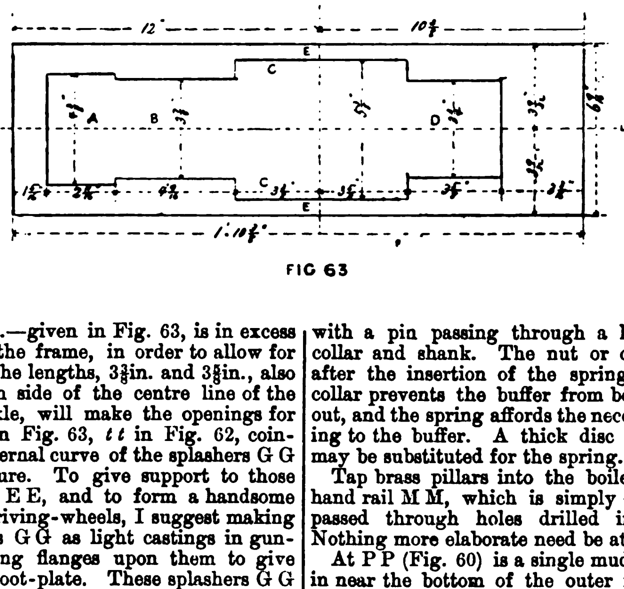


FIG 63

ng them as castings also saves the
f bending and riveting angles to the
-sheets. The flange *r*, shown in Fig. 62,
pon the splasher, and the curved portion
ot-plate is riveted, screwed, or soldered
This will make a strong as well as an
e finish. The foot-plate H can be
screwed to the buffer-beam at *u*, and to
-plate at *v*. It may be also riveted or
to the angles that are riveted to the
lates.

eans of the two lugs *s s*, the splashers are
l at their ends to the foot-plate. Radial
e cast to relieve the otherwise plain
nce of the splashers. It will improve
pearance if a name is cast upon them.
rved top portion that arches over the
is so thin—$\frac{1}{16}$in.—that the best way to
in the pattern is by bending strips of
board round the curved edge of the body.
to their unequal form, caused by the
end of the foot-plate being lower than
the front, two splasher patterns, one right, the other left, will be required.

The buffers S S are of gunmetal, and consist of the following parts:—The casing, with a square foot to screw to the wooden buffer-beam. This is drilled out to receive the buffer-shank, and shouldered to receive the coiled wire spring. The buffer itself is turned, shouldered, and screwed to take either a nut or a collar held on with a pin passing through a hole drilled in collar and shank. The nut or collar is put on after the insertion of the spring. The nut or collar prevents the buffer from becoming pulled out, and the spring affords the necessary cushioning to the buffer. A thick disc of indiarubber may be substituted for the spring.

Tap brass pillars into the boiler to carry the hand rail M M, which is simply ⅛in. brass wire passed through holes drilled in the pillars. Nothing more elaborate need be attempted.

At P P (Fig. 60) is a single mud-plug screwed in near the bottom of the outer fire-box, to be removed when the boiler has to be cleaned out.

I have given no height yet for the centre of the boiler. The plates on p. 95 are dimensioned for a height to centre of boiler of 6⅛in. above rails. That height will be suitable for an engine made without reversing gear (Vol. LI. p. 438). If reversing gear is introduced, then the boiler centre must be raised ¼in. or ⅜in. higher to permit the reversing gear to clear its under side, and some of the dimensions of the plates be modified in accordance therewith.

Parts whose reference letters are not alluded to in this article have been noted in the one previous. Some parts not noticed there, but previously described, are reversing gear (Q Q, Vol. LI. p. 504), guide-bars (R R, p. 437), crosshead S S ditto.

**J. H.**

# HOW BOOKS ARE BOUND.—XI.

By "Practical Bookbinder."

WHEN we have finished the edges of our books, whether marbled, sprinkled, or plain, we proceed to make them ready for covering. With the better class of books the following preliminaries are gone through. They are first laid upon the press and the back slightly beaten with the hammer to rectify any flatness or defects in shape caused by the former processes; then two pieces of ornamental headband is cut so as to fit exactly from joint to joint on the back of the book. This headband is simply an ornamentation, which is made in silk and cotton in different sizes to suit the square or projections of the boards. It is made in long strips, and is composed of a piece of cloth about ¾in. broad with a little bit of split cane, or stiffening of some sort, running along one edge. This cane is covered with the silk or cotton threads of different colours, and woven in a pattern. The silk is very nice, and should always be used on good books. This is a difficult matter to show by means of an illustration. I have shown its position at *a*, Fig. 31. Of course, there is a piece at both head and tail of the book. The headband is glued on, and the ornamental part is laid evenly along the back edge of the book. Cloth-bound books and the cheaper kinds of leather binding are seldom treated to headband—in fact, it looks quite out of place on cloth books, although our American friends are very fond of using it on this class of work. The next step is the lining of the backs, and as this process is varied according to the style, I will give details of all, for one style of lining would not serve all purposes.

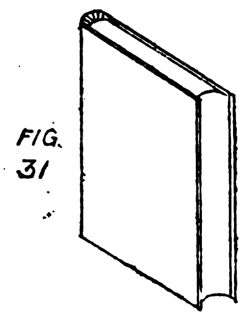


FIG. 31

To line cloth books, a cheap kind of muslin is used. It should be cut in pieces a little less than the length of the book, and about 1½in. broader than the back. After having glued the back of the book, the muslin is laid on so that about ⅜in. overlaps at each side; this is to strengthen the joint, for, as already explained, the boards of cloth books are not laced to the book. After the muslin has been rubbed down, the back is again glued, and a lining of paper put on, which must cover the back evenly from joint to joint and from head to tail of the book. This is all the lining cloth books get. As there is a lining of paper in the back of the cases when the books are put in, they are not glued, so the backs are open.

The greater number of leather-bound books are lined open back. For this purpose a stiff paper is used—a greenish-grey paper, called "pressings," is in general use, but for the sake of economy the thick magazine covers are utilised. The book is put into the lying press with the back up, the back is glued, and the paper is laid on about ⅛in. from the left-hand side, and carefully rubbed down. It is folded back from the right-hand side and brought over to the left, without any glue. The space at the left hand serves to tack it to that side. It is again folded, and the back glued, and the paper brought over to the right and cut off flush with the joint. By this method there is one ply of paper glued to the back of the book, another left open, and another ply glued to the open one. If the book is desired to be extra strong, as in the case of a large family Bible, it is quite usual to glue two plies to the book.

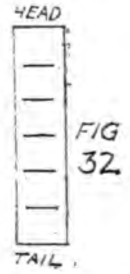
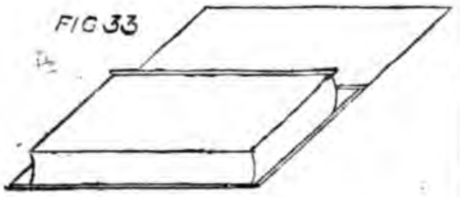


FIG 32

Books that have been sewn flexible, with the bands *not* sawn in, are simply lined with one ply brown paper between the bands; the bands being left bare, such books are always close back—i.e., the leather cover is always glued or pasted to the bare back of the book.

After books have been lined the bands are put on if the style of binding admits of this operation. Bands are sometimes flat, and these are made by gluing two or three plies of stiff paper together and cutting into narrow strips when dry. Flat bands are generally used for books bound in calf, while in the case of morocco-bound books it is usual to put on a round band, which is simply a piece of cord. Whatever is used, care must be exercised to insure them being straight. It is usual to put on five bands. The back of the book is divided carefully, as shown at Fig. 32. The bands are glued and laid on to the marks. The book is now ready for the cover. But before describing the process of covering a book in leather, I will deal in a few words with what is called *casing*—i.e., putting a book in the publisher's case. I have already described all the other processes which lead up to this, so all that remains is simply to tell how to fasten the book in the case.

FIG 33



There are a great many different methods of doing this. When a large number have to be done we have to think of the quickest method so as to save time and money; but the following will answer our purpose at present. After having rounded the back of the case, lay it out flat upon the bench with the front toward you, and place the book down upon it carefully, as shown at Fig. 33. Bring the other side over, and turn it half-way round with the back towards the left hand. Be sure that the square of the board is even all round, open the back board again, and glue the end of the book all over, taking care that the glue is under the muslin as well as over it. Shut this board, and, having turned the book over, repeat the operation on the front side. When this is done, put it between pressing boards, and put it in the standing press and screw down tightly, and leave until dry. After having taken it out of the press, it is finished, and requires no further treatment.

The leathers most commonly used for binding are morocco, calf, roan, and sheep. There are a great many varieties of all these leathers, and there are also imitations, which, although cheaper, are often more durable than the real thing.

Whatever may be the leather used for a book cover, the manipulations are much the same in every case. In cutting the covers out of the skin great care has to be exercised for the sake of economy. The cover is cut so as to have about 1in. projecting all round. It must be pared round the edges with a shoemaker's knife (in our trade called a paring-knife) on a marble slab (often a lithographer's stone which has been discarded) by laying it down the smooth side below and taking off the flesh side by moving the knife diagonally from about ⅛in. of the edge gradually down to it. The cover must be held firmly with the left hand, and care must be taken not to cut holes in the leather before reaching the edge. If the leather for the cover is calf or imitation calf, it is carefully wetted all over with clear water, using a sponge; and if of a bright colour, care must be taken to avoid staining it. Morocco and roan should not be wetted.

The cover is now pasted well over with the brush, leaving no more than what is necessary to make it adhere.

It is then laid upon the table, the volume is taken in the hands, and the squares of the boards adjusted at head and tail, and laid upon the nearest side of the cover in such a position that the back of the volume, which is away from the workman, will be in the middle. The far part is then brought over to the other side. The cover cannot be drawn on too tight, as every part must "stick" well to the book. When it has been drawn on, it is rubbed first with the open hand and afterwards with a smooth folder to efface any marks or wrinkles that may appear.

The cover is now turned in—i.e., the leather which projects beyond the board is turned into the inside of the board; the foredge is first operated on, then the head and tail. To do this successfully the book is taken by the foredge and placed upright on the bench with the boards extended (see Fig. 34), and with the hands, one on each side, slightly forcing back the boards close to the headband, and turning the leather into the back, with the thumbs pressing it in tightly and carefully, so that no fold or wrinkle is seen. As soon as all the cover is turned in, the book is again opened, and the corners of the cover cut with the scissors and pared with the knife, and laid over each other, neatly rubbing down with the folder. The setting of the headband is the next operation, and this is very important to the beauty of the binding. A little cap is worked over the headband with the folder. The double-fold of the leather is rubbed together to make it adhere, and brought over the headband, the volume is placed upright upon a smooth board, and the folder rubbed round the back a number of times so as to make the leather nice and flat. The book should now be placed between two boards—like cutting-boards—and *nipped* in the lying press to make the leather stick in at the joints. It should be taken out immediately, and laid aside to dry. Books that are half-bound, so called from the backs and corners being covered with leather only, present no difference in the covering from what has been given above. The leather should come about 1½in. on each side, and back and corners should be neatly pared before putting them on.

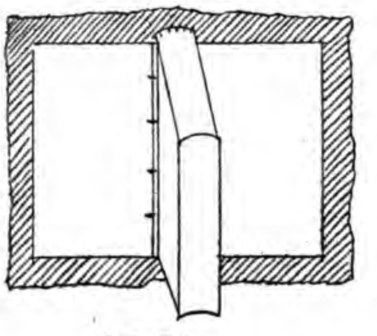


FIG. 34

In using morocco and other grained l care must be taken not to make them to with the paste, and they must not be dra tightly, as the grain is liable to be des If the grain in morocco is not suffi developed, it can be raised by rolling the doubled on the table with the hand. very liable to get stained, therefore wa paste being used must be clean and Sometimes we want to cover books in s velvet. I need not say that they requi carefully treated. Silk should be prepa pasting a piece of paper thereon and lea dry, so that when pasted for covering th will not affect its appearance. Velvet, of the nap, is a peculiar substance to wor Having ascertained the direction of th glue one side of the book, and lay it dow the velvet, turn it over, and rub careful the hand the way of the nap; turn the bo again, and glue the back and the other the book, and rub down as before. G turn in with the fingers, and turn in ver fully. This completes the stage called warding" in the trade. "Finishing" taken up in the next.

## MASONS' IMPROVEMENTS IN HYDROGEN MICROSCOPES

MR. R. G. MASON, of 69, Claphan road, Clapham, S.W., has introdu above form of lantern and table micros patent for which has been applied for. U present time the lantern microscope has distinct instrument from the table form o

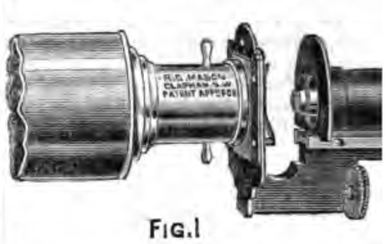


FIG. 1

By the union of the above parts, an ins is obtained that, when not in use fo projections, can be easily altered, as per No unscrewing is required, and there are parts. Fig. 1 shows instrument as use lantern. It is very convenient for the teacher or general lecturer, as a demon may be made to either a small or large a with equal facility. The lower part, carries the joint for inclining instrumen angle, is fitted with concave and flat mi

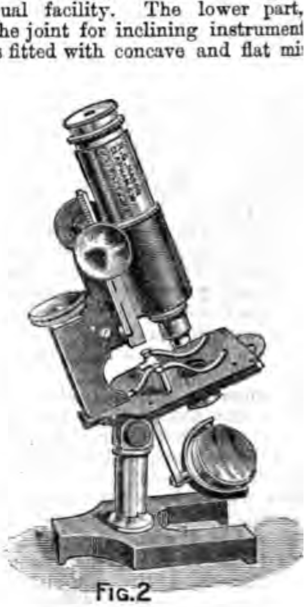


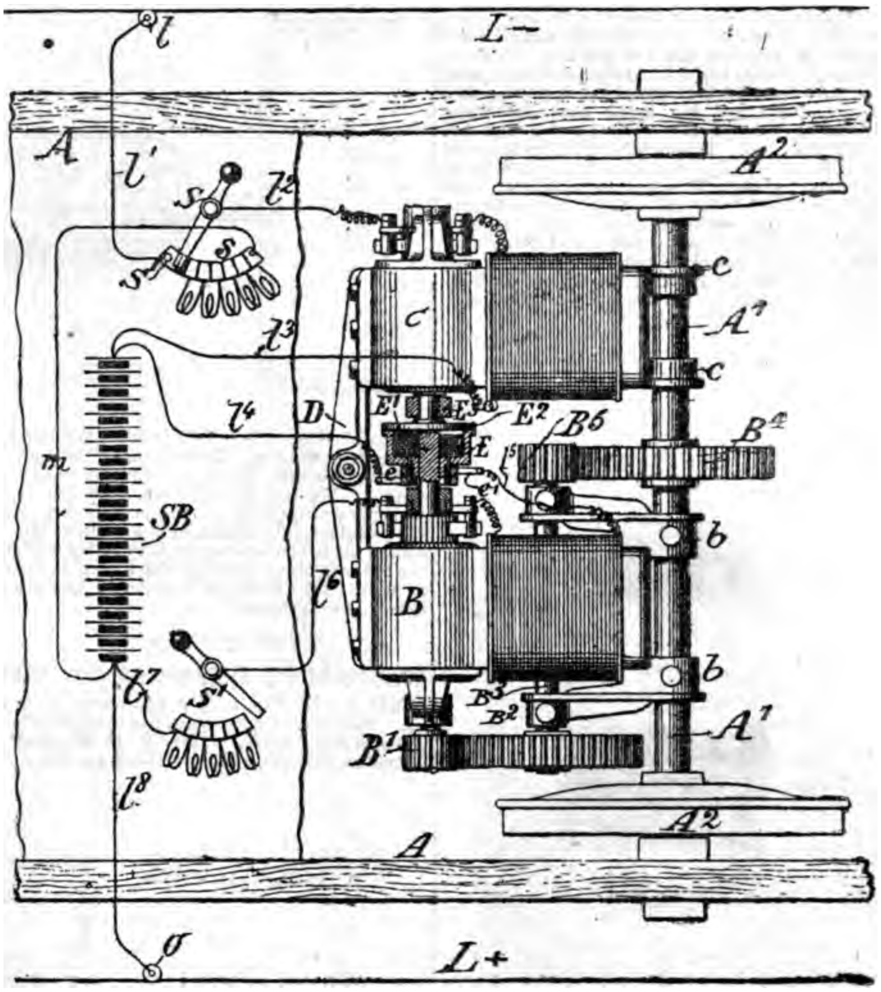
FIG. 2

swinging arm, also with the universal stage fitting tube for apparatus. The l draw, which fits into the upper part, is diameter, and is screwed with the Socie screw, thus enabling any ordinary mi objective to be used with it. It is fitte first-class rack, and also screw fine working steadily under high powers. motion is especially useful in photo-micr The stage being of the usual form, bo

ctive are in view, and easily manipulated
use, thus doing away with an objection
ten present in the older forms of lantern
pe. A further improvement is a spring
bling the object to be easily changed
scratching the labels, &c., its construc-
itting of either a deep zoophyte trough
innest 3 × 1 slip being held gently, but
The parts are supplied separately, so
one needing only the lantern arrange-
. add the other at any future time.

## RRIE'S ELECTRO-MOTOR APPARATUS.

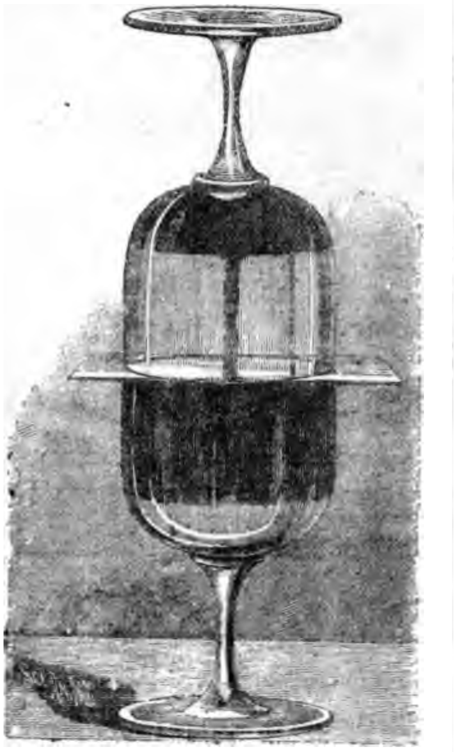
improvements in electro-motor apparatus
pplied to tramway and other cars have
ented here by Mr. S. C. C. Currie,
in Philadelphia. The invention involves
n features, co-operating and, in one
itually dependent upon each other, but
adly considered, not being necessarily
it upon the other. These general features
organisation of motors and a storage
n which the battery may be charged from
e source (in the case of a street-car, by
overhead or conduit wires, in connection
nain generating station), the arrange-
ing such that the excessive variation of
quired by the motor or motors is mainly
by the storage battery, which, at other
being continuously charged from the
ource of electrical energy. Thus, when
is light, the batteries are being charged,
n the other hand, when the load is
e batteries are discharging and assisting
nt from the outside source in the coils
otor. An arrangement by which in-
ower and efficiency are obtained when
test amount of power is required, and
ordinarily arranged, the motors have
st efficiency; that is upon the starting of
The drawing is a bottom, diagrammatic
a section of a car-body A, showing
$A^1$, and driving and carrying wheels
Two motors, B, C, are swung at *b b* and
the axle $A^1$. At their opposite ends the
s are bolted to a frame, D, which is
o the under side of a car body. The
shaft of the motor B carries a pinion,
ing in a gear $B^2$, on a shaft, $B^3$, and a
on this shaft, gears with a cog, $B^4$, on
xle. The shafts of the armatures of the
rs, B, C, are in line with each other,
een the two shafts a clutch-mechanism
ded for locking them together. An
agnetic clutch device is shown, which is
y constructed in the following manner:—
e end of the armature-shaft of the motor
lectro-magnet with two cores, the outer
eing in the form of a hollow cylinder,
nner one, $E^1$, solid, the wire being
etween the two. In the drawing the
e $E^1$ is shown as formed by the end of
ture-shaft, while the outer cup-shaped
rical casing or core is secured to the
-shaft. The armature, $E^2$, for this
onsists of a plate or disc mounted upon
f the shaft of the motor C, and presses
n the outer core; or, in other words,
edge of the cylinder E, the inner core
a trifle shorter to prevent contact with
ture $E^2$. The armature $E^2$ may have a
y upon the end of the motor C, or the
lf may have a slight endwise motion in
g $E^3$. The current is led to the coil of
net E $E^1$, through brushes *e* $e^1$, bearing
ely upon insulated rings mounted upon
rried by the cylinder E, with which the
of the coil of the magnet are connected,
y indicated in the drawing. The organ-
us far described is a suitable one for
g the invention, but the patentee does
t the invention to this special con-
. S B represent a storage battery
s carried within the car. L + and
present the leads from a source of
energy. The current is taken from
L — by a wheel or rubber *l*, and line $l^1$,
ntact $s^1$, of a switch S, through lever of
d conductor $l^2$, to the motor C, which
of any ordinary character. From the
e circuit passes by line $l^3$, to one pole
rage battery S B. From the conductor
m this same pole of the storage battery,
, runs to the brush *e*, through the electro-
clutch-coil, and out by brush $e^1$, and by
through the motor B, and thence by



wire $l^6$, to the lever of a resistance switch $S^1$, the contacts of which are connected by a line $l^7$, with the opposite end of the storage battery S B, this pole of the battery being connected, through line $l^8$, with a suitable rubber or roller *o*, bearing on the lead L + of the outside circuit. This same pole of the storage battery is connected by a wire *m*, with the end contact-plate *s*, of the resistance switch S. The lever of the switch S being upon the contact $s^1$, the current from L – passes to the switch lever and by line $l^2$, through the motor C, to the storage battery. The current will therefore be constantly running through the motor C, and through the storage battery, the result being that the former is revolved and the battery charged. If the car is at rest, the motor C being without a load, will revolve at a very high speed, and, in doing so, will increase the opposing E.M.F. between the end of the battery and the line L –. A small current will therefore be running into and charging the battery. On starting the car, the switch $S^1$ is turned so as to allow a current to pass through the motor B, and the electro-magnetic clutch E $E^1$ being in circuit $l^4$, from the storage battery and from line $l^3$, the clutch magnet attracts its armature $E^2$, which is revolving at a high rate of speed. The result is the motor B is actuated by the current flowing in its circuit $l^4$, $l^5$, $l^6$, and at the same time the armature shaft of the magnet C, which is running at very high speed, is by gradually increasing friction of the clutch, locked with the armature of the shaft/ B and the full power of the motor C, which is then running at its greatest efficiency, will assist the motor B in starting the car or performing the work to be done. As the speed of the motor C is gradually decreased, the current through this motor will be relatively increased, and the two motors will consequently assist each other, and eventually run together at the same speed. Upon slowing down, the current in the motor B may be decreased by the manipulation of the resistance switch $S^1$, and finally cut off altogether by the opening of that switch; and when this occurs the clutch magnet releases its armature, and the motor C again runs up to its fullest speed without any load, and continues to effect the charging of the storage battery. By placing the lever of the switch S upon any one of the contacts, *s*, of the resistance switch, the motor C will obviously be included in a circuit running from the storage battery only. Both motors, B, C, would then be in parallel, and both run from the storage battery only. This arrangement of circuits, switches, &c., is a suitable one; but the invention is not necessarily limited to it. The relative E.M.F. of the storage battery and outside circuit, as well as resistance of motors and circuits, will of course be adapted to the necessities of each case. For illustration, it may be assumed that the E.M.F. of the outside circuit is 400 volts, and that of the battery 200 volts. It will be observed that, since the motor C, when connected with the outside circuit, is always in circuit and in series with the battery, a current will be running through the motor and through the storage battery, the results being that the former is rotated and the latter charged. If, as above stated, the car is at rest, the motor C will be without any load, and will revolve at high speed. However, when an excessive amount of work is to be done by the motors, then they are fed both by current from the outside circuit and from the storage battery. And when the battery is sufficiently charged the outside circuit may be disconnected and the motors run as before stated from the storage battery only. By employing an organisation in which, when the car is at rest, the motor C is run without load at a high speed, on the starting of car, this motor is at the height of its efficiency, and acts to assist the other motor B in starting.

## EXPERIMENT ON GRAVITATION OF LIQUIDS.

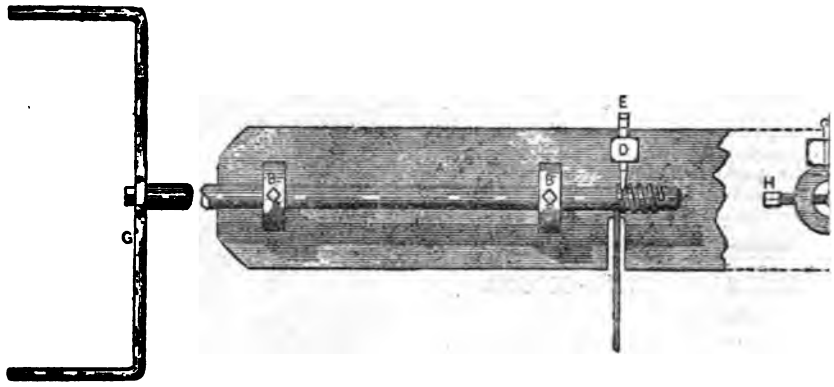
AN amusing trick can be performed at the dinner-table with the aid of two wine-glasses and a visiting card. Take two claret glasses of the same size, and fill one with claret quite to the brim, and the other with water. Cover the glass containing the water with the pasteboard card, and then ask if anyone at the table can transfer the claret into the glass containing the water without pouring out or spilling the liquid in either glass. At first it appears that this is quite impossible; but it may be easily accomplished by inverting the glass containing the water and placing it upon the other glass. After the edges of the two glasses have been brought opposite one another, the card is slipped carefully to one side so as to open a small communication between the two glasses; this done, there immediately begins an exchange of the liquids, and it is observed that the claret is flowing in a gentle stream into the upper glass, the water descending through the small opening and displacing the claret. The claret soon begins to spread out in an even body over the water contained in the upper glass. This process continues until there is a complete interchange of the two liquids. Of course the explanation is simple enough. The water, being a heavier liquid than the claret, sinks into the lower glass, and the claret is forced up to fill the displacement of the water. It flow in a steady, clear-cut stream, and the effect as i.



rises through the water is very fine. It is remarkable that in this experiment there is no observable intermixture of the liquids. The water contained in the lower glass after the experiment is quite clear and transparent. It is also curious that the water in the upper glass passes the space between the rims of the glasses, and enters the lower glass without any leakage whatever. This, however, is fully explained by the surface tension existing on the liquid at this point. The card used in this experiment is about the thickness of an ordinary postal card. The experiment is easily performed, and is worthy of trying. The upper glass containing the water, may be lifted and carried about while the card is attached, without holding it on with the hand, thus illustrating in a well-known way the effect of atmospheric pressure.—*Scientific American.*

## MACHINE FOR COILING SPRINGS.

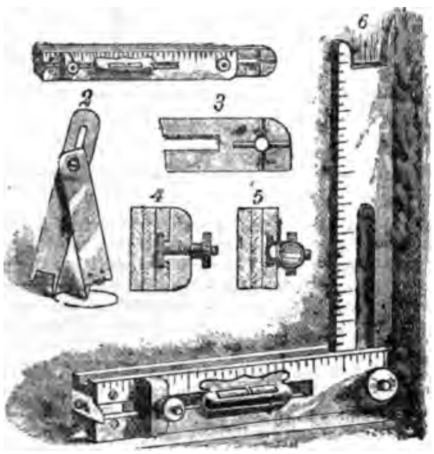
THE description and sketch of the machine for coiling springs given herewith is contributed to the *Blacksmith and Wheelwright* by "B. F. H.," of Johnstown, Pennsylvania, as a machine for use in a shop where a spring is occasionally wanted. A is a plate of Bessemer steel or iron, about 8in. or 10in. wide and ¼in. or $\frac{5}{16}$in. thick by 4ft. long, to which are riveted the two lugs marked B, and they are V-shaped at bottom, so as to allow any sized bar, marked C, you should wish to use. D is a slotted lug, also riveted to the plate A. In the slot a distance or gauge piece marked E is put for the purpose of setting the coils any distance apart the smith should desire; this piece is placed up close to the bar, so as not to bear too tight; it is held to its place by a small key. F is a slot cut in plate A for the purpose of allowing the wire more heating space, the plate A being placed over the fire at that point. The bar C is kept in place by set-screws marked H, being let down so as to almost touch the bar. The bar, you will notice, has a small hole on one end for entering the rod, and on the other end it is squared to suit the double handle marked G, by which it is turned. When it is necessary to coil springs close, the distance piece E must not be used. The lugs all ought to be put on the plate with square holes, so they cannot turn around should they get loose. After the spring is coiled, the end



in small hole must be cut off in order to remove the spring from the bar. The diameter of bars marked C must, of course, be according to sizes of springs desired. We coil springs from wire ¼in. to ⅝in. diameter on bars from ¾in. to 3in. diameter. Hence the usefulness of the machine in a smith's shop. In coiling up it is necessary to hold pretty well on to the rod as it passes through the fire on to the bar, so as to make it fit the bar closely, and thereby make the coils round.

## WOODRUFF'S COMBINATION TOOL.

THE combination tool, or instrument, shown in the annexed engravings, has been patented in America and Canada by Mr. R. G. Woodruff, of Hamilton, Ontario, and is intended for the use of



iron and wood workers as a tool to be carried in the pocket. As will be seen, it is a combined rule, square, bevel, scribe gauge, spirit level, and dividers. Fig. 1 is a side view of the device folded, Fig. 2 shows its principal portions employed as dividers, Fig. 3 is an inner view of a joint section, Figs. 4 and 5 represent transverse sections of the device when folded, and Fig. 6 shows it in the form of a square. The stock has two equal-sized strips, or side pieces, held spaced apart at one end by a slightly-tapered block, a slotted blade-piece being held intermediate of the main side pieces, and a screw bolt and nut being adapted to clamp these pieces, while a longitudinal rib on the inner surface of one side piece of the stock makes a transverse groove in the blade piece near one end, to hold the blade at right angles to the stock when the rib and groove are interlocked. As shown in Fig. 6, the square is available for testing and measuring objects on its inner surface; but by extending the blade in the opposite direction, a square will be formed with graduations on its outer edge.

## THE ELECTRO-MAGNET.—VII.*

WE are now in a position to understand the bearing of some curious and important researches made about forty years ago by Dr. Julius Dub, which, like a great many other good things, lie buried in the back volumes of Poggendorff's *Annalen.* Some account of them is also given in Dr. Dub's now obsolete book, entitled "Elektromagnetismus." The first of Dub's experiments to which I will refer relates to the difference in behaviour between electro-magnets with flat and those with pointed pole-ends. He formed two
cylindrical cores, each 6in. long, from the
of soft iron, 1in. in diameter. Either of the
be slipped into an appropriate magnetisi
One of them had the end left flat, the othe
end pointed, or, rather, it was coned dov
the flat end was left only ½in. in diameter,
ing, therefore, only one-fourth of the an
contact surface which the other core posses
an armature there was used another piec
same soft iron rod, 12in. long. The pul
electro-magnet on the armature at different
was carefully measured, with the following

| Distance apart in inches. | | Pull on Flat Pole (lb.) | | Pull on I Pole ( |
|---|---|---|---|---|
| 0 . | .... | 3·3 | .... | 5 2 |
| 0·0055 | .... | 1·1 | .... | 1·8 |
| 0·0110 | .... | 0·9 | .... | 0·7 |
| 0·0165 | .... | 0·71 | .... | 0·5 |
| 0·022 | .... | 0·60 | .... | 0·4 |
| 0·044 | .... | 0·38 | .... | 0·20 |
| 0·088 | .... | 0·19 | .... | 0·0 |

Dub's next experiments relate to the empl
of polar extensions or pole-pieces attached
core. These experiments are so curious,
expected, unless you know the reasons why
invite your especial attention to them. If
gineer had to make a firm joint between tw
of metal, and he feared that a mere attach
one to the other was not adequately strong,
and most natural impulse is to enlarge th
that come together—to give one, as it
broader footing against the other. And
precisely what an engineer, if uninstructed
true principles of magnetism, would do in
make an electro-magnet stick more tightly
armature. He would enlarge the ends of
both. He would add pole-pieces to give the
ture a better foothold. Nothing, as you
could be more disastrous. Dub employed
experiments a straight electro-magnet h
cylindrical soft iron core, 1in. in diamete
long, and as armature a piece of the same i
long. Both were flat-ended. Then six p
soft iron were prepared of various sizes, to
pole-pieces. They could be screwed on
either to the end of the magnet core or to
the armature. To distinguish them we
them by the letters A, B, C, &c. Their dim
were as follows, the inches being pres
Bavarian inches:—

| Piece. | | Diameter. | | Len |
|---|---|---|---|---|
| A | ...... | 2in. | ...... | 1i |
| B | ...... | 1¾in. | ...... | 1¼ |
| C | ...... | 1⅜in. | ...... | 2i |
| D | ...... | 2in. | ...... | ¼ |
| E | ...... | 1¼in. | ...... | 1i |
| F | ...... | 1in. | ...... | 2i |

Of the results obtained with these pieces
select eight. They are those illustrated by t
collected sketches in Fig. 19. The pull req
detach was measured, also the attraction
at a certain distance apart.

| Experiment. | On Magnet. | On Armature. | Traction. | A |
|---|---|---|---|---|
| I. | None | None | 48 | |
| II. | D | None | 30 | |
| III. | E | None | 32 | |
| IV. | C | None | 35 | |
| V. | D | A | 20 | |
| VI. | None | B | 50 | |
| VII. | None | D | 43 | |
| VIII. | None | C | 50 | |

It will be noted that, in every case, putti
pole-piece to the end of the magnet diminis
the pull in contact and the attraction at a d
it simply promoted leakage and dissipatio
magnetic lines. The worst case of all was
which there were pole-pieces both on the
and on the armature. In the last three c
pull was increased; but here the enlarged p
attached to the armature, so that it help
magnetic lines which came up into it to fl
laterally to the bottom end of the electro-
while thus reducing the magnetic reluctanc

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* Extracted from the Cantor Lectures delivered by Prof. SILVANUS P. THOMPSON, B.Sc., before the Society of Arts.

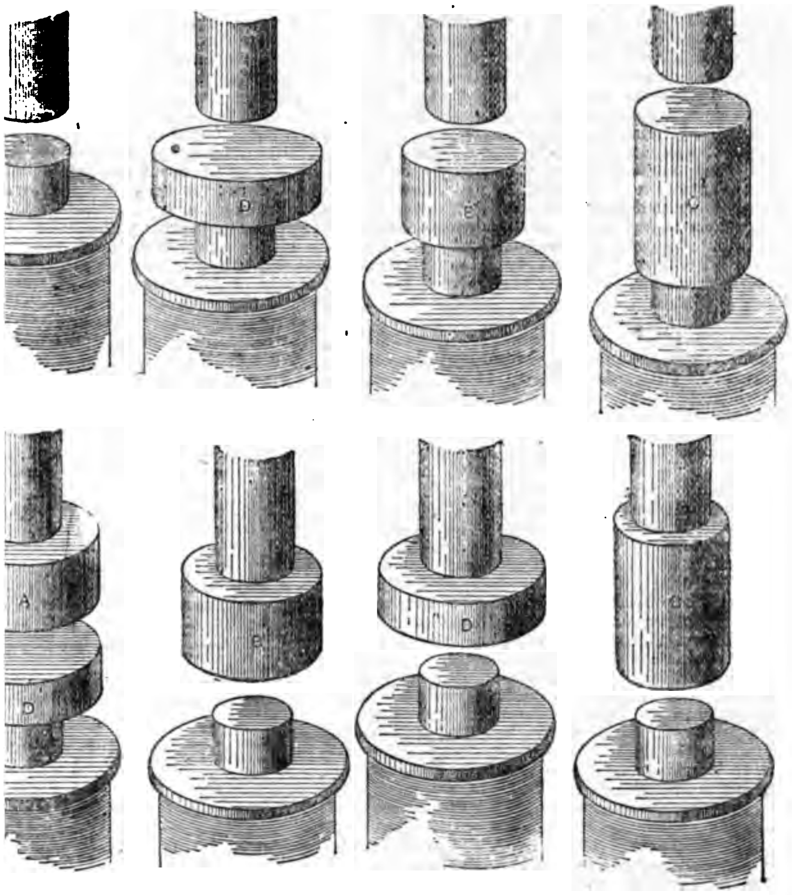


FIG. 19.

through the air, and so increasing the of magnetic lines, did not spread that issued up from the end of the

ing up Dub's researches, it was ex-esting to find that so important a fact ed the observant eye of the original the electro-magnet. In Sturgeon's tal Researches" (p. 113) there is a tten apparently about the year 1832, s follows :—

tro-magnet of the above description, ., and furnished with one coil of wire, lb. The poles were afterwards made larger surface by welding to each end ic bar a square piece of good soft iron; teration only, the lifting power was bout 5lb., although the magnet was nuch as possible."

at this straight electro-magnet, whether de-on or end-on, could act on the lle at some distance from it, and deflect experiments there was no return-path etic lines that flowed through the iron at afforded by the surrounding air. wed round in wide-sweeping curves to the other; the magnetic field being ve. Now, what will happen if we turn path? Suppose I surround the et with an iron tube of the same length lines will flow along in one direction ore, and will find an easy path back side of the coil. Will the magnet thus more powerfully or less on that little agnet? I should expect it to pull less or if the magnetic lines have a good ere through the iron tube, why should emselves in such a quantity to a dis-h air in order to get home? No; they return short back from the end of the tubular iron jacket. That is to say, a distance ought to be diminished by hat iron tube outside. Here is the et up. And you see that when I turn nt my indicating needle is scarcely l. The iron jacket causes that magnet less action at a distance. Yet I have le who actually proposed to use nets of this sort in telegraph instru-n electric motors, on the ground that igger pull. You have seen that they action at a distance across air, but ains the question whether they give a contact? Yes, undoubtedly they do; thing that is helping the magnetism to the other end increases the good-agnetic circuit, and therefore increases netic flux.

this experiment upon another piece of apparatus. one which has been used for some years at the Finsbury Technical College. It consists of a straight electro-magnet set upright in a base-board, over which is erected a little gallows of wood. Across the frame of the gallows goes a winch, on the axle of which is a small pulley with a cord knotted to it. To the lower end of the cord is hung a common spring balance, from the hook of which depends a small horizontal disc of iron to act as an armature. By means of the winch I lower this disc down to the top of the electro-magnet. The current is turned on; the disc is attracted. On winding up the winch I increase the upward pull until the disc is detached. See, it required about 9lb. to pull it off. I now slip over the electro-magnet, without in any way attaching it, this loose jacket of iron—a tube, the upper end of which stands flush with the upper polar surface. Once more I lower the disc, and this time it attaches itself at its middle to the central pole, and at its edges to the tube. What force will now be required to detach it? This tube weighs about ½lb., and it is not fixed at the bottom. Will 9½lb. suffice to lift the disc? By no means. My balance only measures up to 24lb., and even that pull will not suffice to detach the disc. I know of one case where the pull of the straight core was increased 16-fold by the mere addition of a good return-path of iron to complete the magnetic circuit. It is curious how often the use of a tubular jacket to an electro-magnet has been reinvented. It dates back to about 1850, and has been variously claimed for Romershausen, for Guillemin, and for Fabre. It is described in Davis's "Magnetism," published in Boston in 1855. About 16 years ago Mr. Faulkner, of Manchester, revived it, under the name of the *Altandæ* electro-magnet. A discussion upon jacketed electro-magnets took place in 1876, at the Society of Telegraph Engineers; and in the same year Prof. Graham Bell used the same form of electro-magnet in the receiver of the telephone which he exhibited at the Centennial Exhibition. But the jacketed form is not good for anything except increasing the tractive power. Jacketing an electro-magnet which already possesses a return circuit of iron is an absurdity. For this reason the proposal made by one inventor to put iron tubes outside the coils of a horse-shoe electro-magnet is one to be avoided.

We will take another paradox, which equally can be explained by the principle of the magnetic circuit. Suppose you take an iron tube as an interior core; suppose you cut a little piece off the end of it; a mere ring of the same size, Fig. 20. Take that little piece and lay it down on the end. It will be struck with a certain amount of pull. It will pull off easily. Take that same round piece of iron, put it on edgewise, where it only touches one point of the circumference, and it will stick on a good deal tighter, because it is there in a position to increase the magnetic flow of the magnetic lines. By concentrating the flow of magnetic lines over a small surface of contact increases B at that point, and $B^2$, integrated over the lesser area of the contact, gives a total bigger pull than is the case when the edge is touched all round against the edge of the tube.

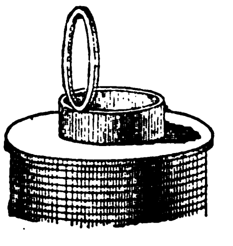


FIG. 20.—Experiment with Tubular Core and Iron Ring.

Here is a still more curious experiment. I use a cylindrical electro-magnet set up on end, the core of which has at the top a flat circular polar surface about 2in. in diameter. I now take a round disc of thin iron—ferrotype or tin-plate will answer quite well—which is a little smaller than the polar face. What will happen when this disc is laid down flat and centrally on the polar face? Of course you will say that it will stick tightly on. If it does so, the magnetic lines which come in through its under surface will pass through it and come out on its upper surface in large quantities. It is clear that they cannot all, or even any considerable proportion of them, emerge sideways through the edges of the thin disc, for there is not substance enough in the disc to carry so many magnetic lines. As a matter of fact the magnetic lines do come through the disc, and emerge on its upper surface, making indeed a magnetic field over its upper surface that is nearly as intense as the magnetic field beneath its under surface. If the two magnetic fields were exactly of equal strength, the disc ought not to be attracted either way. Well, what is the fact? The fact, as you see now that the current has been turned on, is that the disc absolutely refuses to lie down on the top of the pole. If I hold it down with my finger, it actually bends itself up, and requires force to keep it down. I lift my finger, and over it flies. It will go anywhere in its effort to better the magnetic circuit rather than lie flat on the top of the pole.

Next I invite your attention to some experiments, originally due to Von Kolke, published in the *Annalen* 40 years ago, respecting the distribution of the magnetic lines where they emerge from the polar surface of an electro-magnet. I cannot enumerate them all, but will merely illustrate them by a single example. Here is a straight electro-magnet with a cylindrical, flat-ended core (Fig. 21).

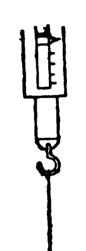


FIG. 21.—Exploring Polar Distribution with small Iron Ball.

In what way will the magnetic lines be distributed over at the end? Fig. 21 illustrates roughly the way in which, when there is no return-path of iron, the magnetic lines leak through the air. The main leakage is through the ends, though there is some at the sides also. Now the question of the end-distribution we shall try by using a small bullet of iron, which will be placed at different points from the middle to the edge, a spring balance being employed to measure the force required to detach it. The pull at the edge is much stronger than at the middle, at least four or five times as great. There is a regular increase of pull from the middle to the edge. The magnetic lines, in trying to complete their own circuit, flow most numerously in that direction where they can go furthest through iron on their journey. They leak out more strongly at all edges and corners of a polar surface. They do not flow out so strongly at the middle of the end surface, otherwise they would have to go through a larger air-circuit to get back home. The iron is consequently more saturated round the edge than at the middle; therefore, with a very small magnetising force, there is a great disproportion between pull at the middle and that at the edges. With a very large magnetising force you do not get the same disproportion, because if the edge is already far saturated you cannot by applying higher magnetising power increase its magnetisation much, but you can still force more lines through the middle. The consequence is, if you plot out the results of a succession of experiments of the pull at different points, the curves obtained are, with larger magnetising forces, more nearly straight than are those obtained with small magnetising forces. I have known cases where the pull at the edge was six or seven times as great as in the middle with a small magnetising power, but with larger power not more than two or three times as great, although, of course, the pull all over was greater. You can easily observe this distribution by merely putting a polished iron ball upon the end of the electro-magnet, as in Fig. 22. The ball at once rolls to the edge and will not stay at the middle.

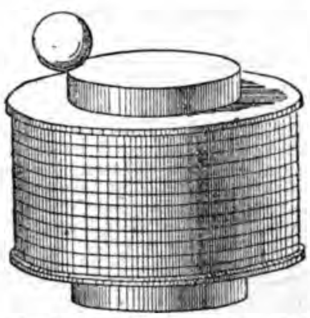


FIG. 22.—Iron Ball Attracted to Edge of Polar Face.

The magnetic behaviour of little iron balls is very curious. A small round piece of iron does not tend to move at all in the most powerful magnetic field if that magnetic field is uniform. All that a small ball of iron tends to do is to move from a place where the magnetic field is weak to a place where the magnetic field is strong. Upon that fact depends the construction of several important instruments, and also certain pieces of electro-magnetic mechanism.

In order to study this question of leakage, and the relation of leakage to pull, still more incisively, I devised some time ago a small experiment with which a group of my students at the Technical College have been diligently experimenting. Here (Fig. 23) is a horseshoe electro-magnet. The core is of soft wrought iron, wound with a known number of turns of wire. It is provided with an armature. We have also wound on three little exploring coils, each consisting of five turns of wire only, one, C, right down at the bottom, on the bend; another, B, right round the pole, close up to the armature; and a third, A, around the middle of the armature. The object of these is to ascertain how much of the magnetism which was created in the core by magnetising power of these coils ever got into the armature. If the armature is at a considerable distance away, there is naturally a great deal of leakage. The coil C around the bend at the bottom is to catch all the magnetic lines that go through the iron; the coil B at the poles is to catch all that have not leaked outside before the magnetism has crossed the joint; while the coil A right around the middle of the armature, catches all the lines that actually pass into the armature and pull at it. We measure by means of the ballistic galvanometer and these three exploring coils how much magnetism gets into the armature at different distances, and are able thus to determine the leakage and compare these amounts with the calculations made, and with the attractions at different distances. The amount of magnetism that gets into the armature does not go by a law of inverse squares, I can assure you, but by quite other laws. It goes by laws which can only be expressed as particular cases of the law of the magnetic circuit. The most important element of the calculations, indeed, in many cases is the amount of percentage of leakage that must be allowed for. To predetermine the probable percentage of leakage one must first distinguish between those magnetic lines which go usefully through the armature (and help to pull it) and those which go astray through the surrounding air and are wasted so far as any pull is concerned. Having set up this distinction, one then needs to know the relative magnetic conductance, or *permeance*, along the path of the useful lines and that along the innumerable paths of the wasted lines of the stray field. For (as every electrician accustomed to the problems of shunt circuits will recognise) the quantity of lines that go respectively along the useful and wasteful paths will be directly proportional to the conductances (or permeances) along those paths, or will be inversely proportional to the respective resistances along those paths. It is customary in electro-magnetic calculations to employ a certain coefficient of allowance for leakage, the symbol for which is $v$, such that when we know the number of magnetic lines that are wanted to go through the armature we must allow $v$ times as many in the magnet core. Now, if $u$ represents permeance along the useful path, and $w$ the permeance of all the waste paths along the stray field, the total flux will be the useful flux as $u + w$ is to $u$. Hence the co-efficient of allowance for leakage $v$, is equal to $u + w$ divided by $u$. The only real difficulty is to calculate $u$ and $w$. In general $u$ is easily calculated: it is the reciprocal of the sum of all the magnetic reluctances along the useful path from pole to pole.

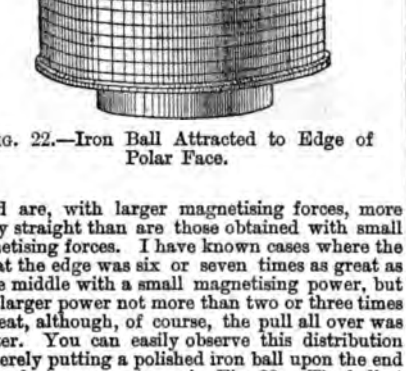


FIG. 23.—Experiment on Leakage of Electro-Magnet.

It has long been a favourite idea with telegraph engineers that a long-legged electro-magnet in some way possessed a greater "projective" power than a short-legged one; that, in brief, a long-legged magnet could attract an armature at a greater distance from its poles than could a short-legged one made with iron cores of the same section. The reason is not far to seek. To project or drive the magnetic lines across a wide intervening air-gap requires a large magnetising force on account of the great reluctance, and the great leakage in such cases. And the great magnetising force cannot be got with short cores, because there is not, with short cores, a sufficient length of iron to receive all the turns of wire that are in such a case essential. The long leg is wanted simply to carry the wire necessary to provide the requisite circulation of current.

We now see how, in designing electromagnets, the length of the iron core is really determined: it must be long enough to allow of the winding upon it of the wire which, without overheating, will carry the ampère-turns of exciting current which will suffice to force the requisite number of magnetic lines (allowing for leakage) across the reluctances in the useful path. We shall come back to this matter after we have settled the mode of calculating the quantity of wire that is required.

Being now in a position to calculate the additional magnetising power required for forcing magnetic lines across an air-gap, we are prepared to discuss a matter that has been so far neglected—namely, the effect on the reluctance of the magnetic circuit, of joints in the iron. Horseshoe electro-magnets are not always made of one piece of iron bent round. They are often made of two straight cores shouldered and screwed, or riveted into a yoke. It is a matter purely for experiment to determine how far a transverse plane of section across the iron obstructs the flow of magnetic lines. Armatures, when in contact with the cores, are never in perfect contact, otherwise they would cohere without the application of any magnetising force; they are only in imperfect contact, and the joint offers a considerable magnetic reluctance. This matter has been examined by Prof. J. J. Thomson and Mr. Newell, in the Cambridge Philosophical Society's *Proceedings*, in 1887; and recently more fully by Prof. Ewing, whose researches are published in the *Philosophical Magazine* for September, 1888. Ewing not only tried the effect of cutting and of facing up with true plane surfaces, but used different magnetising forces, and also applied various external pressures to the joint. For our present purpose we need not enter into the questions of external pressures, but will summarise the results which Ewing found when his bar of wrought iron was cut across by section planes, first into two pieces, then into four, then into eight. The apparent permeability of the bar was reduced at every cut.

Suppose we are working with the magnetisation
of our iron pushed to about 16,000 lines to
centimètre (i.e., about 150lb. per sq
traction), requiring a magnetising force
$H = 50$; then, we find that each joint
iron offers as much reluctance as would
0·0005in. in thickness, or adds as much
as if an additional layer of iron about
had been added. With small magnetis
the effect of having a cut across the ir
good surface on it is about the same as t
had introduced a layer of air $\frac{1}{200}$in. th
though you had added to the iron circuit
of extra length. With large magnetis
however, this disappears, probably beca
attraction of the two surfaces across that
stress in the magnetic circuit, with hig
forces running up to 15,000 or 20,000 li
square centimètre, will of itself put on
of 130lb. to 230lb. to the square inch, a
resistances are considerably reduced;
down in fact to about $\frac{1}{20}$th of their ini
When Ewing specially applied compress
which were as large as 670lb. to the s
which would of themselves ordinarily,
tinuous piece of iron, have diminished
netisability, he found the diminutio
magnetisability of iron itself was nearl
sated for by the better conduction of the c
The old surface, cut and compressed in
closes as it were magnetically up—does n
a cut at all; but at the same time you l
much as you gain, because the iron itsel
less magnetisable.

## SCIENTIFIC SOCIET

## BRITISH ASTRONOM ASSOCIATION.

THE first ordinary meeting of the abov
tion was held Wednesday even
November, in the Hall of Barna
Holborn, the President, Capt. W. Noble,
occupying the chair. There was a large a
the hall being quite full. Several prese
the Society were announced, among the
tion of photographs, the publications of
nomical Society of the Pacific from the c
ment, and the first vol. of the publicat
Lick Observatory, from Prof. Holden, wh
early and in this practical manner reco
Association, and expressed his good will t

The President, in opening the procee
marked that it had been alleged by
certainly should have known better, that
ciation was in some sense in antagonism
tion to the Royal Astronomical Society:
this was a most unfounded suspicion. Tw
out of thirty of the executive were Fello
Society. The Royal Astronomical Socie
more devoted servant than himself, and h
the slightest suspicion of any such rivalr
would have induced him to accept h
position. Referring to the Solar section
able direction of Miss Brown, he remark
daily photographs of the sun taken at
did not do away with the need for
observations, for no photograph that he
seen gave any indication of the complic
ture of a typical sunspot, while the so-call
spots" of Trouvelot, and the late lamen
Perry, had so far eluded the photogr
altogther. Nor was it impossible
persistent observer might behold a re
the strange meteoric (should he ca
outbursts, such as were seen simulta
Carrington and Hodgson in 1859, and b
1864. In these days, when the cost of la
ments had been so materially reduced,
like to point out to their possessors
spectroscopy offers a promising field, and
that a section might be added devot
branch of research. It was needless t
the work still to be done on the moon by
section, superintended, as it was, by
most eminent selenographers living.
was an almost inexhaustible field for
observer, be the size of his telescope wh
for in comparison with what we actuall
physical selenography and selenology, ou
was terrible. The way in which the very
(so-called) "craters," "ring-plains," a
were formed could only be determined, i
the most painstaking accumulation of d
able and efficient head of the section
posed to devote its energies to the st
giant planet Jupiter, Mr. Waugh, h
issued such an excellent series of directi
need add nothing to them: but he earn
that planetary work would by no mea
fined to Jupiter, as questions were
solution in connection with other mem
Solar system which only required united,
and well-directed observation for the
We had, for example, recently been
being told that the periods of rotation

Mercury and Venus were, as in the case
moon, identical. Now, here was a
essentially to be determined by the pos-
of small and moderate telescopes. Every
l observer whom he was addressing knew
narkings or faint details of any sort were
rceived on Venus, it was only with moderate
s. Before finally dismissing the subject of
rvation of members of the Solar system, he
press his regret that no Cometary section
l in the programme. In comets they had
subject in which our knowledge was small
gnorance enormous. Comet-seeking and
y observation generally were peculiarly
he province of the amateur, being a type of
which the enforced routine of a public
ory by no means lent itself. It had a
on all its own, and he commended it to the
ation of beginners anxious to do useful
Passing on to the stellar universe, he found
had sections devoted respectively to Coloured
resided over by our chief English authority
al chromatics, Mr. Franks; on Variable
irected by that equally eminent astronomer,
re: and one on Double Stars under the
of Mr. Tarrant, whose own measures of
jects enjoy so deserved a reputation for
r. His friend, Mr. Espin, *nulli secundus* in
branch of observation, presided over the
devoted to Stellar Spectroscopy, a subject
ly connected with that to be pursued by the
Mr. Franks directed. What might be done in
of observation of variable stars by the aid
nple field-glass has been amply shown by
e and by Major Markwick. Here was a
within the reach of any persevering observer,
xtremely modest equipment needed only
for its adjunct. The last section on the
that devoted to the study of Meteoric
my, which was, as they knew, under the
d competent direction of Mr. Booth; and
ce again, was a fertile source of valuable
nent for young observers, requiring, as its
ion did, no instrumental appliances what-
That meteor streams were in some intimate
nnected with the cometry orbits, and
l in closed curves as defined in their direction
wn path about the sun, seemed fairly well
ed; but there was still a discussion as to
y or mobility of certain radiant points in the
question which could only be ultimately
by long and patient observation. In con-
he remarked that the object of his address
e attained, if he succeeded in interesting
inners among their brotherhood in a single
he subjects he had passed so rapidly in
and induced them to take that subject up
w their whole heart into its investigation.
d been well said, "It is the man at the eye
the instrument to whom we must look for
ults. "Whatever," said a trite proverb,
orth doing, was worth doing well." Let
n and woman among them adopt this as a
principle, and it could not, and would not,
ere the British Astronomical Association
definite and permanent mark in the history
glorious science for whose advancement it
n founded.

Brown's programme of the Solar section
l by Mr. Bartlett, and a supplementary
om Miss Brown was read by Mr. Cottam.

hambers said that he had great faith in the
of an inter-Mercurial planet, and he would
as supplementary to the ordinary solar
ions, that special note should be taken of
, however small, during March and Novem-
n the hypothetical planet would be most
transit the sun.

E. Walter Maunder, referring to Miss
recommendation of Prof. Thomson's discs,
had had occasion to use them, and found
ive the heliographic positions of spots
to within 1°.

'augh's programme of the Jupiter section
l by Dr. Smart.

. M. W. Downing read a paper on the best
of observing eclipses of Jupiter's satellites.
ed out that the usual method of noticing
es when the satellite was first seen on
g from the shadow, and when it attained its
htness was faulty, for many circumstances
erture of the telescope, the character of the
e keenness of the observer's sight—all in-
the result. Besides which, it was just at
o phases that the brightness of the satellite
most slowly. The better way was to ob-
means of a photometer the time when the
was just half-eclipsed, for it was then that
d in brightness most rapidly, and that phase
erefore be determined most accurately.

lex. Freeman said that Mr. Downing had
ribed the instrument necessary for such
ions, but presumed the description would
in the paper as printed. His personal
ce was that the eclipses of the satellites
a very short time. There was only a very
terval between first appearance, half
s and full brightness, so that there could
y great uncertainty about the observation.

Mr. Downing replied that his experience did not correspond with that of the last speaker. He thought that two minutes would be found to be the average time taken by the satellite to emerge from the shadow.

Mr. E. Walter Maunder read a paper on Mars, by Mr. A. Stanley Williams. This was a review of such observations of the past opposition as had yet been published. Of these, amongst the most interesting were a series of photographs of Mars which were obtained with a 13in. telescope stationed on Williams's Peak, California (6,200ft. above the level of the sea). Not only were distinct and identifiable spots and markings well shown on the photographs, but a further important result was obtained. The white polar spot or snow-cap showed a marked enlargement on one photograph over its size as shown on one taken the previous evening. The most probable explanation of the change was that there was a fall of snow or a formation of cloud over an area of two and a half million square miles. Prof. Schiaparelli had also witnessed some extraordinary developments of his "canals." The well-known round black spot, known to the old observers as the "Oculus," and called on Mr. Green's map "Terby Sea," was crossed on one occasion by a narrow bright yellow band. "Herschel II. Strait" of Mr. Green's map, one of the most familiar of markings, was also seen separated into two divisions by a straight bright band. Some of Schiaparelli's "canals" had been observed by Prof. W. H. Pickering, Dr. Terby, and by Mr. Stanley Williams himself.

Mr. N. E. Green, speaking as an artist, expressed great doubts as to the reliability and accuracy of Schiaparelli's drawings of the markings on Mars. His drawings of the larger areas differ in shape, and do not correspond with the average results of other observers, and if the larger objects were figured in so unreliable a manner, how much more doubtful must the more minute drawings be!

The President alluded to the fact that Schiaparelli had described a Martial continent as having been submerged, whilst it has been continuously seen by American observers.

Mr. T. G. Elger's programme of the Lunar Section was read by Mr. Cottam, as secretary, as also Mr. W. S. Franks' programme of the Coloured Star section.

Mr. C. E. Peek inquired whether the tintometer exhibited at the Royal Society a few years ago would be of any practical service in this section?

Mr. J. E. Gore's programme of the Variable Star section was read by the secretary.

Mr. E. Walter Maunder recommended α Orionis for Mr. Gore's observation. It was catalogued as a variable; but very little was known about its variations.

Mr. K. J. Tarrant's programme of Double Stars" was then read, in reference to which

Mr. Downing urged that it was of the utmost importance that the personal error of each observer should be always given. There were various methods of ascertaining this error which it would take too long to detail; but it was absolutely necessary to accuracy that the observer should adopt a systematic position for his head with reference to the line joining the two stars.

Mr. David Booth's programme of the Meteoric section was read by the secretary, who also read a short paper by the Rev. S. J. Johnson, on "Some Early English Astronomical Records."

Mr. Duke, as secretary, read the names of those members who had joined the Association since the general meeting. These were 43 in number, making the total membership up to 327.

Mr. Chambers proposed a hearty vote of thanks to the president for his able and interesting address, and also to the directors of sections for their valuable programmes. Remarking on the necessity and value of sectional work, he reminded the meeting that a large number of double stars had been quite neglected of late years. He would endorse Mr. Maunder's suggestion respecting α Orionis; his own conclusion was that it was not a variable; at any rate, it would repay further observation.

The resolution was seconded by Mr. Perigal, and carried enthusiastically.

Mr. Bartlett desired to make a personal explanation. By some mistake he had been described in the new Oxford Dictionary as a F.R.A.S., whereas he was only a member of the Liverpool Society. He hoped no one would suppose that he has been intentionally sailing under false colours.

The President, in concluding the meeting, emphasised the necessity of stating, with every observation, the aperture and kind of telescope used, and also the magnifying power.

A LATE issue of the Salt Lake City *Tribune* says that there are in operation in that city forty-two miles of electric railway and seven miles of road operated by steam motors. Eight miles more of electric road are building. There is great activity in building, and the real estate transfers in the first nine months of this year were 38 per cent. more than in the whole of 1889.

# SCIENTIFIC NEWS.

THE comet discovered by Prof. Zona, of Palermo, on Nov. 15 (mentioned on p. 267) has been observed from several stations. Dr. Bidschop, of Vienna, calculates that it passed its perihelion about the end of last July. It may be picked up in Perseus by good instruments. Dr. Spitaler's comet does not seem to have been detected since Nov. 16.

Further news of the "comet" stated to have been observed by Mr. Eddie., F.R.A.S., of Grahamstown, is awaited with some curiosity, as it seems to have been observed for about three-quarters of an hour, and then faded away (p. 289). Some mistake seems to have been made in the telegram.

A total eclipse of the sun will take place on Dec. 12, but the central line is visible only from the Southern Ocean. In New Zealand, Tasmania, and portions of Australia a partial eclipse will be visible.

In this month's *Knowledge* Mr. A. C. Ranyard has a paper on the vexed question, "Is the Moon covered with Ice?" accompanied by reproductions of two fine photographs taken by MM. Henry with the 13in. refractor, showing the moon at 240 hours and at 265 hours old.

The death is announced of Mr. Bernard Waymouth, the secretary of Lloyd's Register of British and Foreign Shipping. Mr. Waymouth was mainly responsible for the new rules as to the construction of iron ships which were promulgated in 1870, and in 1873 he was raised to the post of secretary. He served on the Royal Commission on Tonnage, and on that on the loss of the *Atlanta*. Mr. Waymouth was born in 1824, and died suddenly whilst addressing one of the committees at the Board-room of the Registry.

Many of our readers will regret to hear of the death of Mr. Joseph Jewsbury, whose contributions will be found in several volumes. He was an ingenious mechanic, and invented many useful applications, which, owing to the state of the Patent Laws and his retiring disposition, were often more of a loss than a source of profit. He lived to see them fully appreciated, and in some instances re-patented by others. Mr. Jewsbury was born at Oakthorpe, in Derbyshire, but lived mainly in Birmingham, where he died on Nov. 21, in his 73rd year, and where also he was widely known as a musician and an inventor, his most important devices being self-acting machinery for making wood screws, and the internal toothed-wheel arrangement for raising heavy weights.

Dr. Koch has been requested by the German Government not to fully disclose the method of producing the lymph for cure of tuberculosis until such time as adequate quantities can be supplied. A private citizen (said to be Herr von Bleichroder, the banker, and British Consul-General in Berlin) has placed at the disposal of Dr. Koch one million marks (£50,000) for founding a new hospital, and also offered the ground.

Meantime nothing more than is already known as to the nature of the lymph is to be expected from Dr. Koch for some time—not until he has satisfied himself and others as to its efficacy. He is now said to be busy in endeavouring to discover a remedy for diphtheria and other infectious diseases. Dr. Koehler, in a report to the German Society for Promoting Public Health, says that even if the exaggerated expectations which are cherished—especially outside medical circles—are disappointed, Koch's discovery, regarded from the purely scientific and therapeutic point of view, is one of the most important in the whole history of medicine.

It is stated that a successful attempt to reach Siberia by sea has been made, two ships and a tug having gone 160 miles up the Yenisei to Karaoul, and returned to London after an absence of 84 days.

News has been received from the United States that three of the American whaling fleet are wintering at Mackenzie River, having provisions for two years. The vessels are within 1,000 miles of the Pole, the discovery of which, however, is not the object of the owners and crews, who hope to secure a large number of whales as soon as the ice breaks.

Mr. G. J. Symons, F.R.S., says that the late

November had the coldest day out of thirty-two years for which he has records, except 1858, when the temperature fell to 20·1 on the 24th; last month the temperature fell to 20·8 on the 29th.

The City and South London Railway was not opened to the public on the 26th ult., the announcement that it would be so opened being unauthorised. The line has been practically "open" for some time, and trains have been running daily; but it will not be opened to the public until after the final inspection by the Board of Trade.

Prof. Kirchoff, of Halle, in an article speaks of the anxiety with which scientific men looked for the meeting of the International Conference on degree measurement, for observations seemed to show that a decrease in latitude was in process, implying an alteration in the direction of the earth's axis. The fluctuation observed is probably due to a minute oscillation caused by some changes in the internal mass of the planet.

From an American paper we learn that Mr. Edison, when asked whether he thought the present style of telegraphy would soon be done away with, replied, Yes, but not until the old-timers have disappeared. The operators now have a deep-seated prejudice against any inventions that will simplify telegraphy. But some of the inventions have already been made, and it is only a question of time when a man can rush into a telegraph office, scratch off a note to his wife in Chicago, and the exact duplicate of his note will be delivered over the wire to his wife. This will not be all by any means, but maps, pictures (newspaper pictures) will be transmitted promptly by wire. These new inventions will be for the coming generation to see in practical use.

Mr. Delany, of New York, patented a battery-strip for preventing creeping in gravity and Leclanché cells; but would not put it on the market until a thorough trial had been made. The strip is of rubber cloth, and is adjusted to the inside edge of the jar, and effectually kept there by a sticky composition. It thus offers a mechanical obstruction to creeping; the salts form under the edge of the strip, and are redissolved in the battery fluid when water is added to make up for that lost by evaporation.

An arrangement has, it is stated, been made by the White Star and Inman Companies to run their vessels on different dates next year, so as to avoid all suspicion of racing. It will be of public advantage, and the Postmasters of the two countries will no doubt avail themselves of the opportunity to forward more mails. Fast as the modern boats are, the Cunard Co. intend, it is stated, to have two very fast and powerful vessels ready for the Atlantic trade of 1892, when the World's Fair at Chicago will be held.

It is intended to lay a double pneumatic tube between New York and Philadelphia (90 miles), through which letters and small packages will be sent at the rate of four miles a minute. A Mr. Leake is said to have discovered a practical system of switching at intermediate points.

In a newly-devised boiler the tube portion of the ordinary locomotive boiler is made into three sections and combustion chambers, the sections being arranged so as to have the one in advance of the other, and the flue area increasing as the sections recede from the fire-box. Counting the fire-box there are, therefore, three combustion chambers and three section tubes, thus insuring better combustion and a minimum flue temperature.

**Railway Readers.**—A contemporary recently stated that a French medical practitioner has been collecting statistics with regard to those of his patients who complain of nervous affections, and has come to the conclusion that all the evil proceeds from the practice of reading in the train. We can hardly accept this view. Many thousands of business men have no other time than the half or three-quarters of an hour to learn the state of the markets, the last move in the politics of the great Powers, general news, and the various items that make up the ordinary contents of a morning or evening paper, and it would hardly appear that the duration of the cause is sufficient to produce the effects assigned to it, whilst the majority of people travel too rarely and read too little to suffer at all. Our contemporary suggests that a paper with specially large type should be printed for the use of travellers by rail. We fear it would prove of little service. We suggest that all carriages should, as a general rule, be supplied with a better light.—*Lancet.*

# LETTERS TO THE EDITOR.

◆◆◆

*[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]*

*All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

*All Cheques and Post-office Orders to be made payable to* J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

◆◆◆

## PATH OF NEPTUNE.

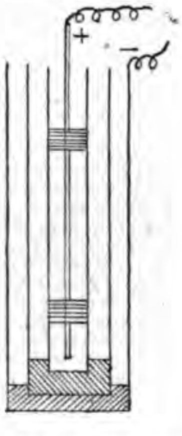
[31842.]—If "Idris, F.R.A.S." (letter 31827, No. 1340), will do me the honour to refer to letter 30546, No. 1286, he will find a map of the path of Neptune up to December 31st, 1890, showing all stars down to 9·5 magnitude in the Durchmusterung scale, which practically answers to about 10¼ in the photometric or ordinary scale of magnitudes. If he wishes to trace the path of Neptune from Dec. 31st, 1890, to March 31st, 1891, he has only to diminish the *Nautical Almanac* places of Neptune by 2m. 6s. in R.A., and by 5½' in Declination, and trace a dotted line as in the map referred to. This will give the place of Neptune with sufficient accuracy for all practical purposes. I believe, from letters which I have received, that the map in question has been of some value to amateur observers.

I shall be pleased, if anyone desires them, to give similar maps of the paths of Uranus and Vesta (the latter at opposition next year is as bright as a 6th magnitude star) during their apparition in 1891; and, later on, of Neptune till Dec. 31, 1892.

**H. S.**

## A FOUR-VOLT CELL?

[31843.]—Being interested in the correspondence now going on *re* 3½-volt dry cell—by the way, rather a heavy voltage for a single pair of elements—it has brought to mind some amusement caused among my friends by a little trick I devised, whereby was produced a cell of over four volts.



In the paper to the Royal Society on the copper-lead storage cell, I described a means of producing high voltage, by arranging plates in grooves, in series, which, on charging, one side of each plate becomes positive, and the other side negative.

This idea, published in 1881, has since then three times been reinvented, and I believe is in the market. But now for the trick.

I constructed three flat lead vessels as A, B, C, each one being ⅜in. less in diam. than the other. The larger had a layer of paraffin wax run in, and whilst hot, the second was bedded in, and, of course, insulated from the outer one. The second one then had a layer of paraffin wax run in it, and the third one bedded in it. A plate of lead, having projecting studs of rubber, was then suspended in inner vessel; before bedding in, the two inner cells on their outer surfaces and plate were amalgamated with mercury. The whole was then charged with sulphate copper saturated solution three parts, water containing one-tenth sulphuric acid one part, and the central plate attached to carbon of five Bunsens in series, the outer vessel being connected to zinc. The plate and outer surfaces of two inner cells become peroxidised, and the inner surfaces of all the vessels have copper deposited in th we get the voltage due to three copper-per lead couples; the same principle can be to the existing type of storage cell or t form. Of course, it is only a trick, but it handy one, as it would require only a f compound cells to put in the ordinary elect circuit, particularly if of the lead peroxide lead type. In the diagram the shaded pa sents paraffin wax. **Henry S**

## PROBABILITIES.—II.

[31844.]—When we wish to judge of th bility of an event happening or failing to we must have certain axioms on which to f judgment, and there are two of them whic necessary and sufficient.

If an event may happen in any one of each being equally likely, and may fail in and if $p$ is the probability of its happenin that of its failing, our first axiom is $p : q ::$

$$\frac{p}{q} = \frac{m}{n} \ldots\ldots\ldots\ldots\ldots\ldots$$

Also, when an event *must* either happe we suppose that the probabilities of its h or failing must together amount to certai if we represent certainty by the numerical we have $p + q = 1$ (Ax. 2.)

If we solve these two equations, we get—

$$p = \frac{m}{m+n},\ q = \frac{n}{m+n} \ldots\ldots\ldots$$

that is, the prob. of an event happenin directly as the number of ways in may happen successfully, and inversel whole number of ways in which it may e If we suppose this whole number to be quantity $c$, we shall have $p = \frac{m}{c}$, and if this becomes when $m = 1$, we have—

$$p = p_1\, m \ldots\ldots\ldots\ldots\ldots\ldots$$

Whence $p_1 = \frac{p}{m}$; or, when an event ma in $m$ ways, each equally likely, the possib it will happen in a specified way is $\frac{p}{m}$ become certainty, and is represented b $p = \frac{1}{m}$.

If we make $m = a + b$, and $m + n = c$, (2) becomes $p = \frac{a+b}{c}$, and the proba happening in one of $a$ ways is $\frac{a}{c}$ of $b$ is $\frac{b}{c}$ and of one or other of $c + b$ it is $\frac{a+}{c}$ sum of the two previous probabilities, bag contains two white, three red, and fo balls, the probability of drawing a white is $\frac{2}{9}$, and of drawing either a white or red is

The probability that two events will *bot* is the product of each of their probabilit P be the probability of their both happenin by the conditions of the problem, it is evi P becomes 0 whenever either $p$ or $q$ do. f an event *cannot* take place, the probabili being so is 0; hence $p$ and $q$ must be fact that is, we may put $P = c\,p\,q$, also when bo *must* succeed, our problem is certain; that $p$ and $q$ are each equal to 1, P becomes therefore $c = 1$, when $P = p\,q \ldots\ldots\ldots$

In like manner, since if $p$ is the proba success, $1-p$ is that of failure, and the pr of both failing together is $(1-p)\,(1-q)$ the probability of an event failing $n$ $(1-p)^n$. And lastly, the probability of o happening while the other fails is $p\,(1-$ $(1-p)$, as the case may be.

These are the chief elementary principl theory, and though they look very sim application of them is often very difficult, the obtaining an expression for the probabi in interpreting it right when we have found example of the latter kind of difficulty will in the case where the right side of equation $p = p_1\, m$, ceases to be an improper fraction.

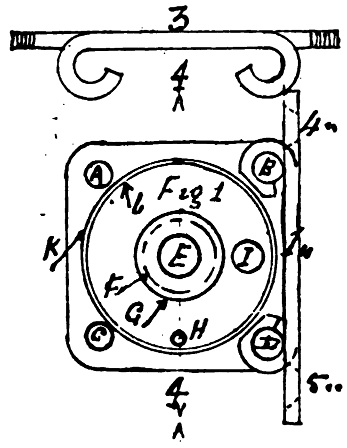
To Mr. Grey.—The probability in qu $\frac{39 \cdot 38}{52 \cdot 51}$ to 20 terms, or, after reduction, $\frac{1}{1828}$

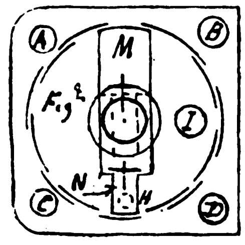
**W.**

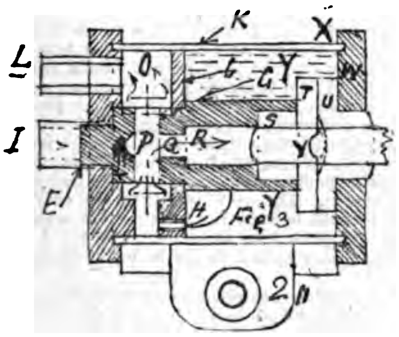
*(To be continued.)*

## AUXILIARY POWER FOR TRIC

[31845.]—Those who have had anythi with small model work know how difficu deal with small pumps and injectors, a want something in a small way to feed ou generator that can be relied upon, I think be found in the following sketch, the whic submerged pump, as it is sealed by the w surrounds it, and therefore prevents any air to prevent its action, and as our quantit for injection is so small, a little matter in that way would put our other affairs to a standstill. The sketch is full size. Fig. 1 consists of a plan of the base, and consists of a piece of rolled plate brass, Muntz metal, or Delta metal, 1¼in. square and ¾in. thick. A B C D are holes drilled and tapped for the bolts to bolt all together, $\frac{3}{16}$in. The hole E is carried right through F recess within an eighth of being through the while. G merely shows the dimensions of shoulders of pump-barrel. H is the suction of bottom valve, and I is the connection from the tank for supply. A B C D is only ⅛in thick full, and the rest turned down for a stop-end J, and to drill this out in the side for the valve boxes, the which refer to section Fig. 2 M N, where I is carried right through, but for H refer to complete section Fig. 3. This is an elevated section in its true position. M is a hole drilled through the side ¼in. full to within ¼in., and then N is ⅛in. continued right through the shoulder, making a seat for the foot valve or section. Over this top end is a piece of triblet tube that is recessed into the bottom that seals all (see K.) Now the barrel of the pump consists of a piece of the same rod metal, ½in. turned







down to the tail piece E to fit well with a shoulder to come up against the recess F, turned down again to the size of the other hole and to the shoulder G. These must be made a good fit, and go home, to seal everything. When this is in its place a bit is put in at O, and the hole P ⅛in. is put through, and the top at O faced off for another valve seat. Now a hole ⅛in. is put through from the face down to P, then a larger one ¼in. bare down to the recess, then recessed out again for packing to S; this packing T consists of a bush made of bone, with a flange to made a tight fit both to the plunger and the rel-pump. This is counter-sunk and crossed h a round file across the face V, and U is another he same material served the same way, that s through the cover W, that is made of a of the same metal recessed for the tube and when bolted on seals all (see ). 1.. 2.. 3.. shows the entablature or method ing up in its place, consisting of a piece of sheet brass, bent over to clip the bolts both nd ends, and bolted by two screws or bolts Now you will see the water enters through . 3) into the body, Y Y goes through the valve at H, up P, and into O, and out at L, you see the pump is surrounded by and by water. The reason why I recommend the building of these things is that there is material in the market to meet the requirements. They are sound and to be relied upon, easily worked, no bother or loss of time in pattern making, and if you make patterns it is impossible to get a reliable casting in more than one, for they are either too spongy, too soft, or distorted; in fact, to make patterns and get castings for such things is utterly waste of time, as I have found to my cost many times; having, after making patterns and waited for castings, had to consign them to the scrap-heap, and found it a great saving of time and temper to get a bit of stuff and dig it out. And as to waste of material in so doing, you can, if your scraps and turnings are clean, always take them back to those you deal with and get an allowance made on the next job you want, or material. At Fig. 3 there is only one ear of the entablature shown. Now don't attempt to make conical-seated valves; get your seat as true as you can, take a piece of hard rod brass and chuck, turn down the pin, and the while it is in the lathe file three flat sides on it, bringing the feathers up to almost a knife-edge; then with a fine tool undercut pin and hood, turn down the hood within $\frac{1}{64}$in. of what you want, then chamfer, and leave the edge just so that you can see it, and take off the worn edge clean, and you will find that if you have followed the instructions, and your lathe good for anything, that you will meet with very little or any trouble. What I have shown there for dimensions I think will be all that will be required. The valves are shown thus + +. **Jack of all Trades.**

## THE HARDENING AND TEMPERING OF STEEL.

[31846.]—In reply to letter 31642, page 103 (and I am sorry that I have not been able to reply before), I beg to refer the writer to *Engineering*, Vol. XXXIII. page 592, where he will find the report of a paper read before the Iron and Steel Institute by G. Woodcock on the mutual relations of carbon and iron in steel. One of the propositions he tried to prove was "That the hardening of steel is due to a metamorphic change in the condition of the carbon, which then assumes a crystalline form analogous to that of the diamond." The whole professes to be a modification of a previous one propounded by Jullien, viz., "that the latent heat effected the crystallisation of the carbon and subsequent hardening."

With regard to the apparent disappearance of carbon in hardened steel, as shown by the Eggertz colour test, I have made a number of experiments upon this point, and find that the carbonaceous matters which separate from hardened and annealed steels in cold dilute nitric acid differ very much in composition. Hardened steel, on the one hand, gives up a precipitate consisting of almost pure carbon; while, on the other, annealed steel yields a precipitate of triferric carbide. Moreover, if equivalent quantities—equivalent in carbon—of these two dissimilar carbonaceous precipitates be taken and dissolved in fresh acid by the aid of heat, it will be found that the quantity extracted from the annealed steel possesses greater colouring power than that from the hardened. Exactly the same thing occurs in the above colour test. So that this apparent disappearance of carbon, as shown by the late Spear Parker (see also *Iron*, May, 1881), and to which diamond theorists attach so much importance, does not by any means prove that *that* amount of carbon has been converted to diamond.

The majority of authenticated facts go to show that *the whole* of the carbon in hardened steel is "fixed"—i.e., it exists there as carbon *per se*, and the above phenomenon as an index of fixation is perfectly valueless. And as to whether the "fixed" carbon is in a crystalline state, as "J. Q." ventures to suggest, all I can say is that I have examined the carbonaceous matter extracted from hardened steel under high powers without perceiving any trace of crystallisation.

"J. Q." asks me to account for the increased coherence of the residue left from hardened steel. I do not see any difficulty there—the microscopic method shows the carbon of the annealed steel as existing in patches, whereas that of the hardened is uniformly disseminated throughout the whole mass of the steel; so that I cannot conceive how the residue—that is, the carbon—from the hardened sample could do otherwise than retain the form of the original drillings.

I am also asked whether I fancy steel to be simply a subcarbide of iron, or an alloy of iron with such a carbide, and to define a limit to the range of the composition of steel, according to the ordinary chemical theory of combination. As to the first question, the proportions of the carbide and the iron will, of course, depend upon the amount of carbon in the steel; the subcarbide must necessarily increase as the percentage of carbon increases. Then I should say, if it be thoroughly established that the carbon in *annealed* steel is present in the form of a certain ferric carbide, then the maximum limit in the annealed condition will be reached when sufficient carbon is added to combine with the whole of the iron, and so form that same ferric carbide. Of course, I am supposing the iron to be theoretically pure, and free from such disturbing elements as silicon, which tends to throw out the carbon in the graphitoid form.

"J. Q." has made a bold attempt to resuscitate an already defunct hypothesis; but he must see that he has no direct experimental evidence, and his *a priori* argument offers little support.

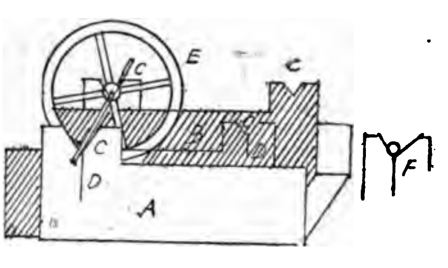
On the contrary, and to recapitulate a few of the arguments in support of the theory of Prof. Roberts-Austin, we have, among others, the following well-attested facts:—(1) The presence of $Fe_3C$ in annealed, and of carbon *per se* in hardened steel; (2) the phenomenon of recalescence; (3) evidences of the passage of iron at 700° C. into an allotropic state; (4) that by suddenly quenching steel after it has fallen somewhat below this temperature, it is possible to keep the carbon as hardening carbon, and yet the steel to remain unhardened. Such are some of the chief links in the chain of evidence upon which this theory is based, and the impartial metallurgist can hardly fail to perceive a logical sequence. **T. M.**

Sheffield, Nov. 29.

## PITCHING CLOCK-WHEELS.

[31847.]—As one who is reading with much interest, though with no practical knowledge of clock-making, the very interesting and practical articles on the construction of a chiming clock now appearing in the "E.M.," may I venture to suggest a method of "pitching" the wheels, which seems to me to offer advantages over the one described last week, in the matter of increased accuracy and saving of time?

My apparatus, which could be made in less than half an hour, is as follows: A B are two pieces of tin about 6in. × 4in., with the ends bent up at right angles, so as to form a sort of trough without ends. B slides nicely inside A, and is equal in width to the space between the clock-plates.



The turned-up ends of A and B are cut as shown; and the arbors of the wheels to be pitched are laid in the notches C C, as shown at E. A and B are then slid in and out until the wheels gear correctly, and the distance from centre to centre is then taken with dividers from the two vertical lines D, D.

Of course care must be taken that the two arbors are quite parallel, and that the sides of the notches C, C *make equal angles* with the vertical lines D, D (not as shown at F), otherwise the lines D, D will not give the direct distances for the centres. **Ursa Minor.**

## SUBSTAGES FOR STUDENTS' MICROSCOPES.

[31848.]—Personally, I am not of the opinion that any good result would follow the appointment of a committee, as suggested by "Microscopist" and Mr. Nelson, for designing a universal students' microscope. My own feeling, indeed, so far as concerns medical students' microscopes, is that almost anything is good enough for their purpose, and when I used the term "students'" I intended a far wider connotation. A medical student has two courses in his curriculum wherein he requires a microscope—first, a three or six months' course of histology; and second, a similar period of so-called practical pathology, including the recognition of the ordinary morbid products in the secretions, &c. Those going in for the higher examinations have to do some biological work in addition, for which a microscope is necessary; but this, once done with, concludes their interest in the subject in the great majority of cases. Any strongly-made instrument, therefore, with the fewest possible arrangements to get out of order, and able to stand the careless, if not rough, usage it is generally subjected to, will suffice for their needs, and there are plenty such already in the market. In some schools the microscopes are furnished by the Laboratory, a fee being charged for their use; and where practicable this seems to me the best plan, as there is a greater uniformity of pattern, and a description of any particular manipulation applies to the whole set. Moreover, in this case they are in charge of a responsible laboratory attendant, and not put away with the front lens of the objectives and the stage covered with balsam or other mess, as frequently happens when the class provide their own instruments.

By "students" I meant all who take an intelligent, far-reaching interest in the structure and interpretation of whatsoever can be submitted to microscopical analysis, and who require, therefore, not the lowest-priced mechanism which competition and sweating can produce, but an instrument thoroughly sound and reliable in its working parts, and one capable of allowing the most to be made of its owner's optical battery, as "Microscopist" puts it. Such an instrument need not be exactly costly, but good work must and should be paid for, and I cannot agree with those who are constantly belauding everything made abroad, and running down our own productions as not only more expensive, but inferior. Continental mechanics work, I believe, for less wages and under conditions such as our own will not accept, and, therefore, are able to undersell us in certain classes of manufactures, including some of the optical; but when we come to such articles as require the highest constructive skill and best materials, I do not find much, if any, difference in the respective prices charged for English and foreign goods.

Erratum.—The rotifer described by Mr. Western at the last meeting of the Quekett Club, should read Dinops (and not Dinos) longipes.

**George C. Karop.**

## SUBSTAGES FOR STUDENTS' MICROSCOPES.

[31849.]—Referring to letters Nos. 31772 and 31821 on substages for student's microscopes, I cannot speak as to the length of time that pivoted substages have been in use; but I can as to the efficiency of Messrs. Watson's combination of pivoted tail-piece, with rack-and-pinion focussing and centring substage, and it compares most favourably with sliding substages having no centring arrangement.

It is not only in America or in Messrs. Swift's instruments that the substage or condenser is made to focus by sliding in a dovetail groove in a fixed tail-piece, but also in nearly all the Continental types of instruments, including Reicherts, Leitz, and even in Zeiss—"Microscopist's" own particular maker.

And further, be it noted, in the high-class instruments, even of these last-named German opticians, there is no provision made for centring the substage condenser. I am speaking of their first-class instruments, made specially for histological and bacteriological research. I do not say they have never made a centring substage, but I do say it is not usual except for photography. Indeed, Zeiss has only recently brought out a centring achromatic condenser for photography which can be centred within its own mount, the substage being still fixed laterally. Now, no fixed substage or tail-piece can be made so accurately as to obviate the necessity for centring screws; yet these are almost exclusively used by the best makers on the Continent. This fact is, I think, a powerful argument in favour of our English makers.

Now about the pivoted tail-piece and substage of Messrs. Watson, the question turns "on the pivot"—Is it a convenience, or is it not? I hold that it is. I think every laboratory teacher will agree that it is an advantage to remove the condenser under certain circumstances; if so, it is certainly less likely to get damaged or put out of the centre when it can be turned aside, than if it were slipped off the tail-piece and put on the table. It is less likely to get damaged by acids, &c., the centring screws are less liable to alteration, and it is certainly much easier to replace in its original position. There is hardly anything more difficult with the instrument in position than to slip a substage into a dovetail groove, more especially in small instruments when in a vertical position.

In the splendid large instruments of the highest type of our best British makers, and the like of which is not made or appreciated on the Continent, it is quite different; there is more space, and they are not used in laboratories, as a rule, for histological or bacteriological work.

Messrs. Watson's tail-piece is certainly pivoted "on one side"; but it is, besides being *rough-centred by a stop-pin*, held accurately in position by the head of that pin, and throughout two years' constant work, both visual and photographical (with their "D" instrument), I have never been annoyed by any untrue movement.

**James More, Jun.**

[31850.]—The spontaneous support of so earnest and practical a microscopist as Mr. E. M. Nelson (31829, p. 290), is a valuable factor on behalf of my suggestion that responsible teachers in medical schools should combine and formulate the *desiderata* of a student's microscope, and that in Mr. G. C. Karop, secretary of the Quekett Microscopical Club, a possible centre of attraction might be found. If, further, Dr. Dallinger, president of the Q.M.C., would signify his approval of the scheme, and join in the formation of a committee, success would be practically assured. The active interest he has shown during many years past in all that relates to the improvement of the microscope, and in the popularisation of microscopy, are too widely known to require more than brief mention; his advocacy of the plan would doubtless largely influence the adhesion of other well-known men whose co-operation would be most desirable.

In view of the formation of such a committee, I think it highly important that the utmost freedom should obtain in their concerted action; and hence it appears to me unwise to fetter them, as Mr. Nelson suggests, by proposing a limit to the price of the microscope they may recommend, or by insisting that no optician shall be invited to co-operate in the design, or by attempting to decide upon a special name for the microscope before it is in fact designed. The committee will have no difficulty in settling such points so far as they may be deemed essential in the task they undertake.

It seems to me, however, that the duties of the committee should not cease with the production of a mere specification, as implied by Mr. Nelson; we must have the microscope itself actually constructed to their satisfaction. A microscope existing only in a specification or on a drawing-board cannot be regarded as a satisfactory outcome of the conferences of the committee. The design may appear admirable on paper, but until the microscope is actually constructed it cannot be properly tested. It is most essential that the committee should superintend the production of the instrument, for that will be the main guarantee that the right standard of workmanship is reached. It might be advisable not to consider the matter closed until the committee are fully assured that the microscope can be issued commercially (1) of the quality approved, and (2) at a price to be named.

If no opticians will voluntarily engage to carry out the specification, we must send round the hat for a guarantee fund, and induce the Editor of the English Mechanic to act as treasurer of the fund, which he would hold at the disposal of the committee.

But is it probable that no opticians will voluntarily engage on the task? They have voluntarily carried out designs recommended by individual patrons; surely, then, they will gladly carry out a design recommended by a strong committee of experts?

Are none of our British makers enterprising enough to risk the required outlay on the development of the design that may be recommended as the Student's Committee Microscope?

**Microscopist.**

## THE REVOLVING NUT — LATHE MATTERS.

[31851.]—When we were discussing the lathe introduced by the London Lathe and Tool Co., several opinions were passed upon the rotary nut upon the lead-screw. One important point was, I think, never referred to. What about returning the saddle so as to drop into the thread correctly in screw-cutting? Everyone accustomed to screw-cutting in the slide-lathe knows how to chalk the change-wheel and face-plate, and by bringing the saddle back by the rack, to get the tool to run into the last cut correctly, even when the pitch being cut is not a multiple of that of the lead-screw; but, with the revolving nut, once you have moved that nut, where are you? Neither with regular pitches nor irregular can you hope to strike into the cut taken last time. If there is an answer to this objection, I should be glad to know of it.

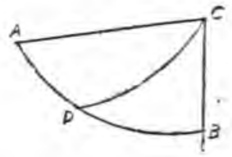
**F. A. M.**

## DRILL-SPINDLES, &c.

[31852.]—In response to "F.A.M." (31792) I offer a few remarks as to drill-spindles, for I gather that he refers to them. "Moulding" drills, cutting on one side only, have therefore a great tendency to vibration which is, I am persuaded, not sufficiently considered and allowed for. Let anyone, who has not already done so, cut a piece of iron upon an anvil and then try to cut it on a plank. In the latter case the chisel edge will be ruined, and the iron not cut. This will give him a good idea of what happens in a degree when, especially in intermittent cutting, a large drill is used in a light drill-spindle.

In olden days amateur work was of a more finical character than now, and the $\frac{9}{16}$ square of the Holtzapffel slide-rest receptacle will not contain a spindle of sufficient size for any but the smaller drills to be used effectively. The larger drills *can be used*, but it takes *three times* as long as when a larger drilling-frame is employed. The drill has to be more frequently sharpened; the cutting is rarely so good owing to vibration, which, with drills of certain patterns, is so great that they will not cut at all, though the same drill in the larger frame (1in. square) will cut as smooth as silk.

As most of us are provided with the small ($\frac{9}{16}$) frame, a few hints may be useful. To minimise vibration (the bane of all light machinery), and obtain the best results, all the apparatus employed must be made to approximate as much as possible to a solid piece; see that the pulley fits without the least shake upon the mandrel; that there is no play in the lathe-collars; tighten up the adjusting screws of the tool receptacle and those of the slide-rest, and as the nut on the main screw is sure to be somewhat worn, adjust the fluting stops so as to prevent any lateral movement; lastly, see that there is no movement endwise in the drill-spindle itself. It is important that the overhead gut should be joined by a small hook and eye, so that there may be no "bump" as it runs round the drill pulley. The slide-rest must, of course, be firmly tightened down, and the binding-screw of the "depth" screw also. All ornamental drills that I have ever seen are wrongly made at the point: instead of being left nearly a quadrant in section like A, C, B, they



are chamfered off on the line C D (I suppose to make them look pretty), and thus materially weakened in their weakest part. Perhaps the greatest difficulty connected with drilling is in preserving the relative proportions of the mouldings on the drill. The best method that I have found at present is to cut several half-holes in the clean edge of a boxwood chuck before I begin to work; these serve as gauges by which to test the shape of the drill during the progress of the work. It will be found that the lower and thinner part of the drill, which does most of the cutting, is worn away long before the upper and thicker part. To remove this material by means of the brass cones fed with oilstone powder would be a very tedious process, so I use a corundum-wheel, 3in. in diam., revolving about 5,000 per minute. The nearer that you approach the axis of the drill the more difficult it becomes to preserve a correct chamfer for the cutting edge. The absence of this is indicated by a rubbed appearance on the work and by (if working on black wood) a deposit of black on the chamfer. If close to the point, it requires very accurate grinding to remove that little piece, *and no more*; but it *must* be done. All straight edges are sharpened on a rapidly revolving Arkansas stone, used nearly dry; this imparts quite a polished edge—good enough for any work. When using an ordinary double-edged drill, examine it with a lens, and sharpen that edge only which is blunted, taking care to sharpen the whole of it so as to preserve the angle at which you started; by just touching the sides of the drill on the side of the stone you keep it thin, sharp, and axial. Too much care cannot be bestowed upon the contour and edge of your drill. The wear of the drill, which in a large piece of work is very appreciable, must be compensated by adjustments of the depth screw.

And now that I have done what I can for "F. A. M." anent the drill, I hope that he or some other of your readers will return the compliment. I paid Holtzapffel £8 15s. for an eccentric cutting-frame, which, *when at zero, is ¾oz. out of balance*, the natural result being that when it is revolved rapidly the whole lathe (though bolted to posts 11in. by 3in., which are sunk 5ft. in concrete) rattles to such an extent that one doesn't like to stop near it. The only assistance and comfort (?) that I could extract from the maker was that I must "submit" to the rattle. Well, I would about as soon submit to go to bed with a rattle-snake!

My intention is to replace the small micrometer-head with a heavy lump of brass graduated and riveted through the square end of the screw; but I shall be glad to hear of a better way out of the difficulty.

**C. C. Ellison.**

## AN IMMENSE RAINFALL.

[31853.]—Naini Tal is a charming sanitarium in the N.W. Himalayas, situated at an elevation of 5,000ft. above sea-level. The summer retreats of English visitors are scattered about the natu
forest which clothes the steep ridges rising from t
clear, deep lake giving its name to the settleme
This beautiful sheet of water is of an oval sha
about three miles in circumference, and
of great depth. This highly favoured
is remarkable for an abnormal rainfall. W
I visited the Tâl, between 30 and 40 y
ago, I witnessed 52 days' downpour, more
less heavy, in succession. I used to change
clothes two or three times in 24 hours. Al
eight years ago a terrible catastrophe occu
many persons, European and native, were wi
any warning entombed in a huge landslip, a
them some of my friends, and there the corp
all who perished still lie, the task of exhun
having been pronounced totally impossible tl
extent and depth of overthrow. A subter
river is said to intersect a considerable por
the lake side. A conspicuous feature of the

ıst landslip of unknown date. In last August was general alarm when 80in. of rain fell in eek, of which 16in. poured down in one day!

**Eos.**

## KBINDING. — SIDEREAL TIME. — OCCULTATIONS.

54.]—The rasp and file may fairly cast the of a book, but the process must, I think, esome, and there seems some danger to ngs along with it. Cutting with a knife will, in the hands of an expert, be unsatisfactory. it some years ago on a vol. of my "E.M.," ound the process lengthy, laborious, and lt, not knowing of the existence of such a ne as the "plough." I contrived a tool r to Fig. 1, which I still use, and find to work

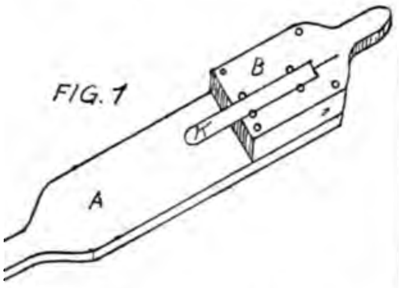


FIG. 1

quickly, and well. A is a piece of hard in. thick, 4in. broad, and 12in. long, left at one end, and cut away at the other 10in. he handle. B is another piece of hardwood, ng by 4in. by 1in., also square at one end and way at the other, and fastened with four upon A, as shown. K is the knife— ally, in my case, a 1in. joiner's chisel, the edges slightly rounded, and the sides d to a level, and held in place by four —part of the head gripping the level, and a cut in the wood 10in. to receive the shoulder,

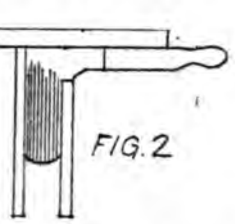


FIG. 2

prevented it slipping back when pressed in g the edge of the work. "Caldemone" will, k, find this tool will do good work for him; his press is a regular bookbinder's one, he put the book he is going to operate upon en two boards, and have their top edges so ed that when the part A of the cutting-tool horizontally on the higher edge, the chisel ıst rest on the lower one, as in Fig. 2. ver saw a bookbinder's press until a short go, and made mine common vice fashion— ieces of beech 3ft. by 8in. by 3in., with one iron screw, which seems, at least to me, to dier than the two screws and constant shifting the handspike from one to the other. To

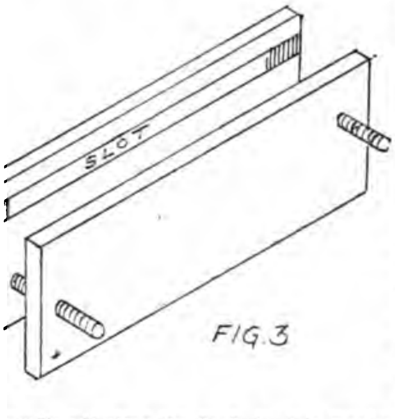


FIG. 3

rouble adjusting the book in this wooden have a frame as represented by Fig. 3. oards, 16in. by 6in. by 1¼in., with two wood pieces glued on to the lower one, and per one movable on them. The lower board lot at the top formed by two short end-pieces and a strip on top, all screwed down. The handle A of the cutter goes through this slot, and works very steadily in it, the chisel moving along the edge of the upper board. I lay this frame on my bench, separate the boards a little, put in the book with a line ruled where I want it cut, adjust this line to the edge of the upper board, squeeze the two boards together, and put the whole in the press and screw up. Fig. 4 is what the whole affair looks like when ready to begin, and any amateur can make one like it with little trouble and a few shillings of expense. I may add, I find I can cut best in one direction—that is, drawing the cutter towards me. A few months ago I had an opportunity of using a brother-amateur's regular bookbinding press, and my opinion is, *quantum valeat*, that my own was the handier.

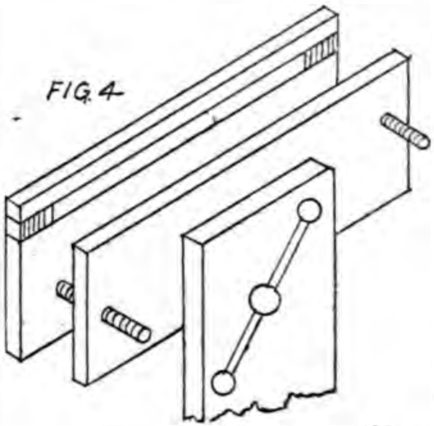


FIG. 4

On looking through a small cyclopædia the other day, which one of my children had bought to enlarge their library, I came upon a method for "travellers and navigators," of finding approximately sidereal time. No doubt it will be known to astronomers as a toy, but thinking it may interest some star-gazers like myself, who have not seen it, I give it.

"Subtract 3 months and 22 days from the date (increased by 12 months if needful), call each month of difference 2 hours, and each day 4 minutes." "If greater accuracy is needed, add to or subtract from the result the numbers of minutes for the appropriate year and month given in the following table."

| Month. | Leap Year. | 1st Year after Leap Year. | 2nd Year after Leap Year. | 3rd Year after Leap Year. |
|---|---|---|---|---|
| January .... | + 4½m. | + 7½m. | + 7 m. | + 8 m. |
| February .... | + 7 ,, | +10 ,, | + 9 ,, | + 6 ,, |
| March ...... | + 2½,, | + ½,, | − ½,, | − 1½,, |
| April ........ | + 3½,, | + 2½,, | + 1½,, | + 1 ,, |
| May ........ | + 2 ,, | + 1 ,, | + 0 ,, | − 1 ,, |
| June ........ | + 4 ,, | + 3 ,, | + 2 ,, | + 1 ,, |
| July ........ | + 2½,, | + 1½,, | + ½,, | − ½,, |
| August ...... | + 4½,, | + 3½,, | + 2½,, | + 1½,, |
| September.... | + 7 ,, | + 6 ,, | + 5 ,, | + 4 ,, |
| October ...... | + 5 ,, | + 4 ,, | + 3 ,, | + 2 ,, |
| November .... | + 7½,, | + 6½,, | + 5½,, | + 4½,, |
| December .... | + 4½,, | + 3½,, | + 2½,, | + 1½,, |

I take an example at random: 11th April, 1876—that is, 4 months, 11 days. Subtracting from this, according to the rule, 3 months 22 days, we get 0 months 19 days. Calling each day 4 minutes, 19 × 4 = 76m. = 1h. 16m. Then, adding the number of minutes for year and month given in table, we get 1h. 16m. + 3½m. = 1h. 19m. 30s. According to "E.M. of 31st March, 1876, the true sidereal time was 1h. 20m. 10·21s.

If the calculation is not too operose, as—rightly or wrongly—I fear it is, will "F.R.A.S." kindly tell me how to find the time of disappearance of a star behind the moon at places differing in latitude and longitude from Greenwich. Very roughly I suppose it could be got in the case of a star disappearing and reappearing in the line of the moon's equator—by dividing the moon's diameter by the distance east or west of the observer's position from Greenwich, and then dividing the period of occultation by the quotient so obtained. Example, 60 miles west of Greenwich :—2160 ÷ 60 = 36; period of occultation, suppose, 60m., 60 ÷ 36 = 1·66m. as the time a person 60 miles west of Greenwich would be later than one at Greenwich in noting the disappearance.

Will "F.R.A.S." also tell me how long before actual will apparent contact of Jupiter and a satellite take place, in the case of a glass that will not divide stars less than 3″ apart.

**J. A. C.**

## ETHER.

[31855.]—There appears to be a general opinion among those of our correspondents who have written on the above subject that the question of the existence of the ether as the medium of electric phenomena requires for its solution a deep knowledge of mathematical processes. I hold that this is a mistaken idea. The problem of the existence of the ether is on much the same footing as that of the existence of metageometrical space. To work out the properties of metageometrical space may require some very profound mathematics; but the simple question of its actual existence is not one of mathematics but of common sense, and one which anyone, whether a mathematician or not, can equally well decide. In the same manner, once the ether has been postulated, the determination of its properties requires mathematical reasoning; but the proof that the ether is something that actually exists is essentially logical, not mathematical. The mathematician and the experimental philosopher are in much the same case with respect to their ability to judge of the conclusiveness of the proof offered. If the ether does exist, we ought to be able to prove that fact by direct inference from experiment, without the aid of mathematics. This consideration has induced me to bring forward the following line of reasoning, tending to show that the ether is an actually existing thing.

We shall take the case of a condenser consisting of a hollow conducting sphere, under which is a smaller conducting insulated sphere, separated from the outer one by a space of air. Such a condenser was used by Faraday in his experiments on specific inductive capacity. In such a condenser there is no "free" charge. The whole of the electric force is manifested in the space between the two spheres. Such a condenser, when charged to some definite potential, contains a store of potential energy. The question is, Where is this energy stored? It is not stored in either of the conducting spheres; for we know that whenever energy in any form enters or leaves a body it produces a change in its physical state. When, for instance, heat enters a body, it either raises its temperature, or liquefies it, or produces a chemical change, or in some other way produces in it a sensible change. Again, when we store energy in a spring, we can only do so by altering its dimensions. When we consider what energy actually is, it is impossible to suppose that energy can either enter or leave a body without producing *some* sensible change in it. But we know that raising or lowering the potential of a body produces no change whatever in any of its properties. When we charge our condenser we produce no change in the physical condition of either the outer or inner conducting sphere. Hence we conclude the potential energy cannot be stored in either of the conducting spheres. For exactly the same reason, the energy cannot be stored either in the space surrounding the outer sphere or inside the inner sphere. This leaves only the space between the two spheres as the place wherein the electric energy can be located. We have supposed this space to be filled with air. We know that energy cannot exist apart from some extended substance which may be said to contain it. We may say, for instance, that a rotating flywheel *contains* a certain amount of kinetic energy, or that a pound of water at a certain temperature contains so much potential energy in the form of heat, or that a mixture of one cubic foot of oxygen and two of hydrogen contain so much potential energy in the form of chemical affinity. Now, the electric energy of the condenser is not contained by the air which fills the space between the spheres. There are two reasons against such a supposition. The first is that if the air in the space between the spheres be blown away and replaced by fresh, the electrification of the condenser remains unaffected. We invariably observe that when any body contains energy in any form it carries its energy with it. A cannon-ball, a can of hot water, a pound of coal, all carry their potential energy with them. If, therefore, the electric energy of the condenser were contained by the air in the space between the spheres, the condenser would lose its charge on a current of air being passed through it. The second reason against the supposition that the air contains the electric energy of the condenser is that the capacity of the condenser is not sensibly affected by the quantity of air in the air-space. Let it be remembered that the electric energy of a condenser is directly proportional to its electrical *capacity*. We may, in fact, look upon capacity as indicating the power of storing energy in the form of electricity. Now, when a substance contains energy in any form, the amount of energy contained in the substance is proportional to the quantity of the substance containing it. 100lb. of coal give out 100 times as much heat as 1lb.; 10 gallons of water at a given temperature contain ten times as much heat as one gallon; a dozen similar watches, when wound up, contain twelve times the amount of potential energy as one watch, and so on. But if we exhaust the air from the air-space of the condenser we are considering, no corresponding diminution of the capacity of the condenser is observed. If the air-space in the condenser measures 1,000 cubic inches, we may remove 999 cubic inches of the air without affecting the electric capacity of the condenser more than 1 per cent. Hence we conclude that the electric energy of the condenser is not contained by the air inside it. The result we have arrived at is, consequently, that the electric energy of the condenser is located in the space between the two spheres, but is not contained by the air in that space. But the only other substance in the air-space is the luminiferous ether, which, since air is transparent, we know must exist in the air-space. Hence we conclude that it is the luminiferous ether that contains the electric energy of the condenser.

It will be seen that the above argument depends for its validity on the postulate that "energy must occupy space"; or as it may be more exactly expressed, "energy is always contained by, or bound up with, an extended substance." The concluding portion of the argument, in which it is inferred that the luminiferous ether is the vehicle that contains the electric energy, illustrates a rule of inductive reasoning of very great generality and wide appli cation. It is this: If any phenomenon can be shown to be due either to a known agent or to an unknown agent, it is assumed to be due the known agent, the unknown agent being treated as non-existent. In the present case the energy of the condenser is ether stored in the ether or in some other unknown medium. The medium of which we know nothing is regarded as non-existent.

G. J. B.

# REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[72284.]—**Cement Kiln.**—If you read the article again you will see what it was meant for—i.e., concrete. Between the two walls, or cobble, instead of brickwork in the mass, there might have been some of it minus, as, being a rapid thinker as well as writer, the two I find very often do not keep time, hence something gets cut short. I am pleased to hear that you are familiar with the form of kiln. The reason you are not successful is that your material is not fit for it. To refractory pure clay, pure chalk, pure silica, why, you cannot have three more refractory materials to deal with. It is scarcely possible for anyone to compete with those manufacturers on the sea borders, or mouths of rivers—as, for instance, the Thames and Medway, which take the cake for quality and quantity, I believe; and the reason: why, they have all the slub from the great metropolis to deal with—in former times more so than now; and these had the chemical aglomeration necessary for the formation of a good cement in the slub on the banks of the Thames ready-made to hand, and in any quantity. Now, what do these consist of? Potash in more forms than one, nitrates, sulphates, iron, silica in its finest form, lime, and things too numerons to mention. The consequence was a fine fusible material, carrying a great quantity of soluble silicate with it, and, not forgetting the aluminum close by and carried up by short seas and the tides from large cliffs of selenitic clay; these fall by the acre and are carried, as I have watched them many times up the Thames and Medway to be deposited at the top of the tides. I have traced this yellow deposit for 16 to 20 miles. When this clay is washed away there are nodes of argillaceous lime that are collected by drag-men and lighters for the making of Roman cement, and in little bays, when the tide is out, will be found beautiful spars and stars of a substance like mica. This is selenite, i.e., sulphate of lime, and with that a lot of material, black, various sizes, some very small like black sand. What is that? you will say. Well, it is a compound of sulphur and iron, bisulphite of iron, or pyrites. This is collected by the poor people that have done it for years. And there are collectors of it, and it is conveyed to a place called the chemical works at Queensbro', and there it is put up in a bank and heats. It is washed occasionally with soft water, and this is collected in a tank; from there taken to pans and concentrators, and crystallised; and goes to the market as copperas, and some of it is burned in kilns for the purpose of making sulphuric acid. Now, some 25 to 30 years ago there was a lot said and written about this cement in the *Engineer*, *Engineering*, and *Building News*. At that time it was in great request, and I think that the cement-makers tried to have it analysed; but to talk about it and do it were two very different things—experiments were made, innumerable quantities of each material to form the pug for cement-making, manner of mixing, firing, &c.; hard, soft, heavy or light, dark or what not, length of time burnt, &c., &c., upon the which, if I recollect right, no two agreed. It was a struggle with them who should take the cake, or the best slice off that that was in the market. Now I would not be at all surprised to hear that these clinkers or materials are more refractory down the Thames than formerly, owing to the sewage scheme being carried out. You cannot get much, if any, soluble silicate out of refractory material, that is certain; therefore if you want a good cement you must study to get a more fusible material for the job. Nitrates, sulphates, and iron, although in infinite proportions barely perceptible by chemical analysis, play a most important part in the silicious material, there is not the least doubt; and the selection of material. If I were to select material for cement-making I should select blue clay. Now, in the basin of clay called the London basin, the which extends beyond Sheppey, just off Sheppey, above Marine Town, there is a bed of silt. I have seen it bored, I think, 50 odd feet, and it brings up in the shell silt, from white to almost all colours of the rainbow; and this lay under the selenitic and blue clay. The tool goes into it like a hot knife into butter. Beyond that I have seen a cliff some 80ft. high go down by the acre, and send up an island about somewhere near an acre and about 20ft. to 30ft. high, from a 100ft. to 150ft. or 200ft. away; the recent October gales, with a short sea, sweeping the lot away. Some acres to the tune of a hundred or two have gone this last 40 years. If this silt was a lake of it inland, what a godsend it would be to the cement-makers on that coast. The reason our lime was so rich in silica was, we never went in for more than a quarter charge of lime upon that of bricks, and in charging some bushels of sand would go down when we have been charged with bricks alone. I have been somewhat astonished at the sand I have had to clear out of fire-race before lighting up. It is said that in some chalks potash is found. This might have been the case with our grey chalk, as it was always wet, as in some parts of the country stone shale is always reeking with moisture. Now, the black stone sometimes found in lime-burning is when you have a good heat, and a piece of sulphate of iron comes in contact with some silica or silicate of alumina—i.e., clay; and if these are broken they may be traced. I know that brick clinkers and cement clinkers are two different things; but the heat that would reduce a good brick should make a cement material run like water. I am afraid I am taking up too much space, so must bring this to a close. Publish address; may be able to help.

Jack of All Trades.

[72658.]—**Electric Lighter.**—Mr. M. somewhat bullies our querist, but does not tell him how to "hold properly" his lighter. One spark, if in the right place, will light the gas; that place is where the top of the flame will be when alight—say about 2in. above the jet. I had some difficulty in teaching my servants this, for they would try to light as with a match. Now no matches are used.

F. G. Ll.

[72685.]—**Yew.**—I cannot understand the replies given to this query on p. 194. "Jack of All Trades" implies that the wood is of little value—he "never saw any sound"; while "Sekon" says the wood "costs about 5s. per cubic foot," say 50lb. in weight. The wood is really hard and of a fine, close grain, flexible, and almost everlasting, of a fine orange red or deep brown, except the sapwood, which is white, but is hard also. In Le Maout and Decaisne's "Botany," the wood of the yew (Taxus) is said to be "hard and capable of receiving a high polish," and is much valued in cabinet-work, to which Dr. Hooker adds, "and for making bows." Please enlighten, those who can.

Nun. Dor.

[72695.]—**Landing Piers.**—One of the longest piers in England is that at Southend, which has a railway on it, but is scarcely a landing pier in the sense understood, although the boats do land passengers there. If the querist requires information of a technical character, I think there is a work by Mr. Harcourt on harbours, docks, and piers, which will probably suit him.

T. M.

[72706.]—**Speeding Pulleys.**—What does a "Poor Mechanic" mean? There is no book specially devoted to the subject indicated; but the rules are to be found in all the textbooks of mechanical engineering, and also many times repeated in the "E.M." Multiply the velocity of the driving-pulley by the diameter of that pulley; divide the product by the diameter of the driven pulley, and the quotient gives the velocity of the driven pulley. See Molesworth's "Pocket-book," Templeton, and sundry other textbooks or collections of rules.

Mekanikos.

[72709.]—**Naphtha Launches.**—The querist must await further developments of the naphtha launches, as there are necessarily many little details to attend to, which cannot well be settled without experiment. As to whether they are suitable for sea-work, there seems no reason why they should not be, and they are easily worked.

T. M.

[72710.]—**Leaves of Plants and Trees.**—Are leaves of trees and plants extra thick when growing near the seashore? If so, will the querist kindly specify which trees and plants he means?

Hortus.

[72733.]—**Dyeing Floss Silk.**—"A. B. A." can dye floss silk in just the same way as he can dye ribbon or other silk; but possibly the aniline dyes will be the best for him to use. He does not specify any particular colour, nor hint at any special difficulty.

Vat.

[72789.]—**Diamonds.**—"Norfolk Horologist" says that if "Nemo" be experimenting on the artificial production of diamonds, and meets with success, he, "N. H.," hopes that he, "Nemo," will not be slow in publishing results. If "Nemo" be wise, he will be exceedingly slow in making common property a knowledge of a successful method. To publish results immediately would be to throw away the value of a discovery whose pecuniary worth would be enormous. The experiments made by Hannay seem to show that the gem can be produced with great difficulty; the process was centainly not very easy, and I understand it was never really tried on a large scale. The danger could easily be avoided by proper precautions. Of course, directly Hannay published his results the newspapers got hold of them, and utterly ignorant persons wrote all sorts of rubbish; just as some are now doing concerning the recent researches of Dr. Koch. It must be borne in mind that an imitation of the original way in which diamonds have been formed—even if we knew it, which is not the case—is not necessarily the way to obtain them in the laboratory. Artificial alizarine is made by a very different process from that by which the natural product was produced, and probably the method which finally succeeds as a means of crystallising carbon will not be the same—it may not even be similar to the method by which the gem has been formed in nature. There is nothing essentially impossible in the artificial production of diamonds. The problem is not like, for instance, the reduction of alumina by means of carbon, which is not possible according to the laws of the conservation of energy. No known natural law asserts, even in the most roundabout way, the impossibility of crystallising the organic element carbon; and that the element will be made to crystallise sooner or later is a very safe prediction.

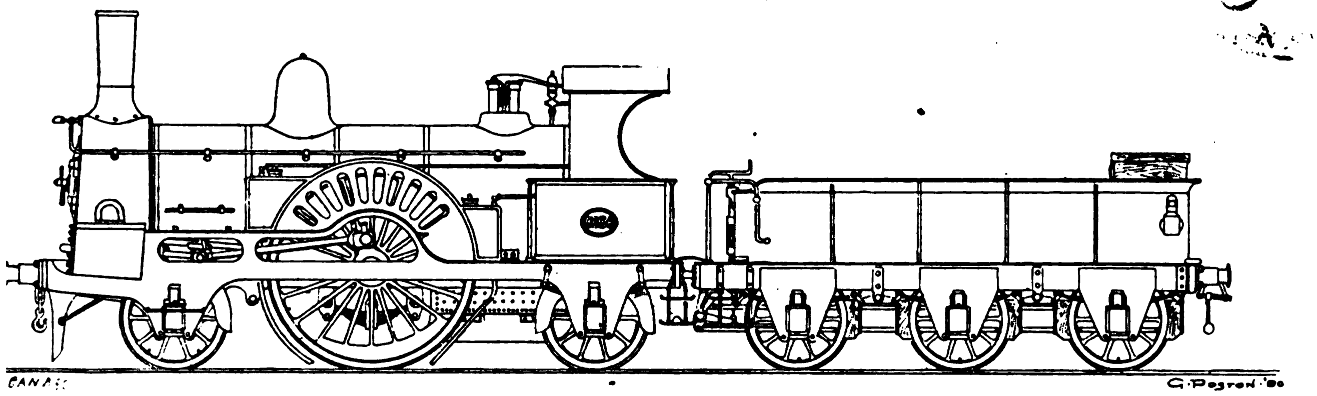
Wm. John Grey, F.C.S.

Analytical Chemist, Newcastle-on-Tyne.

[72789.]—**Diamonds.**—To Wm. John Grey, F.C.S.—As you ask for communications in referto the manner in which diamonds might be formed, I would suggest the following. Liquefy one of the following basylous radicals, viz.:—Methyl ($CH_3$), ethyl ($C_2H_5$), propyl ($C_3H_7$), butyl ($C_4H_9$), amyl ($C_5H_{11}$), caproyl ($C_6H_{13}$), or Marsh-gas ($CH_3H$), (the hydride of methyl), or one of the many compounds of hydrogen and carbon alone, by means of pressure or intense cold, in a strong platinum or palladium chamber, which contains an insulated platinum plate. Then try and decompose the liquid by means of a suitable current of electricity by connecting the insulated plate to that pole of the current which would liberate the carbon, and the chamber to the pole which would liberate the hydrogen. Then, providing the liquid was a sufficiently good conductor, and could be decomposed (electrically) the result would be that the carbon would be liberated on the plate either in the form of powder, as in graphite, or in the form of a crystal as in the diamond, and the hydrogen would be liberated on the sides of the chamber, through which it would be occluded, as platinum and palladium possess the power of occluding hydrogen gas. The strength of the current required would require to be ascertained by experiment, and the rapidity of the decomposition would have to be adjusted so that the hydrogen gas could be occluded as fast as it was liberated. Perhaps the gas containing the greatest amount of carbon and the least amount of hydrogen would be the most suitable to use. The insulating of the platinum-plate in the chamber so that it could be connected up to the source of supply of current may prove somewhat difficult on account of the great pressure it would have to withstand; but I believe it could be overcome by fixing the connection-wire in a thick plug of glass, which would be hermetically sealed in the cylinder. Perhaps some other substance than platinum or palladium could be used for the containing-chamber which would have the power of occluding the liberated hydrogen gas. Perhaps the manner in which the carbon would be set free on the plate would be affected by the time the decomposition takes, as I think that a crystal wou be more apt to form if the decomposition was ver slow. The experiment would be somewhat expe sive to try. Perhaps some information in conne tion with this subject, and the formation of ge &c., could be obtained from a work entitl "Memoirs of Andrew Cross, the Electrician" my memory serves me right). I would be to have your opinion of the above.

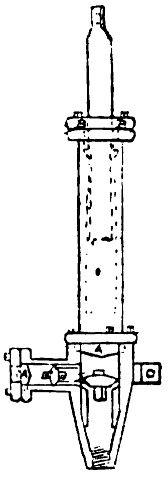
New South Wales. W. Drowley Filme

[72803.]—**G.E.R. Single Locomotives.**— above sketch represents the class of loco. to w "North-Western" refers, only that the nur he mentions—viz., 0275—was rebuilt some time with the substitution of bogie for leading wh This engine was designed and constructed by R Sinclair in or about 1859. Some years later it altered by Samuel W. Johnson, and aga



3romley. The motion is of Mr. Gooch's y box-link type. The principal dimensions llows: Diam. of driving-wheels, 7ft. 3in.; and trailing, 3ft. 9in. Wheel base 15ft., :hus: From leading to driving, 7ft.; from to trailing, 8ft.; length of boiler-barrel, .; diam., 4ft. 2in.; height of centre above :. 8¼in.; length of firebox shell, 5ft. 5in.; 13, 1⅜in. diam. externally. The bogie wheels ire 3ft. 3in. in diam., and 6ft. apart centres, ı to driving-wheel centre 9ft. 6in. The 'heels are 3ft. 8½in., with 5ft. 8½in. centres; of tanks 2,000gals. G. POSTON.

.]—**Pump.**—I inclose drawing of a force n pump of the size you mention, which :ceedingly well. Cornish valves with brass



coned). A A are guard bars to fix clacks, ing-box gland. See Exchange Column.
(CHISEL) WELL-BORER.

.]—**Canal Boat.**—"Caldemore" is quite The boats A and B travelling in opposite s, each at a speed of three miles an hour, s that if the jumper ran along the deck of direction of B's motion) at the speed of an hour, he would cancel the motion of d could jump from A to B as if both boats tionary; or, to put it another way, sup- ie jumper noticed a chalk mark on B, and g the deck of A, keeping pace with the ırk (or any other mark), the same result tain. F. M.

]—**Portable Engine Tubes.**—"One ' should take out the tubes, cut one or two or 6in. lengths, close end of tubes, place gth over ½in., well braze, cut tube to right eplace again. M. W. S.

]—**Boring Taper Holes.**—If the size of will admit the cutter, I should drill to nall end and cut the taper with my slide- ch has its upper slide on a swivel, and is with an index and divided plate, so that set without difficulty to any angle.
HORO.

]—**Boring Taper Hole.**—I have just ⅜in. to $\frac{1}{16}$in. ⅜in. long without any diffi- t probably in a clumsy way. I, being an first drilled with a ¼in. drill about ¼in. n deeper with a ⅛in. drill; lastly with a l. I then turned a piece of ⅜in. rod to the taper, then filed half of it away to form a d hardened and tempered it, and rimered to the taper without any difficulty.
J. W.

] — **Muslin Stamping.** — Thanks to All Trades" for his reply. I thought I had expressed pretty clearly what I wanted. How advertising my address would help I do not see. What I wanted was, and is, to know how and in what to make the mould for such stamps. I was thinking of trying equal parts of founders' sand and potters' clay, and if this does not succeed, I shall try the pumice-stone powder and pipeclay. It will not do to make the stamp of bent brass, as I wish to bend it to a circle and mount on a wheel, arranging an inking-wheel to work on it, so that the stamping can go on continuously. I thought of using sheet lead, bent to shape to form the mould with in the sand—it is so much easier bent and cut to shape than brass, and the sides could be so easily bevelled to make it deliver easily from the sand; but the stamps I have seen seem to have been cast without bevel. WRITER.

[72960.]—**Equation.**—I fail to understand how W. C. Jocelyn arrives at his result. Let me quote from his reply:—

"$A - x - y : B - x - y : B - A :: 35{\cdot}37 : 47{\cdot}91 : 12{\cdot}54$."

So far so good. The next step is a decided mistake.

"$12{\cdot}54\ (A - x - y) = 47{\cdot}91\ (B - x - y) = 35{\cdot}37\ (B - A)$."

This is a mathematical untruth. Let me illustrate.

$$12 : 10 : 8 :: 6 : 5 : 4.$$

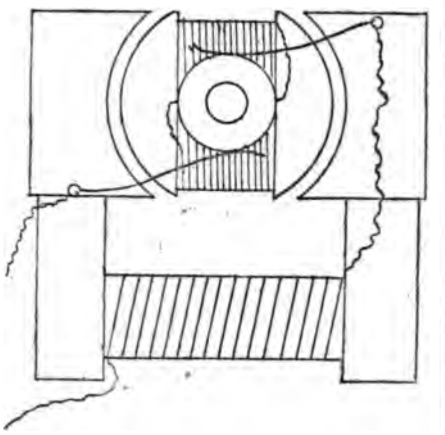
Therefore, says Jocelyn—

$$12 \times 4 = 10 \times 5 = 6 \times 8$$

which is absurd. W. C. Jocelyn has solved two equations for three unknowns—an impossibility.
ASSOC. N.S.S.

[72963.]—**Atmospheric Pressure.**—A siphon barometer is one in which the variation of vacuum is produced by mechanical means, or by condensation of steam. The greater the vacuum—i.e., the nearer it approaches the Toricellian vacuum of the ordinary mercurial barometer, the greater play of the outside air on the mercury. Hence it rises. If the vacuum gets less, then there is more air-pressure on the mercury in the long tube (at the top of it) to counteract the pressure of the outside air.
X. Y. Z.

[72974.]—**Electromotor for Model Boat.**—To MR. BOTTONE.—You will get very little motive power out of 12 volts 2 ampères—about ⅙ of a man-power at best. I annex sketch of motor and its

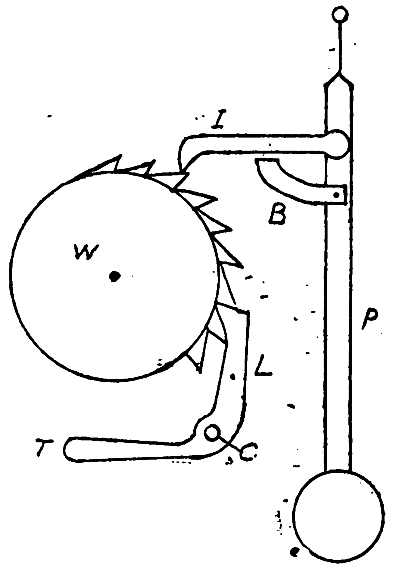


connections. The armature should be wound with 6oz. No. 22, and the field-magnet with about 1lb. No. 18, connected up in series with the armature. The motor can be used upside down if the propeller shaft is low in the boat. S. BOTTONE.

[72971.]—**Magic Lantern.**—I have seen, heard, and experienced a good deal of the working of oil-lamps in optical lanterns during the past twelve years, and, in my opinion, three and four wicks are a mistake. They give more heat and glare, but less steady, concentrated, and defining light than a good two-wick lamp. I have seen no all-round results to equal those of the two-wick lamp supplied with the improved Sciopticon. The ends of the lamp are fitted with circular glasses, which are, therefore, evenly heated all over, and liability to crack is almost *nil*. The glasses in mine have been used some scores of times during the last six or seven years, and have never cracked. Of course, I turn the wicks up gradually and evenly. I would advise your correspondent to end his troubles by fitting his lantern with one of the Sciopticon lamps.
REV. JAMES M. RUSSELL.
Hexham, Northumberland, Nov. 22.

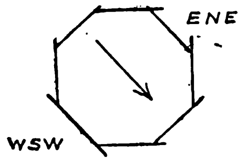
[72973.]—**Manufactured Jewels.**—I saw some crystals at the Paris Exhibition. They were splendid, and shown (some also in the crucibles in which they were made) cut and mounted. They were clear, good size; they were not small like the manufactured diamonds. I know there was much written about it in "Ours" at the time.
Z. Y. X.

[72976.]—**Wheel Driven by Pendulum.**—W is the wheel having ratchet teeth. P is the pendulum, I is the impulse pallet loosely pivoted on P and supported by B when not engaged with W



on the backward swing of the pendulum, during which the wheel W is prevented from returning by the locking pallet L pivoted at C and weighted or controlled by a spring at T. HORO.

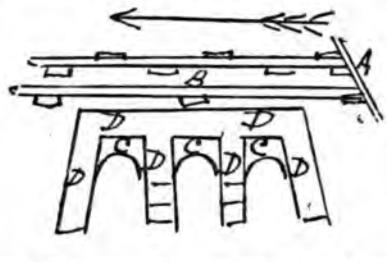
[72980.]—**Tower Roof-Ridging.** — Spires as steep as "A. B. T." represents require no ridging to keep out the wet. Cut both edges of the W.S.W. slates, and one edge of each of the others,



except the E.N.E., one, to project an inch over the adjoining one. A plan of any octagon being like this. To look well, its visible sides should be all equal, requiring the plan lengthened a little in the direction of the arrow. E. L. G.

[72984.]—**Railway Bridge.**—There is no advantage in making separate blocks. Four rings of the bricks, one over the other, will answer as well, and need less centring. E. L. G.

[72984.]—**Railway Bridge.**—You do not say whether you want to hug your stream, or whether there is any right of way to be provided for, what the foundation is like. You might prepare your blocks, and place them and lay, and fill with concrete. You have not stated the width. If you are going to hug the stream, put a weather waling in at angle 45 up-stream, joggled into the bank; then put another waling against bank, with piles, and another planking about a foot away, with piles, and fill between with some good clay and some old, rotten hackle straw well rammed down; then carry out the excavation 3ft. below bed of stream, and lay the foundation in as per sketch. A, weather waling; B, waling against bank for dam; D, walls; C, concrete the foundation to be got out to E E E, not disturbing the bank more than you can help; carry the concrete up to the skew backs. If you go in for a segment, do not go in for more than $\frac{2}{3}$ of a circle. JACK OF ALL TRADES.



[72987.]—**Gravity Electric Clock.**—A small weight falling against a pendulum could supply the motive-power; but it would have to fall more than once in 30 seconds: otherwise you would have to give it such an impulse to start with that you would get no time out of it at all. The energy of a pendulum is taken from it in little pieces, and should be restored in the same manner, not once all of a lump. The frequency of the impulse would be determined by the work the pendulum does in moving on the train of counters. A weighted lever, pivoted, and having at its other end a catch, would serve to retain the pendulum weight, and the catch might be depressed in order that the weight might fall by a lever moved by a pin in a suitable wheel of the train—on top of the clock frame, say. The idea is ingenious, but too delicate to be certain in its action, I think. The clock would have a lot of work to do in disengaging the weight. The weight being uniform and always falling the same distance, is but one factor. The pendulum must not swing out too much, or else you get a large circular error. Any fairly constant cell would do, chromic-acid, say. For the weight an electro-magnet with an automatic make-and-break controlled by the weight rod would be best, I think.

CHARLES A. JONES.

[72992.]—**Purifying Vitriol.**—There are only two ways of purifying it. Making hot and passing hydrochloric acid gas, to get rid of the arsenic; and by distillation. JACK OF ALL TRADES.

[72999.]—**Colliery Pumping Machine.**—"One in Charge" does not give character of his Cornish valve facings; if flat, at least 2in. wide, setting on down stroke on, of course, a 2in. facing, he may, with advantage, allow at least $\frac{3}{4}$in. lift. He would find it of very great advantage if he fixed a best tanned hide washer under each valve. This washer should be a disc slightly larger than the valve, and fixed by an iron ring with set-screws, the ring being slightly smaller than the water passage under valve. (CHISEL) WELL-BORER.

[73000.]—**Electric Light.**—"W. L." is a little mixed in his ideas. To light a lamp you require no coil; connect the lamp direct to battery, and should it be a 2 or 3 volt lamp, it will light very well. By inserting a coil of wire in the circuit you are wasting current. H. H. HEADWORTH.

[73008.]—**Boring Pistol-Barrel.**—I am sorry I did not see your query in time to answer in this week's "E. M." I would advise you, as an amateur, to bore your barrel from both ends: I mean, bore half-way from one end, and then reverse and meet the hole from the other end. You must take care and centre both ends as correctly as possible. Have a turned drill, and make sure it runs as true as possible; then, with one centre against your back centre and the other to your drill, just drill about half-way; then reverse your barrel, and drill the other half. Possibly the two holes may not exactly meet; but to rectify that, have your drill a little smaller than you intend the size of the bore to be when finished. Of course, you will understand that in the trade there are special machines, &c., for this kind of work; but I am endeavouring to give you instructions to do yours with what is at your command. Now you can devise some means of holding the barrel while being drilled. In fact, you might do it with your hand; but a hand-vice, or any other means, it will not require much holding. Now, as is most likely, the two holes will not meet exactly; you can nicely remedy that by having a turned reamer made with only two flats filed on it, the remainder left plain. If you do not understand the kind of reamer (or rimer, as they are called in the trade), I will, if you publish your address, send you one, when no doubt from it as a pattern you can make one for yourself. The reason I advise you to bore your barrel from both ends is because I think it is the safest for an amateur; but permit me to tell you that there are other ways. If you have a slide-rest to your lathe, you may fix your barrel in the lathe and fix your drill in the rest; or you can reverse matters, and fix the barrel in the rest and have the drill in the lathe. In any case you ought to get on all right. In any case have your drill smaller by at least ·02 than you intend the bore to be. Now you want a lubricant for drilling. Use soapy water, unless your steel is very hard, then I would say oil; any kind of oil will do. You say, how to properly adjust the sights? Now, I beg to tell you that in the case of saloon pistols there is no such thing as adjusting the sights, and, as a rule, there is only one sight, and that a mere bead near the muzzle. This sight is placed near the end, and I can assure you there is no rule for it. You may screw it in, as a rule, about $\frac{1}{2}$in. from the end. But when I put them on I dove-tail the fore-sight on. If you want a back-sight, place it 2in. from the joint of the breech, and dove-tail it in. Should you want any more information, don't stick at asking. I hope you will succeed. ARMOURER.

[73008.]—**Boring Pistol Barrel.**—After having squared both ends of your steel, find the true centre at both ends by means of a scribing gauge, either on a surface plate, or the lathe bed, mark, and centre punch; then drill a small hole at both ends, 1in deep and about $\frac{3}{32}$in. diam. It will now be necessary (if, as I presume, it is a breech-loader) to let in your lump on one of the flats of the octagon, as per accompanying sketch No. 1. This having been well dovetailed, you next proceed to braze it with hard brass spelter, using borax as your flux. After it has been brazed, the steel should be placed in a clear fire to anneal, and allowed to remain there till cold. You now, after cleaning away from the breech any scale or superfluous brass, proceed to open up the breech and muzzle ends, 1in. in depth each time, with a twist drill, which should be about $\frac{1}{30}$th smaller than the size of bore when finished. The drill must be more than half the length of the steel, so that the last inch drilled will complete the aperture from breech to muzzle. The next operation is what is termed "fine boring," and must be done by a square bit, which should be 2in. longer than your steel. The point should be tapered a little, so as to allow it to enter the bore; the cutting part of the bit, $2\frac{1}{2}$in. long, the last 2in. of which must be perfectly cylindrical. Care must be taken that the cutting edges of the cylindrical part of the bit are not too keen, else they are apt to cut too fast and tear. A slow speed must be employed for this operation, and the bit occasionally taken out and cleaned of cuttings. Plenty of clean oil or soapsuds should be used. The barrel is fed to the bit gently by the back centre as far as possible, or, if you can manage to pack it true in the slide-rest, that do even better. Sighting.—Cut a dovetail the top of the barrel $1\frac{1}{4}$in. from the breech e let the sight in from left to right (lookin breech end), leaving the dovetail tight eno allow of the sight being driven in. The he the back sight will depend on the height of th sight. Drill a small hole as nearly can measure above the axis of the bore, and Screw a piece of steel wire into it. Don through into the bore. Leave the wire long to admit of filing shorter. Cut a small V middle of the back sight, and try a few shots distance you intend to use the pistol, and if it low, reduce the height of the front sight unti the spot aimed at. If it shoots to the right move your backsight accordingly to the reve a little until it is correct; file or turn a sma on the tip of the front sight. Should you de further information, write through these colu

Edinburgh. FABRICANT D'A

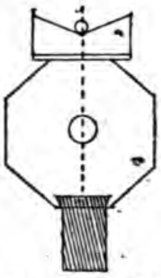


FIG. 1.—Showing how Lump is let in and Position of Back sight; also, how to Take Aim with Front sight.

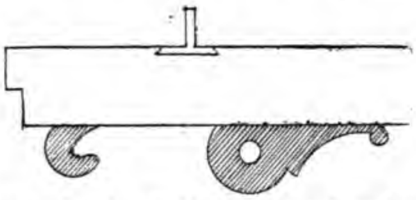
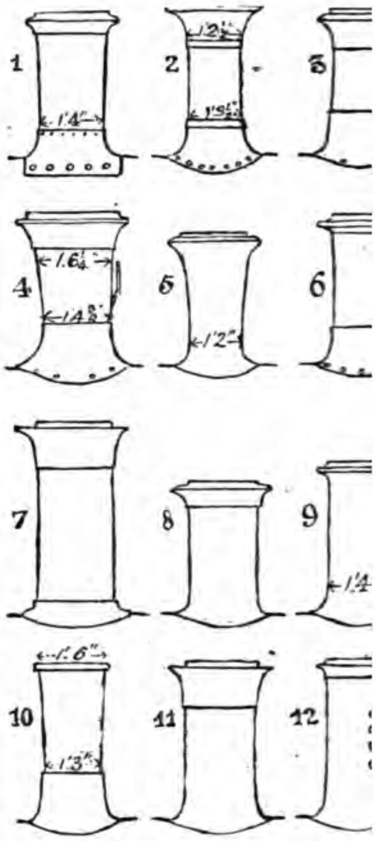


FIG. 2.—Showing Finished Lump and mode of letting in Back sight, and Position of same.

[73012.]—**From "Jack of All Trade** thought everyone knew what a flicking co I suppose the query was to clean brushes washing them—i.e., with damp sharp san ordinary large comb, I expect.

JACK OF ALL TR

[73015.]—**Locomotive Funnels.**—I send types of the principal railways. No. 1 re the standard type of North-Western; usual of top from rail 13ft. $1\frac{1}{4}$in. No. 2 is the Midla nel on Mr. Kirtley's engines, usual height 13 No. 3 is of Mr. Johnson's, the standard type. No. 4 is a Great Northern, usual 13ft. 4in. No. 5 is a Worsdell funnel, on the Eastern, height 13ft. and 13ft. 1in. No. Manchester, Sheffield, and Lincoln. No. 7



of the original broad-gauge G.W.R. No. standard narrow-gauge type G.W.R., heig presses) 12ft. $10\frac{1}{2}$. No 9 is one of the South- bogie express funnels, height 13ft. 4in. N one of Mr. Adams's funnels, S.W.R., (express) 13ft. $2\frac{3}{4}$in. No. 11 is a Bright No. 12 a Highland. The Great-Eastern fun very similar to No. 10, but shorter and small

C. F. DENDY MAR

[73019.]—**Watch Movements.**—Very p the cause of the watch's not going, or ceasi very soon, is due to the fault of the pivot balance not being made long enough, so t do not act fully on the endstones, or cease after a little wearing down. With the en off, the weight of the balance should m pivots protrude substantially through the holes. The balances also might not be fitt enough. WATCH FIN

[73019.]—**Watch Movements.**—To suitable reply in this case, it would first b sary to know what amount of knowl uerist possesses in regard to watchmaking. Perhaps the only legitimate answer would be to ecommend to him the machine-made watches, such is the Walthams, in which necessarily there is little variation in the standard of excellence, and in which the pivots of hard, tempered steel are made n the twinkling of an eye. It is likely enough hat in the near future machine-made watches will have generally superseded the others. Assuming, however, the querist to be but an amateur, the following hints may be of service to him in seeking for a Geneva watch that will not be liable to stop going, and sometimes in remedying the stopping. Take the movement out of the case and hold it close o the ear, and in different positions in order to hear whether there be any scraping or rubbing noise, such as would be caused by foul contact among its parts. Then hold the movement with the ¾-plate undermost, and see that the hairspring does not ouch the centre wheel. Proceed next to take the movement to pieces, first taking off the dial and hen letting down the mainspring—in doing which he click of the barrel-ratchet is to be pushed back with a peg held in the mouth, as the two hands are hardly sufficient for this purpose. When removing he balance-cock from the plate, always push it up by driving a needle into the notch in the under surface of the cock. With nothing but the balance remaining in its place, examine carefully the position and form of the hairspring, and in particular see that it does not touch any of the three arms of the balance, and that the collet does not touch either of the jewel-screws when the movement is turned upside down. Now turn round the balance as far as it can go, and let it swing freely—first having one plate uppermost and then the other—and if it be well and freely fitted, the vibrations will reach a high number in both cases. Having removed the balance, next take the 'scape-wheel in hand, and proceed to try its freedom of motion in the jewel-holes, and this is done by simply blowing upon it from the mouth, for if it be sufficiently free, the force of one's breadth will keep it rotating some instants. I have sometimes improved the going of a watch by taking a fragment of Arkansas stone, or a ruby file, and rounding off the edges of the outer sides of the triangular "pallets" of the scape-wheel, thus diminishing the friction in the action between those pallets and the cylinder. The acting part of the cylinder is cut away to one half, and below this it is cut away in a greater degree—to about one-fourth—in order to allow the balance to have full swing. The width of this lower cutting is often too narrow in the cylinders as they come from the shops, because it would be well to have it fully equal to the height of the pallets above the rim of the 'scape-wheel, so that the wheel would admit of being put sideways into the cutting. By observing the cylinder with a magnifying glass, a circular streak will be observed, inside and outside, where the pallets of the 'scape-wheel act upon it, and the height of this streak above the edge of the lower cutting should properly be one-half the height of the pallets above the rim of the 'scape-wheel. In remedying the escapement, it is sometimes necessary to move the plugs (of which the pivots form a part) up or down a little in the cylinder, and for this purpose it is requisite to have a "riveting stake" and peculiar punches. If the hairspring be unpinned in the collet or stud, make a new pin by filing down the end of a piece of brass wire; but, before cutting it off, try its fitness by putting a bit of hairspring into the hole, and pushing in the fine end of the wire, then trying whether the wire cannot easily be withdrawn from the hole, for if it can, it must be retouched with the file until it holds fast. In examining a second-hand watch it is essential to know whether the balance pivots have been worn down, and accordingly take off the endstone jewels, and see then whether the pivots will project sufficiently through the jewel-holes. Those pivots are often made too short in Genevas, and more frequently so in levers, and in the latter are often, moreover, much too conical, and sometimes too thin. The wearing away of the conical balance pivots in a lever watch is generally indicated by its action falling off, and finally stopping. In my opinion, the long duration of a watch depends mainly on having the balance pivots made of hard-tempered steel which will not wear away, and having them also of sufficient length, and, in Genevas, on having also the cylinder made of hard steel, because the harder is the less the friction will be; and sometimes in soft cylinders the 'scape-wheel even wears a groove into the metal, thereby increasing the amount of friction. Hence an amateur who has plenty of time at his disposal can prolong the existence of a Geneva watch by drilling holes into the cylinder plugs and inserting therein pivots of much harder steel than the substance of those plugs. A needle of the hardest steel can readily be reduced to any degree of thinness by placing it horizontally on the of a small vessel filled with aquafortis and spirit lt, and turning the needle round; but afterwards all traces of the acid must be thoroughly removed, or else it will rapidly corrode away.

Schloss Schwerin.

[73023.]—**Piano Dampers.**—To Mr. Schucht Mr. Davies.—I should esteem it a great favour if you could kindly give me your valuable assistance as follows:—I have a pianoforte (Broadwood upright grand) with under-dampers, and in a few of the notes, more especially in the bass, there is a very disagreeable twanging noise which seems to me to be caused by the dampers. Could you advise me as to how I could remedy the defect? I read with much pleasure your replies in this week's Mechanic (*re* piano dampers), and I may say here that I agree with you that over-dampers are preferable to under-dampers.

R. E. D.

[73031.]—**Gas-Fire Furnace.**—Do you think of using ordinary coal-gas for this purpose? If so, I am afraid that you will find it very expensive. Water-gas is the fuel generally used in furnaces of this kind.

Snowball.

[73030.]—**Telescope.**—The focal length is very short, though I could not say whether it would be impossible to use it or not. Apropos of this and other questions of a similar nature which have been asked recently, it may be worth mentioning that the Department of Science and Art issue a syllabus for use at the Royal College of Science (late N.S.S.) of "Demonstrations and Practical Work in Astronomical Physics," which may be obtained of Eyre and Spottiswoode for three-pence. Among many other things, it contains full working details for making a 2in. astronomical telescope. As I myself have made one with its aid, I can vouch for its value.

Director R.R.L.

[73034.]—**Tablets.**—Stick the letters on with thick shellac varnish. You will make this varnish by simply putting some shellac into a bottle with a little methylated spirits. Let it stand in a warm place until melted.

Patternmaker.

[73034.]—**Tablets.**—Warm your plate sufficiently, and melt on same sufficient beeswax to form a thin film. Then arrange your letters whilst still warm, and when plate is cold they will be quite firm. I have made hundreds of name-plates for moulding this way.

H. E.

[73036.]—**Accumulators.**—The size of the dynamo has nothing to do with its charging powers. What you require is to know the output in volts and ampères. So with regard to the horse-power required to drive the dynamo: whether you drive it for five seconds or five hours, the H.P. of engine needed will be the same. Let us reckon roughly that each 16c.p. lamp of 48 volts takes 1 ampère to light it. Then 50 such lamps will require 50 ampères for 5 hours, or 250 ampère hours. This gives you the size and number of cells of accumulator required, which would be 25 to 26 cells of 15 L type. The charging current for these cells is from 25 to 30 ampères, and since the E.M.F. of the dynamo must not be much less than 2·5 volts per cell to be charged, it should give a current of not less than 25 ampères, at a pressure of not less than 65 volts. This dynamo, giving 25 ampères and 65 volts = 1,625 watts, will take nearly 2¼H.P. to drive.

S. Bottone.

[73038.]—**Lithanode.**—Lithanode and zinc can be used in conjunction with salammoniac solution; but then the combination is not much more powerful than a good Leclanché cell. As a matter of fact, with a well-amalgamated zinc and dilute sulphuric acid there is little or no action when the circuit is broken, so that in view of the greatly reduced E.M.F. when salammoniac is used, I am doubtful whether there is any real advantage in using salammoniac.

S. Bottone.

[73039.]—**Regulator Clock.**—The regulator trains given in Britten's book are those in general use, and you will not improve upon them. High numbered pinions are much better than low ones. They transmit the power more evenly, and wear less. Cut pinions are better than drawn. The size of wheels varies in direct proportion to the number of teeth they contain. The majority of regulators have a centre-wheel of from 2 to 3in. diameter, according to train adopted.

F. J. Garrard.

[73039.]—**Regulator Clock.**—You have been wrongly informed as to pinions of 7 and 8 being superior to pinions of 12. The latter are best, as you get with them the action all after the line of centres. There is also the advantage of the wear being less on high-numbered pinions. Cut pinions are best if you can get them of good quality, smoothly cut, &c.; but if you are going to make them yourself I should advise you to use pinion wire, in which case you should file up the leaves nice and smoothly and polish them out with emery, and crocus with a piece of wood. If you make your regulator after Britten's description you will have the sizes of the wheels he gives them. The size of the pinions can best be obtained with the sector, which is described and illustrated in his book. If you have tools this should give you little difficulty in making. There is one other way of getting the size of a pinion from a wheel, or vice versâ. The diameters of wheels and pinions gearing together are directly proportional to the numbers of teeth in them (the diameters at the pitch circle. Thus a pinion of 12 will be $\frac{1}{9}$th the diameter of a wheel of 108 with which it gears at the pitch circle). But the outside diameter of your pinion will have to be larger than this by the roundings of the leaves, which project beyond the pitch circle. The size of the wheel cutter should be slightly over that of the pinion leaf. If you specify further points I will endeavour to attend to them.

C. A. Jones.

[73040.]—**Telephones.**—To Mr. F. C. Allsop.—If you make the transmitters of the "E. M." type they will answer very well for this distance. The bobbin is drawn full-size, and should be wound with No. 38 silk-covered wire to a resistance of about 40 ohms. The Bell patent expires Dec. 9, 1890, after which you can use ferrotype iron diaphragm. Ordinary electric bells will do for signalling for this distance.

165, Queen Victoria-street. F. C. Allsop.

[73041.]—**Detector Galvanometer.**—See my book, "Electric-Bell Construction," in which you will find quantities and resistance of wire for coils, and also scale drawings of the different parts.

165, Queen Victoria-street. F. C. Allsop.

[73041.]—**Detector Galvanometer.**—Much depends on the delicacy which you desire to give to your instrument. The ordinary sizes are 24 for the low and No. 36 for the high-resistance coil. About 1oz. of each will give good results for ordinary work.

S. Bottone.

[73041.]—**Lineman's Detector Galvanometer.**—The resistance of the "intensity" coil should be 100 ohms, and that of the "quantity" coil not more than 1 ohm. The wire which is most suitable for the intensity coil is silk-covered, and its diameter is ·0065in., while that for the quantity is very much thicker, and its size is No. 20.

Newcastle-on-Tyne. Percy Reid.

[73042.]—**Electro-Magnet.**—It is absolutely impossible for anyone to tell you how to wind your electro-magnet to lift 15cwt., by cells giving 1·4 volt each. To be able to assist you, I must know the internal resistance of the cells, since it is the current in ampères, and not the voltage of the battery, that decides the amount of magnetism obtainable in a given mass of iron. If you will kindly turn to p. 244 of the "E. M." for Nov. 14, you will see that the section of the iron decides the pull, and not the length at all, and that a section of 15sq.in. of wrought iron, equal to a square bar nearly 4in. in the sides, can be wound to pull a ton. You will also see that you need not use a greater length than is absolutely necessary to carry the requisite amount of wire to produce the desired number of ampère turns. On a square bar, not curved, owing to the magnetic circuit not being complete, only one pole being used, I reckon you would need nearly 38,000 ampère turns of wire.

S. Bottone.

[73043.]—**American Organ.**—With every desire to assist "J. H. S.," I am afraid I must confess my inability to tell him the most important part—where to get such boards. The large makers will construct anything to order; but six rows (full sets, as he calls them), on one board, and five on another are, with two 16ft. sets on pedals, rather a large order. He might get three-row boards (C scale), perhaps even four-row boards, of some of those dealers who advertise in your columns; but as I never saw so large an affair, I cannot do much to help him. There is a good action for two manuals in the number for May 12, 1882, with six rows on lower, and four rows on upper manual—but not all full rows; and another plan in number for Dec. 16, 1887, which gives an idea of arranging for two manuals, with both octave and manual couplers, with pedals (also coupled); but if "J. H. S." intends to have two rows on pedals I suspect he will find it necessary to have separate bellows. The boards will probably be 40in. by 20in., and as he has 4½ft. of width, he can allow so much between the sides of the case as to get a bellows, say, 46in. long; but it certainly must be as large as possible, with large feeders. I have no doubt the big firms would make such an instrument to order; but if "J. H. S." takes my advice, he will be contented with three rows on each manual, and one row on the pedals, especially as they are to be coupled to one or both of the manuals. The sizes of reeds vary. The address of the Munro Company was Worcester, Mass., U.S.A.

Organon.

[73044.]—**Dynamo, Heating of.**—If the heating is confined to the horns of the pole-pieces, it would be hardly worth while doing anything to it. It may be that you are running too many lamps in parallel, so that too much current is passing through the wire of the armature. This would betray itself by the armature getting warm. But the heating effect of the pole-pieces is most probably caused by the projecting teeth of the armature. In this latter case it would be well to try whether a plain ring armature would not improve matters. But if the machine is small and the output, comparatively speaking, large, heating is sure to show itself.

S. Bottone.

[73045.]—**Shocks from Dynamo.**—In cases where the voltage of a dynamo does not exceed 100 volts, there would be absolutely no danger in touching both terminals with the dry hands. If the dynamo were a direct-current machine, the shock would not be painful; if it were an alternate current dynamo, the shock would be very unpleasant. Since the dry, human hand presents a resistance of about 3,000 ohms, and since the ampères of current that can pass are equal to the voltage divided by the resistance, it follows that the utmost current in ampères that a human being could get to pass through his hands when touching such a machine, is equal to $\frac{100}{3000}$, or $\frac{1}{30}$ of an ampère, or, say 33 milliampères. S. BOTTONE.

[73047.]—**Coils for Compounding Dynamos.**—To MR. BOTTONE.—"No Sig." is not quite correct in stating that "most of our leading makers do the reverse"—that is to say, place the shunt coils under the series coils. Now, as a matter of fact, Messrs. Goolden put 25 convolutions of copper strand (composed of 19 No. 15 wires) for the series, and over this 2,712 turns of mixed 15 and 16 for the shunt coils. If the machines are of the drum type, they employ 66 turns of two No. 6 in parallel for the series, and wind over this 2,600 turns of No. 15 for the shunt coils. In Paterson and Cooper's "Phœnix" we have the series under the shunt. In Mather and Platt's "Manchester" the shunt coils are under the series. In Laurance and Scott's machines the series coils are wound on the two upper magnet cores, and the shunt coils on the two lower ones. Crampton's "Trade" dynamos have the series coils laid on first, then the shunt. In practice it makes little difference which plan is adopted, since whichever coil is placed outside can be made more active by increasing the number of ampère turns, to compensate for the greater distance from the core. With regard to the second question, I should advise that the amount of wire laid on the core should never exceed on either side the thickness of the core itself.

S. BOTTONE.

[73050.]—**Gassner Battery.**—If chloride of zinc be used, salammoniac is unnecessary. There would be no harm in having the carbon plates in duplicate, provided they were electrically connected. A better shape would be a large cylinder; but, of course, the larger the carbon the less room for the depolarising mixture—hence the quicker the battery would be spent. If an amalgamated zinc rod were used, it would be well to make the carbon into the outer containing vessel, as in the Judson form of Leclanché. This would greatly reduce the resistance. S. BOTTONE.

[73053.]—**Banjo.**—In reply to "K. C. B.," his banjo should have a 12in. German-silver or nickel-plated brass hoop, double spun, lined with ash, oak, or sycamore, about 24 fittings, and Roger head; length of arm 18⅝in. from nut; walnut with ebony finger-board; pegs, celluloid or ivory. Any further information I would give by post or through "E. M."

4, Garnet-road, Willesden. C.

[73053.]—**Banjo.**—I shall be delighted to render "K. C. B." all the assistance I can from my own experience; but let him in the first place refer to a former answer of mine on the same subject in the "E. M." (No. 1302) of March 7th, 1890, to another correspondent, where he will find some information which will help him considerably with regard to dimensions, woods for, and cost, &c., of making a really first-class instrument. Furthermore, if he takes the hint contained therein, I shall be most happy to communicate with him direct. If he is really handy with a few carpenters' tools, and has patience, there is no earthly reason why he could not turn out a very creditable banjo; but he must not expect to rival Dallas of London or Stewart of Philadelphia just yet. BANJOKER.

[73055.]—**Mosaic.**—Perhaps the following may be of some use to "Mosaic":—Some years ago I was at Malloch, and went into one of the works where they make inlaid work; it is the staple trade of the place. First comes the marble worker, who, in the lathe or at the bench, fashions the various articles in the black Ashford marble, whether it is vases, dishes, inkstands, or whatever it may be. Next comes the worker with various coloured stone or marble sawn into thin slabs about a sixteenth thick; out of these he makes leaves of various sizes and colours, petals of flowers, &c.; now comes in the artist—I suppose we must call him—he takes these petals, leaves, &c., which are all coated on the back or one face of them with shellac, and lays them on a slab of the marble, say, for instance, a letter weight, that being one of the simplest articles I should think they make; he lays these on to form a group of flowers to his own idea or taste, it is then stood in a hot closet. When the shellac melts it fixes all these pieces on the marble; when all is cold he goes all round the pattern with a sharp steel scriber; it is warmed again, and all taken off then with fine chisels; all is cut out within the lines; all the pieces are put in with cement, then all ground down to a face, then all stalks and tendrils to the flowers are cut in with a fine tool, such as a graver; these lines are then filled in with cement of various colours, and the final polish put on. F. G. FRANCIS.

[73056.]—**Scaling.**—A ruinous affair, and utter destruction to any iron boiler. Get him to put some linseed in, and a little soda ash.

JACK OF ALL TRADES.

[73058.]—**Gas.**—(1) 1lb. of zinc and 1½lb. sulphuric acid will yield 5·6837c.ft. of hydrogen measured at 740mm. and 15° C., supposing that both zinc and acid are 100 per cent. Of course, they are not, therefore the yield will be less. I believe zinc is £25 and sulphuric acid about £5 a ton. You can easily procure prices for small quantities. (2) Theoretically, hydrogen gives better results than coal gas, since the heat of combination is greater, and less oxygen required for total combustion. I do not think anybody uses it; it would not be worth the trouble of making. (3) I am not sure that I recognise your jets. They are all "safe." The chamber jet, having one nozzle, in which the gases are mixed before combustion, is the best for lantern work. The light is reduced to the smallest possible dimensions, the wear of the lime is the minimum, and it is the most economical in gas. Burners having two delivery tubes, where the gases mix at the point of combustion, are wasteful of gas, make a large flame, and are only suitable for illuminating purposes. The ether-oxygen light will not compare with the oxyhydrogen: it is far inferior, and wasteful of gas. SM.

[73059.]—**Accumulator.**—To MR. BOTTONE.—Lithanode against lithanode makes an excellent accumulator. Dilute sulphuric acid is used as the fluid. An accumulator with a pair of plates measuring 4in. by 1½in. would have a capacity of about ¼ ampère hour, which means you could get an ampère for a quarter of an hour, or a quarter of an ampère for an hour. The last question I cannot answer, because I don't understand it.

S. BOTTONE.

[73063.]—**Motor.**—To MR. BOTTONE.—I regret that I cannot find time to redraw the cuts and redescribe the machine figured and described in No. 1322; but you will find full description of mode of making this and similar motors, along with details as to method of making a commutator, in my book "Electro Motors" (see Sale Column). It does make all the difference which way the magnets are wound, also which way the slits on commutator stand with respect to brushes when the four magnet poles face each other. The commutator consists of a short length of brass tubing slit longitudinally into two halves. S. BOTTONE.

[73064.]—**Allowance for Turning.**—For a working fit, you may allow ⅛in. to the foot good.

JACK OF ALL TRADES.

[73067.]—**Electric Light.**—You should get 2 volts from each cell; the number to use for a 5c.p. lamp depends on the voltage required. If a 10 volt, of course it will need 5 cells. Most lamps are marked with the voltage required. Arrange the cells in series, and with a good solution they will run for about three hours.

H. H. HEADWORTH.

[73067.]—**Electric Light.**—Four cells, such as you describe, if connected in series, will light a six-volt 5c.p. lamp for three hours, if charged with chromic acid. You need not, however, use more than one zinc between two carbons in each cell. Chromic acid, with the above arrangement, will give two volts per cell. You will find full details for working this battery in my "Electrical Instrument Making." S. BOTTONE.

[73068.]—**Telephone.**—The Bell receiver requires no battery whatever, unless it is connected up with a microphone for a transmitter. As to whether they would be as loud as E.M. receivers, that would depend on the length of line used, the strength of the permanent magnets in the Bell receivers, and also on the number of cells put on the line with the E.M. receivers. I have generally found that loudness in a receiver is gained at the expense of clearness. If "Bernard's" line is of any considerable length, I should advise him to use electro-magnetic receivers with ferrotype diaphragms (after the 12th inst.) ACOLYTE.

[73069.]—**Safe Pressure of Boiler.**—"Constant Reader" does not say what the boiler is made of, or how the joints are made. The following is for wrought-iron plate:—The bursting pressure of the boiler shell, if single-riveted, is 650lb. per square inch; if double-riveted, 812lb. per square inch; collapsing pressure of firebox, if *perfectly* circular, is 1049lb. per square inch; so the shell is the weakest part, and taking the boiler as being single-riveted, 650lb. is the data for safe working pressure, which, if the workmanship is good, may be one-eighth, or 80lb. per square inch; if the joints are brazed, 30lb. would be the safe limit, but it entirely depends on the workmanship.

SNOWBALL.

[73074.]—**Chromic Cells.**—Theoretically, the larger the quantity of solution the longer the current should keep to the same pitch. As a matter of fact unless the fluid is agitated, the current falls off very rapidly, even in the large cells, owing to the fact that as no gas is evolved to set up movement in the liquid, the zinc remains in contact with spent solution, and action ceases from this cause alone. After three hours there is little or no current, no matter what be the size of the cell. If, however, the fluid be agitated from time to time, the large cell will go on for a time proportionate to its size. A half-gallon cell would give 20 ampères for 10 or 15 minutes—not more. Probably the liquid would get very warm if such a large current were taken from the cell. It is of little or no use adding more sulphuric acid when the solution is spent. The colour changes from an orange brown to a greenish brown when the chromic acid is exhausted.

S. BOTTONE.

[73075.]—**Wheatstone Bridge.**—I have made and sold circular Wheatstone bridges. It is no advantage, but actually a detriment, to have the stretched wire of low resistance. When the resistance of this latter becomes as low, or lower than that of the remainder of the circuit, no true indications can be obtained from the instrument.

S. BOTTONE.

[73076.]—**Black for Tools.**—Blaze them off over a smoky fire with linseed oil.

JACK OF ALL TRADES.

[73076.]—**Black for Tools.**—Heat in a fire made with new coals, so that the article just does not turn red, and then clean up any bright parts with the emery stick when cold. If the tool requires to be tempered it must be done at the same time, care being taken not to heat to redness any more than can be ground up bright afterwards. This gives a nice dead black finish to the work, which must have been properly filed up first. SNOWBALL.

[73078.]—**Wimshurst Machine.**—If "Puzzled One" desires to obtain the greatest length of spark from the glasses, then he should use new sectors of the dimensions given—the objection to larger sectors is that their increased size reduces the length for insulation between sector and sector, and also between the sectors and the bosses. Having the jars too large relatively to the power of the machine increases the thickness of the spark, but reduces its length. Why do you connect the outer coatings of the jars to the terminals? The proper arrangement is to connect the two inside coatings to the two terminals, and the two outside coatings to one another. If the brushes are rightly placed, then it is not possible for the current to change over. The occasional sluggishment or excitement is owing to either the brushes being old and dirty, or to them not being in absolutely metal contact with each other. J. W.

[73079.]—**Magneto Machine.**—You appear to have a short-circuit in the frame of the machine. Probably the hole through which the spindle passes has lost its ebonite or ivory bushing, or else the spindle at the centre, where the two halves are separated from each other by the insulating washer, has come into contact by overscrewing. See my "Electrical Instrument-Making," p. 90, for further details. S. BOTTONE.

[73079.]—**Magneto Machine.**—You do not need platinum on spring, as the rubbing insures a clean metallic contact. Most likely you will find the fault with the spring: it must only rub against the projecting corners of the armature spindle, clearing the flat sides. Also, the spring pressing against the end of spindle must not touch brass frame. The armature should revolve as close as possible to magnet without touching.

H. H. HEADWORTH.

[73080.]—**Bell Telephones.**—Seventy ohms is, on an average, the general resistance of these, though I have found they vary from 40 as a minimum to 100 as a maximum. If you are going to use them without a microphone, I think you will find 70 ohms suit you best. If in parallel, I should wind them with a slightly higher resistance.

165, Queen Victoria-street. F. C. ALLSOP.

[73081.]—**Ancient Clock.**—If you put a seconds pendulum (39·14in.), your centre wheel (or driving-wheel as you call it) will revolve once in two hours. You therefore want a pinion of eight to drive hour-wheel, which will make the latter revolve six times slower—i.e., once in 12 hours. If you use half-seconds pendulum (9·78in.) you will require a small wheel of 16 teeth to drive hour-wheel. Weight required to drive will depend on strength of train-wheels, and pendulum as heavy as the weight will easily maintain. F. J. GARRARD.

[73081.]—**Ancient Clock.**—If you could have given the length of pendulum I could have told you the number of the lost wheel, or vice versâ. As it is, it is rather difficult; but it is very likely that your 30-hour one-hand clock had a seconds pendulum (from the train it has), in which case the driving wheel would revolve once in two hours. I presume this is the wheel driven directly by the weight. In that case, if the little wheel on its arbor hour-wheel direct, it will be a "wheel" s the hour-wheel revolves once in 12 hours 8 teeth, a pinion of 8 revolving once in would cause the wheel of 48 to revolve relve.

C. A. JONES.

]—**Problem in Acoustics.**—Let $s$ = f sound in feet per second, and $v$ = velocity feet per second; then we have—

$$300 : 330 :: 1 : 1 + \frac{v}{s}$$

h—

$$300 + \frac{300\,v}{s} = 330$$

$$300\,s + 300\,v = 330\,s.$$

we get— $v = \frac{s}{10}$

2ft. per second, or a fraction over 80 miles

WM. JOHN GREY, F.C.S.,
cal Chemist, Newcastle-on-Tyne.

]—**Problem in Acoustics.**—The best ttack this is to assume one of the two ous motions annihilated. Suppose, for the whistle is stationary, and the ear vards it $x$ feet per second. Also assume nd the waves in the space of $x$ feet are so to speak. Then, by virtue of the a certain number (call it $n' - n$) of waves ntered. If $n$ = number per second, the gth must be $\frac{1,120}{n}$ft., and the number ncountered in $x$ feet will be $\frac{n\,x}{1120}$. Now, had not been moving, the number $n$ would heard. Therefore the resultant number

$$= n + \frac{n\,x}{1120} = n\left(1 + \frac{x}{1120}\right)$$

$$\frac{.120\,(n' - n)}{n} = \frac{1120 \times 30}{300} = 112\text{ft. per sec.}$$

sponds to the *somewhat* high velocity of s per hour.

DIRECTOR R R.L.

]—**Resistance.**—You have set yourself a ficult task with the apparatus you have, k the best way for you to proceed will be of your coils wound up to 300 ohms by who has a Wheatstone bridge or other for testing resistances. Having one coil istance you know to be 300 ohms, you can ff the others in the following manner:—ttery (one cell will do) in circuit with your coil and galvanometer, and observe the . Having done this, you can start to wind coils, testing each one by putting it in ith the battery and galvanometer, and the deflection, which, when it is greater e first instance, you will know that you put enough wire on the coil; if, however, tion is too little, you will know that there h wire on the coil, and you must take ntil you get the same deflection as you the coil which was measured by a proper . N.B.—This is a rather tedious way of

tle-on-Tyne.

PERCY REID.

## NSWERED QUERIES.

*bers and titles of queries which remain unan- five weeks are inserted in this list, and if still are repeated four weeks afterwards. We trust will look over the list, and send what information the benefit of their fellow contributors.*

it Making, p. 110.
am Launch, 110.
aching Cotton Goods, 110.
am, 110.
me Clock, p. 111.
nch Book on Moulding, 111.
r Gearing, 111.
ltitubular Boiler, 111.
at Northern Loco. Sheds, 111.
ht Hospital Ambulance Van, 111.
luction of Focus of Lens, 111.

manent Way, p. 195.
minous Crayons, 195.
R. Goods Tanks, 196.
V.R. Locos.

nerate for Leclanches.—The *Bulletin nal de l'Electricité* gives the following the manufacture of agglomerate for use bés:—Binoxide of manganese, 40 parts; 44 parts; tar, 9 parts; sulphur, ·6 parts; parts. This mixture must be reduced t er, then compressed and heated to about 2° Fahr.) The heating drives out the most of the tar. Some of the sulphur with the volatile products of distillation, at combines with non-volatile residue.

## QUERIES.

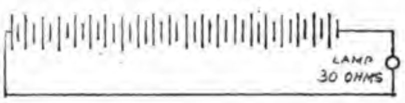
◆◆◆

[73089.]—**Equation to Curve Wanted.**—The base of a curve measures 5in.; it is divided into eight equal parts. The heights of the ordinates are as follows:—

| | |
|---|---|
| At the 1st division | ·023 inch. |
| ,, 2nd ,, | ·054 ,, |
| ,, 3rd ,, | ·09 ,, |
| ,, 4th ,, | ·137 ,, |
| ,, 5th ,, | ·195 ,, |
| ,, 6th ,, | ·281 ,, |
| ,, 7th ,, | ·382 ,, |
| ,, 8th ,, | ·498 ,, |

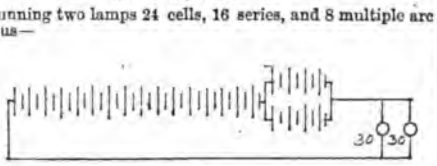
It is required to find the equation to the curve, and a simple method of describing it graphically. It does not appear to be in any of the books. Will some kind reader oblige with an answer?—PUZZLED.

[73090.]—**Glow Lamp.**—I wish to run a glow lamp, which requires a current of ·5 ampère, 40 volts, and has a resistance hot of 30 ohms, from a battery which has an E.M.F. of 2 volts, and a resistance of 1·5 ohm per cell. By connecting up in series, I obtain ·6 ampère of current, which will answer very well, as I can easily reduce this by inserting a resistance of ·1 in one of the mains. I should state that the resistance of mains is practically *nil*. If, however, I wish to switch in another lamp at the same time, I find that I must increase my battery-power by the addition of at least four more cells, and find that I obtain the best result by connecting my battery as shown in sketch. Running one lamp E.M.F. 2 volts per cell, resistance 1·5 per cell, 20 cells in series.



$$C = \frac{E}{R} = \frac{2 \times 20}{(1{\cdot}5 \times 20) + 30} = \frac{40}{60} = {\cdot}6 \text{ ampère.}$$

Running two lamps 24 cells, 16 series, and 8 multiple are thus—



$$C = \frac{E}{R} = \frac{20 \times 2}{(1{\cdot}5 \times 16) + \left(\frac{1{\cdot}5 \times 4}{2}\right) + 15} = \frac{40}{42}$$

$= {\cdot}95$ ampère, or ·475 through each lamp which would suffice.

Is there a better way of connecting up the battery? And as I increase my lamps, must I also increase my battery-power in proportion, having, of course, a due regard to the voltage?—ELEKTRON.

[73091.]—**Curious Pictures.**—Can any of "our" readers give any information on the following? Some time since I was shown some pieces of wood about 7in. by 5in. square, on which someone had apparently been dabbing a paint-brush, or rather more than one, for there were several colours to be seen, but looking as if the colours had been poured on the panel, and allowed to run about at their own sweet will. I know a little of pictures, but could make nothing out of these, and stated as much, when my friend produced a piece of metal, I think, silver. It was about 3-16in. thick, 2in. high, and about the same broad, and bent to form almost a half-circle—the outside was highly polished. This, on being placed with its two edges level with the back edge of the panel, placed flat on a table gave a beautiful picture on the polished surface with no distortion. Can anyone give this process a name? The panels were very old, they had belonged to the exhibitor's father, who had shown them to people, but could find no one who knew anything like them.—NO NAME.

[73092.]—**Wimshurst Machine.**—Am anxious to make a 4-plate Wimshurst machine. Would Mr. Bottone kindly say how the inside neutralisers are fixed, and if the two inside plates would be driven from one pulley? Would a ball carrying three collecting arms answer, the outside arms for outside of plates; and a central one with spikes, one each side, for inside plates? About what spark might I expect from four 8in. plates? Would a 6in. plate machine charge four 1 pint Leyden jars? Do you think ebonite better than glass for the plates? Have seen some machines with small round buttons on end of sectors—what are these, and do they increase power of machines?—NEW SUB.

[73093.]—**Tangent Galvanometer.**—Would Mr. Allsop kindly give directions for making an accurate tangent galvanometer—such as size of wire, diameter of ring, how to fix pointer to needle, &c.? I hope to see his articles on electrical testing in book-form.—TANGENT.

[73094.]—**Isle of Man Steamers.**—Can any of "ours" give me particulars of two comparatively new boats (the *Victoria* and *Prince of Wales*) belonging, I believe, to the Isle of Man Steam Packet Co., running between Liverpool and the Isle of Man, built, I understand, about three years ago?—INLAND.

[73095.]—**Black Figures for Silvered Dial.**—Should like to know the best composition for blacking-in the figures of a dial I have made. The figures are cut in, and after they are filled up, the dial will be silvered by chloride of silver. Should like to know a good varnish for same, to keep it from tarnishing—varnish must be quite clear.—C. F.

[73096.]—**Manchester Dynamo**—To MR. BOTTONE.—Would you please give me a sketch of dynamo, with armature 4½in. diameter, as you proposed? Will the same amount of wire do? How many sections should I wind armature with? Are segments of charcoal iron, about No. 20 B.W.G., best to build armature of? Also state in sketch the sizes of field-magnets and diameter of bobbin cores, and oblige.—BLONDON.

[73097.]—**Greenhouse Construction.**—If some kind reader would contribute some letters on the above subject, I feel sure that they would be of the greatest interest and use to many besides the writer. I am aware that short directions appeared long ago—I think in Vols. XV. and XVI. on the subject, and they are also to be found in other publications; but none of these deal with any of the details of construction. Many amateurs not learned in such details could carry out the work, if they only knew how; and the great stumbling-block seems to be in the matter of joints. The necessary material can now be procured ready prepared for all parts at little over the actual value of the timber. Should therefore any article result from this appeal, I would respectfully call attention to the desirability of describing the correct methods for corner joints of the various plates, joining and fixing the uprights to these, joints for frame for door, rafters, &c., and how the sashes (either fixed or opening) are fitted. We are not all experts in details of construction, and as there is a correct and incorrect method in all construction, I must plead my ignorance, and wish to learn the correct method in this particular subject as excuses for troubling you.—GLASSHOUSE.

[73098.]—**Quantivalence of the Elements.**—In connection with the correspondence that has recently been carried on in your paper with regard to the atomic weight, &c., of the elements, will some of your chemical readers furnish me with the quantivalence (accepted or otherwise) of these elements?—QUANTIVALENCE.

[73099.]—**Wheel Grease.**—In our works, there is a large quantity of oil that drips from heavy bearings of engines and shafting, some of which is too dirty to sieve and use again as oil, but which would make admirable grease for cog-wheels if combined with suitable solid lubricants—such as soap, tallow, &c. If any fellow-reader will kindly say what substances are the best, and in what proportion they should be mixed, it would, I feel sure, be welcome to others besides—WORKS MANAGER.

[73100.]—**Jibbing Horse.**—What is the best thing to do with a strong horse that will not draw an empty cart? It is called "bucking" in some places.—ANGULUS.

[73101.]—**Oxygen Cylinders.**—Can anyone kindly inform me whether the compressed oxygen rapidly rusts the inside of the cylinders, or is some means adopted for preventing it? About how long would a cylinder last in constant use with fair treatment?—W. W.

[73102.]—**Microscopical.**—Can any readers inform me as to the arrangement of an A eyepiece of a compound microscope? I have two lenses—the eye-lens 1in. focus, and the field-lens 2in. focus; and I should like to know (1st) the distance between the lenses? 2. The position of the stop, and the size of the aperture? 3. What indication will there be when all things are correct?—C. F. RATCLIFFE.

[73103.]—**Steaming Timber.**—I have a large quantity of ash squares 9ft. long, and 2in. square, to straighten before turning, and also to straighten any that spring after turning. Will any subscriber oblige me with the best manner of doing this? Is it of any benefit to have the steam under pressure? And I shall be glad to know the time the wood should be under the process.—SAWMILL.

[73104.]—**Model Traction Engine.**—I wish to make a model traction engine, with boiler like the one drawn in No. 1289 (for the model locomotive). I should feel obliged if some kind reader would give me size of cylinder suitable. Perhaps "J. H." would favour us with a few articles on fitting up a model traction engine, with a boiler the size he described in No. 1289? I feel sure it would assist a number of readers. I have seen models in London, but do not know if castings can be obtained.—AN OLD SUBSCRIBER.

[73105.]—**Flint Glass.**—To "MONS."—The formula given in Vol. LII., No. 1328, query 71958, I have only just had an opportunity of trying with utter failure as to the result; the mixture forming a substance similar to white marble, which cannot be removed from the pot. As requested, I give the result of my experience for the benefit of "ours." And if anyone else has tried the same formula, I should be glad to know their experience.—BARYTA.

[73106.]—**Paddle Steamers.**—Will any of "ours" be good enough to help me out of the following difficulty? I have recently constructed a model of a Clyde river-paddle steamer, scale ½in. to the foot. Mark you, everything is made exactly to scale. The original makes 44 revolutions, with a pressure of 50lb.; whereas my model feeds condensers, and makes 120 revolutions on 10lb. of steam. And this with a common spirit-lamp which I understand gives only half the duty of coal. What is the reason?—PADDLE-WHEEL.

[73107.]—**Hard Steel, to Drill.**—Can any reader tell me how to drill holes in pieces of watch spring without making it soft. I have to make the end I want the hole in soft and punch it out with a punch now, which spoils the temper and look of the spring? Have seen some that look as if they had been done without softening. I break about one out of three my way. They are about 1-16 to ⅛in. wide. The holes to take a small watch screw. NO SIG.

[73108.]—**Chemical.**—To "SM."—What is conine, and what book (not expensive) do you recommend as a sequel to Remsen's "Organic"? Also please say what is the best periodical for a student to take, anxious to continue the study of general experiments and analytical chemistry? Have passed second class Honours Inorganic and first class Advanced Organic; but am now living where no tuition can be obtained.—B.

[73109.]—**Horse of the Future.**—Can anyone give an account of this machine, as described in this cutting? It is said to have been exhibited in the Military Exhibition at Chelsea:—"Ten years from now you will not see so many horses in London," said a German gentleman to one of our reporters. "A firm in Munich is making carriages to be propelled by gas generated from benzine. Several of the new vehicles are in successful operation, and the company is securing patents in all the big nations of the world. I rode in one of the carriages only two months ago. On the country roads we went at the rate of ten miles an hour, but in the crowded streets we moved about as slowly as a four-wheeler. The motor is placed in the rear over the main axle, and the bezine is carried in a receptacle under the seat. It holds enough for a journey of eighty miles. The gas mixture is ignited in a cylinder by an electric spark. The motor is started by simply turning a lever. A link-chain, belted to a wheel on the rear axle, applies the power. In its make-up the carriage is something like a tricycle, having only three wheels, and it is guided in precisely the same way. It is easy to increase or diminish the speed, and the carriage can be stopped in a moment. The system can be applied to small or large vehicles. The cost is comparatively low."—Angulus.

[73110.]—**To Mr. F. C. Allsop.**—If the resistance of a secondary coil equal 100 ohms, what should the resistance be of the two receiver coils (Bell)? Magnets 4in. by ⅝in. Is there any rule for finding correct proportion of above?—F. T.

[73111.]—**Model Engine.**—I cut out a print and also some descriptive matter of an engine exhibited at the Manchester Exhibition. Is is a vertical compound engine by Browett, Lindley, and Co., Salford. The high-pressure cylinder is 5½ diam., low-pressure, 9in. diam., with 10in. stroke. It is run at 210 revs. with a pressure of 90lb., and will develop 20H.P., and, according to the description, it is supposed to run with very economical results. I should feel oblige if some of our engineering readers will give me the following information, as I am going to make one for myself:—What thickness of cylinders (metal), which are one above the other, high-pressure at top, diameter of piston rod in each cylinder, diameter of connecting rod and length, diameter of shaft. Also can I have the crank-shaft cast in any metal? I want it with cast-iron balance weights. The description states that the crank-shaft is of steel with slotted cranks, having polished cast-iron balance weights attached by wrought-iron bands. Also size of flywheels which has two and about the cost in fuel for running same with full load. —A. Harris, High-street, near Ashby de la Zouch.

[73112.]—**Contents of Cylinders.**—Required an easy method of determining the approximate contents in gallons of a number of horizontal cylinders containing different depths of liquor, the length and diameter of cylinder and the depth of liquor being known.—Distiller.

[73113.]—**Electric Ignition.**—Would any of your readers kindly give a sketch of an electric ignition for petroleum engine from a dynamo or battery?—P. Merthyr.

[73114.]—**Hand Dynamo.**—Am about to make a hand dynamo for experimental work, and I want it be of the highest efficiency. Would Mr. Bottone recommend one with Siemens or Gramme armature? A few hints as to size and weight of wire for magnets and armature, together with shape of magnets, would be acceptable. Would it be any drawback to the machine if the pole-pieces were screwed on to the magnets? Is it best to drive with band or gear?—Ex. Dyn.

[73115.]—**Lacquering Instrument.**—Would some one kindly give a hint or two on lacquering electrical instruments, as I find a great difficulty in doing them?—Lacquer.

[73116.]—**Screws for Instruments.**—Would Mr. Allsop kindly say what sort of screw thread is used in electrical instrument work, as I find I cannot get the right sort of plate to cut them?—Screw.

[73117.]—**Punching.**—Will any of "ours" give size of common punching bear to punch ½in. hole in ¼ plate to be made of cast iron? What diameter and pitch of screw? C. T. O.

[73118.]—**Blackening Zinc Surface.**—I have some vessels brought from India, which are said to be made of zinc or spelter, inlaid with figures of silver, and in order to produce contrast the zinc has been treated in some way so as to produce a nearly black surface, in appearance not unlike very dark slate. As this black surface has been worn off in some places in polishing the silver figuring, I shall be obliged if any reader can inform me how I may again turn the bright metallic surface where thus rubbed into a black.—C. L.

[73119.]—**Angling.**—Have incandescent lamps ever been tried for fishing in fresh water (lake) for pike, trout, or perch? It is known they are attracted by artificial light, but will they take any bait? Any information on the subject will be appreciated by—Nero.

[73120.]—**Bookbinding.**—On reading the articles "How Books are Bound," and thinking I would try my hand, I commenced on newspaper folded to size and following the instructions. I did exceedingly well (for first attempt); but unfortunately my book is still in the same state, as Fig. 18 page 72, boards laced and edges cut. I have been waiting for instructions how to finish the binding in either cloth, or half leather; but the remaining articles appear to be taken up with decorating edges.—A. B.

[73121.]—**Carbon.**—I should be much obliged for information how to make carbon balls ⅜in. diameter, and how to prepare the same to obtain a given resistance.—J. P.

[73122.]—**Composition of Gas.**—What is the relative proportion of carbon and hydrogen in gas of different illuminating powers, such as 16 and 21 candle used in London and Liverpool, and in the best paraffin oil, as used in most oil lamps? Also what is the volume of gas formed from any quantity or weight of the best paraffin oil, such as sold in retail shops about 1s. per gallon?—H. Boadler.

[73123.]—**Banjo.**—I am thinking of taking up the banjo, and should be greatly obliged if some one would tell me which is the best kind of instrument for ordinary amateur work, and why?—five, six, or seven strings, peg or machine head, metal rim or not. I always understood a six-stringed was the best, but am told everybody uses a five-stringer now.—Benje.

[73124.]—**Traction Power.**—Will any kind reader help me out of a difficulty? 1. I understand the traction power of a locomotive is equal to for every pound pressure to inch (diameter of cylinder)$^2$ by stroke, divided by diameter of driving wheel, all in inches. The answer being pounds, I want to know how to find the traction power of a compound. 2. In a compound what should the diameter of the cylinders be to make it of equal power to an 18¾in. diameter high-pressure, the stroke being 26in., and diameter of wheel 8ft. in each case?—Inventor.

[73125.]—**To Mr. Bottone.**—I want to make a powerful coil. I have a bobbin, 7in. by 3½; core ⅝; wood round core 1-16. I find by calculation it will take 2lb. 15 gauge and 4lb. 28 gauge to fill it. I intend putting 30 sheets tinfoil, each sheet cut in three for condenser. I want to leave the two ends of primary wire out at one end, and the two ends of secondary wire out at other end. Would you kindly say will this proportion work, and will I require to insulate each layer of primary and secondary, and how? Will I require to insulate between primary and secondary, and with what? Will foolscap well gummed do to insulate condenser, or please say what will? —Quæro.

[73126.]—**To Mr. Bottone.**—A few months ago I made up some cells as follows:—Glass jar with porous pot, broken carbon and plate packed all round between jar and pot; solution 3oz. of bichromate of potash and 6oz. of sulphuric acid to 1 quart of water, each cell holds 1½ pint of solution. Porous pot filled with cold water and an amalgamated zinc cylinder. Now, two days after making up I found porous pot half-empty, and at end of four days quite empty, so I cleaned every cell and put them away, being too busy just then to bother with them. Last week I made them up again with the same result. Can you tell me what has become of the water? It cannot have gone into the outer cell, because the fluid there is just the same height as at first. The porous pots are all right for porosity. I tried them with water and they sweated in less than fifteen minutes. The cells are in a very cool cellar. Please tell me how to keep the water from disappearing.—Vanished.

[73127.]—**Quadrant Electrometer.**—Am anxious to construct a simple and efficient quadrant electrometer suitable for ordinary student's work, and should be very thankful for a few hints from some of our electrical friends as to size of parts, &c. I have a lathe, &c.—Bato.

[73128.]—**Cement for Iron and Glass.**—I am making a bisulphide of carbon prism for a polariscope. Could any kind reader give me a recipe for a cement that will unite iron to glass, and not be affected by the bisulphide of carbon?—Laura.

[73129.]—**Small Windmill.**—Will "Jack of All Trades" or some other subscriber (who knows) kindly inform me of the best method of making a small windmill? I want it for occasional work, to drive a lathe, grindstone, &c. I want to make a compact one after the American style, with a circular wheel containing radiating fans in place of the ordinary four sweeps. How is the gearing arranged to feather the fans according to wind pressure, and what is the estimated horse-power of various sized wheels? Would a 6ft. diameter be large enough? Are there any drawings or descriptions of such a thing in any back numbers of the "E. M.," and if so, where could I procure them or get to see them, as I do not know, being only—A New Subscriber.

[73130.]—**Steam Launch.**—Can any practical hand advise me as to the most efficient preparation for the bottom (outside) of my steam launch? The hull is a wood one, and has a tender plank or two on the water line only. These I do not wish to be at the expense of hacking out and replacing. My intentions were to lay zinc plates over these parts, extending over the tender places on to sound wood, and am at a loss to know what would be the best thing to put under these plates. She has not had her bottom repaired for two years, and then it was done with Stockholm tar, and, I may add, that in places this peeled off in sheets as big and even bigger than one's hand. I have no means of getting her out of the water except by flood in the river?—D. L. A. C.

[73131.]—**Switch-board.**—Would any of our kind readers oblige me with a sketch of the following? I wish to make a switch-board. I have got a piece of slate 17in. by 2ft. 4in. by 1in., also a pair of 40 ampère switches, 6in. diameter. I have got some copper strips, ¾ by ⅛, for all connections. I should like connecting blocks for this board, and also convenient places for fuses. Also a pair of meters of from 0 to 150 volts. If 36 gauge copper s.c. wire will do, I have plenty, at hand. Ammeter to register 0 to 50, in wooden cases preferred. I have all tools at hand except a Wheatstone bridge.—A Constant Reader.

[73132.]—**Zonal Railways.**—Will some one kindly say what book gives full particulars of the Hungarian Zone system on their railways can be found, or perhaps some reader would give them for the information of the general readers of the Mechanic?—Zone.

[73133.]—**Star Diagonal.**—Will some one kindly give sketch with description of a star diagonal suitable for a 3in. telescope, or state how one is constructed? Also give size of prism for a sun diagonal for same size telescope. I am sure these particulars would be very useful to many amateurs, who could make them as well as objectives, speculas, &c., and although in the last 20 vols. of "Ours" there are several sketches of sun diagonals, there are no dimensions, and I do not think a single particular, of a star diagonal.—Tel.

[73134.]—**To Mr. Bottone.**—Will you kindly explain the following to me:—I have just fitted up an installation of bells in a house, and when I came to test with my galvanometer, there was no short-circuit; but when I disconnected the wires off the galvanometer and placed them on my tongue, I felt a strong taste. I then went and tested each room separately, but still could not find bad places. All the wires are about half an inch apart. The battery has been connected up for a week, and the bells are ringing all right, and the zincs are quite shining yet. The battery is under the flags in a damp cellar. Again when I was testing with my tongue, I found that the taste was still there when I had only one wire on my tongue (that from the carbon, the other end being connected with the indicator). I would like you to examine my galvanometer to see if it can be relied upon. I gave 14s. 6d. for it.—Perplexed.

[73135.]—**Gas Generator.**—Will any of "ours" be good enough to tell me how to construct a small gas generator (for light oils), to be worked by or from foot bellows? I have one of Mr. Fletcher's hot-air gas blasts and bellows, but, having moved, I have now no gas. Any information on this subject will greatly oblige.—Parvo.

[73136.]—**Compressing Air.**—Will any kind reader please answer my questions? By compressing air into a case the size of a six-gallon barrel, what amount of pressure could be gained, or will air and water combined produce more pressure than only air when compressed alone?—C. Fallon.

[73137.]—**Portable Mineral-Oil Stove.**—I wish to make a small portable mineral-oil cooking stove, suitable for making tea in a railway carriage, or boiling eggs and cooking a chop in a bedroom or cabin of a canoe. It is for constant use when travelling, fishing, &c. Size must not exceed 4¾in. wide by 6in. high, so as to pack with other things in travelling lunch basket. The flame must be adjustable. The stove must be absolutely free from all smell and smoke, and have some secure fastening or screw cap over burner, so that no oil can escape when packed for travelling, even if the package be knocked about or turned upside down. I have been hitherto using a spirit stove, but in out-of-the-way country parts in England and abroad I find it frequently impossible to buy methylated spirit. Mineral oil can be obtained everywhere. I should be greatly obliged if anyone will tell me how to construct such an oil-stove as I require.—H. R. P.

[73138.]—**Effect of Glycerine on Metal.**—What effect has glycerine on ordinary lead piping, and on vulcanised indiarubber when in contact for many months? Also has alcohol any effect upon vulcanised indiarubber under similar circumstances?—Arinas.

[73139.]—**Canoe.**—Could anyone inform me as to the method of fixing, mode of working, and position of a centre-board in a 16ft. canoe?—G. A. W.

[73140.]—**Wires for Mechanical Telephones.**—Can any of "ours" say if bronze wire will do for mechanical telephones, instead of three-stranded steel wire? I have a pair, and I have to renew the wire about every 18 months or 2 years at most, as it is close to the sea. The salt air and sulphur from the chimneys soon corrode it, so that it becomes too thin to repair. I shall be glad of any information on the subject.—Celt.

[73141.]—**Induction Coil.**—What weight in pounds of silk-covered wire should I need on the secondary coil, and how much wire on the primary to give a spark of 2in.? What numbered wire would be best?—Ignorant.

[73142.]—**Diamonds.**—Can Mr. T. Preston Battersby or Mr. John Grey inform me what was the pressure (about) in Mr. Hannay's tubes, when reducing paraffin and lithium by which he obtained the diamond dust? I have seen Mr. Grey's advertisement, but am afraid I should not be of much help.—Nemo.

[73143.]—**Traction Engine.**—Will some reader oblige me with dimensions of traction engine, as I am about to make a model? Will a firebox 5in. by 3½in. by 3in. deep burn coal?—Loco.

[73144.]—**Strength of Cylinder.**—I wish to make a copper cylinder with the ends flanged, and the whole riveted together, and to be tinned inside, 11in. diameter by 24in. high. What is the least thickness of copper (by the Birmingham wire gauge) can I use to stand 10lb. per square inch pressure of carbonic-acid gas, and what shape and size rivets should I use?—Ohio.

[73145.]—**Phonograph.**—Can any one inform me how to construct the vibrating needle for the diaphragm on phonograph, with rough sketch if possible? Also the ingredients composing the wax for the phonograms, and proportions of each. I shall be glad to advertise my address.—Phono.

[73146.]—**To Mr. Bottone.**—I have a small surgeon's lamp, about the size of a pea, which I wish to use for seeing the time on a watch, and also as a night-light. 1. What is its voltage and candle-power? 2. How many No. 1 Leclanché cells would I require to light it, and for how long will the light last? 3. What kind of battery would you recommend? It must be primary, cheap, and comparatively constant. What is your opinion of the Leclanché?—Savant.

[73147.]—**Operating on Stocks and Shares.**—Will someone kindly explain with figures showing how averaging is done, and to what extent it benefits? Any hints will oblige one who holds a lot of shares that have gone back 5½ points.—V. W.

[73148.]—**Self-acting Fountain.**—To H. S. C., Cheshire.—Your contrivance for the above appears to be an admirable one. I should like further particulars concerning the indiarubber bellows—how they are made, or whether anything suitable can be bought to answer the purpose, and what plan is adopted to keep the pressure of water from bulging the sides in, as the piston does not work tight against the sides. I should think a sofa spring would do very well for the spiral spring. If I may be allowed to make a suggestion, it is, that in the case of a table fountain without the aquarium, the bellows should be fixed upside downwards and expand downwards, and the waste water be led inside the bellows. In this case, the valve would be placed on the under side of the piston and open downwards, and thus the water in the basin of the fountain would be always at the same level.—F. E. A.

[73149.]—**Organ Query.**—Are "sesquialtera" and "mixture" mechanical stops or not? A short description of these stops will greatly oblige.—Genseric.

[73150.]—**Discount.**—Will some one kindly explain the rationale of the following process? To take 62½ per cent. off £1 4s. 6d.—

(1) $$\frac{100 - 62{\cdot}5}{5} = 7{\cdot}5$$

(2) $$\frac{\text{£1 4s. 6d.} \times 7{\cdot}5}{20} = \text{9s. 2d. answer.}$$

It is a method much used.—Q.

[73151.]—**Bunsen Battery.**—How long will a cell remain in working order if porous pot is partially paraffined and the cell is only used for one hour daily?—Novice.

[73152.]—**Lithanode Accumulators.**—Will these cells lose their charge by standing unused, and in how short a time?—Novice.

[73153.]—**Pole Finding.**—To Mr. Bottone.—On putting the + and − wires from a dynamo into a glass of water, one will bubble and the other will smoke. Which is the + and −?—Engineman.

**iston Rings.**—Will any kind reader me how to expand piston rings, as I have a ıe that requires expanding, and I wish to do ARRY.

**stro. Telescope.**—I have been making cope with a 48 focal convex lens. When I oon I cannot get a clear picture of it. What of this? I am using a 1in. lens for eyepiece. e sufficient? If not, what eyepiece could I I have a diaphragm about 8in. from o.g.—

**rindelia Robusta.**—I have been recom- y the solid and liquid extract of Grindelia ure for asthma. Can any reader tell me the l how they should be taken?—G. R.

**oumiss.**—Can any reader tell me how to ı or fermented milk?—G. R.

**urst Boiler.**—Can any chemical be put in ed for heating a church by means of hot- o prevent its freezing when not in use and ipes? Of course the chemical must not be he boiler or pipes.—URSA MINOR.

**elatine.**—I notice under replies to queries he following, referring to transparent un- terial by S. Bottone—viz., "Gelatine con- of bichromate of potash becomes tough and ater." I have seen this stated several times, I have tried over and over again, cannot whatever. Any further information on the be gratefully received.—F. A. RAINBOW.

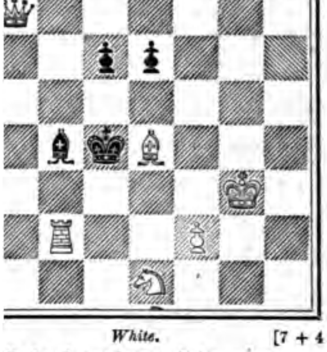
**as - Engine.**—Will any reader describe tube-firing in detail, as used now in many —FIRING.

## CHESS.

unications for this department must be 'J. PIERCE, Knollside, Yawl, Lyme Regis,

PROBLEM MCCXXXI.

*Black.*



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SOLUTION TO 1229.

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Also 1. Q-K Kt 6.

TICES TO CORRESPONDENTS.

lutions to 1229 by White Knight (2)—obvious, Clark (2) (a B P at K R 2 would make this . Rogers (2), T. H. Billington (2), W. Gleave ck (2), Biene (2), C. P. P. (2), F. W. N. Lambert (2), Fr. Fernando (second solution), W. L. Lieut.-Col. Ryan (second solution); to 1228 lington, W. Jay, F. W. N. Lambert, Lieut.- Vhite Knight (neat and clever), Link.

LIAMS.—We have not forgotten.

EJOY.—Look again at 1229. It cannot be done t 3.

cannot be done by Q-Q 3.

## GES FOR ADVERTISING.

| | s. | d. |
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| 'ords .. .. .. .. .. .. | 2 | 6 |
| ditional Eight Words .. .. .. .. | 0 | 6 |

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TISEMENTS in EXCHANGE COLUMN—for

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| ' succeeding Eight Words .. .. .. | 0 | 3 |

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| ' succeeding Eight Words .. .. .. | 0 | 6 |

e borne in mind that no Displayed Advertisements can 'Sixpenny Sale Column." All Advertisements must be eduction is made on repeated insertions, and in cases ant sent exceeds One Shilling, the Publisher would be O.O. could be sent, and not stamps. Stamps, however penny stamps), may be sent where it is inconvenient to .

s included as part of the Advertisement, and charged

ts must reach the Office by 1 p.m. on Wednesday to in the following Friday's number.

## ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

### HINTS TO CORRESPONDENTS.

**1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.**

***** Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

**The following are the initials, &c., of letters to hand up to Wednesday evening,** Dec. 3, **and unacknowledged elsewhere:—**

J. M. K.—Lathe Driver.—A. E. B.—H. A.—H. C. L.—Dooit.—S. B. Kincaid.—Steel.—C. D.—A Novice.—Norman Maclean.—Ursa Minor.—F. C. Allsop.—A. S. Lukin. — Piedmont. — Snowball. — Edward Butler. — F. A. M.—Thomas Shonfeld.—A Fellow of the Royal Astronomical Society.

E. ROSS WALKER. (No room for magic squares just now. Besides, the subject was practically exhausted so far back as Vol. XXIII., in the index to which volume there are no fewer than eleven references to communications on the subject. See also the index to Vol. XXVII. That volume contains four letters on the subject, giving all the rules. A letter on page 60, number for March 16, 1888, contains the pith of the whole matter. 2. All about the ginger-beer plant has been given several times. It is generally Mycoderma saccharomyces; but several other forms of low fungi will set up alcoholic fermentation in solutions containing saccharine matter. See number for Oct. 7, 1887, and the indices of back volumes; for illustrated description, see Grove's "Synopsis of the Bacteria and Yeast Fungi," Chatto and Windus.)—J. T. THRASH. (If you are a reader you must surely have seen the letter on page 102, Sept. 26, 1890, in which lithanode is described by its inventor.)—W. B. T. (There are several cements that will do, such as freshly-burned plaster of Paris mixed, as wanted, with gum-water; white and red-lead ground with oil; or, perhaps best of all, marine glue.)—NOVICE. (Please see indices of back volumes, or procure some of the papers published by the Aëronautical Society. We do not see much advantage in the design forwarded, and the drawing cannot be reproduced in a manner sufficiently clear to make it of any use.)—GEORGE KENDALL. (Do you mean tables only, or the art of screw-cutting? If you called on Mr. Calvert, Great Jackson-street, Hulme, Manchester, he could probably show you the chief works on the subject, and you could then select that one best suited to your wants. Holden's book is a useful one. We believe it is published by him at Swindon. Another and later handbook is Price's "Screw-Cutting, Coneing," &c., published by E. and F. N. Spon, 125, Strand, W.C.)—D. W. FARNER. (Reverse it, and see how it acts then: put the bulb in a mixture of snow and salt, or in ice just changing to water. If that does not send the mercury below 64 deg. there is certainly something wrong, and you had better take the instrument to a maker.)—MUNDANAS. (Perhaps the tubes were not properly annealed; but of what use will so short a tube be? Pour the mercury in through a little paper funnel so that air can escape, and shake down occasionally. The glass should be chemically clean.) — SAVANT. (Simply treated much in the same way as parched peas are produced, the grains being heated until they burst or pop.)—A POOR FOWLER. (For browning gun-barrels, see the number for Jan. 21, 1887; or Jan. 23, 1885. The latter contains very full directions from two correspondents, and can be had for five halfpenny stamps, direct from this office.)—GRAMO. (There are several methods of procuring the desired surface on a blackboard. Any stained varnish mixed with a little fine grit, such as powdered coke, pumice, or fine emery will do. Perhaps the best way is to stain the board black first, then coat with copal varnish, and dust over very fine emery or finely-sifted coke dust. Rub down, and repeat. The simplest is to mix black paint with copal, and apply the dust, which should be so rubbed down as to give a bite to the chalk while offering little resistance to the subsequent operations for removal of the marks.)—H. We do not remember the "collision pads" named. Where did you find any mention of them, as being in actual use in, or supplied to, various navies?) — MEPHISTO. (Mr. Wesley, Essex-street, Strand, W.C., can no doubt supply all the publications mentioned. The *Monthly Notices* is published by the Society (apply to the assistant secretary); the *Sidereal Messenger*, by W. W. Payne, Northfield, Minnesota; the *Astronomical Journal*, by B. A. Gould, Cambridge, Mass.; the *Ast. Nach.* is in German, by Dr. Krueger, Kiel. As a rule, single numbers cannot be bought.)—AN APPRENTICE. (Nichols's work on "Boiler-Making" could be had from the author at Blackpool; but possibly Mr. Calvert, Great Jackson-street, Hulme, Manchester, can supply it.)—BOBBINS. (The question has been frequently answered—see indices, or any textbook of electricity or physics. Zinc and copper plates, for instance, separated by canvas or cloth wetted with salt-water or with vinegar, will yield current. 2. Take the engravings out and clean with stale bread. 3. Not if you mean the actual details of construction.)—AN OLD SUBSCRIBER, Folkestone. (You must get real *tin*-foil, not lead-foil, and it will amalgamate with the mercury or quicksilver, especially so with the aid of heat. Equal parts will form a solid amalgam. Ten parts of mercury to one of tin remains liquid, but these metals combine in all proportions with the aid of heat.)—NOVICE. (Better write and ask Messrs. Bailey and Co. direct).—URSA MINOR. (Please repeat query not inserted.)—E. E. M., MODEL STEAMER, PARVO (In type).

**Recovery of Mr. T. J. Ritson.**—Writing from 18, Queen's-road, Brighton, he says:—"Though ten days only have elapsed since I commenced to wear your Electropathic Belt, it nevertheless affords me the greatest pleasure to be able to testify to its marvellous recuperative properties. That eternal feeling of exhaustion which frequently came upon me after a few hours' mental and bodily work has, even after so short a trial of your Belt, already vanished; in fact, I already feel myself to be a new man, enjoying better health and greater elasticity of mind than I have experienced for many a year. I am recommending your Belts in all directions." All in search of health, strength, and vigour should either call at the Electropathic and Zander Institute, 52, Oxford-street, London, W., and avail themselves of a free personal consultation, or write for descriptive pamphlet and book of testimonials.

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## OUR EXCHANGE COLUMN.

*The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.*

**Village Cart**, 12 hands, light running, sound. What offers in exchange?—FORD, 72, Queen's-road, Bowes-park London, N.

**Safety**, hollow rims, tangent spokes, balls throughout; Tricycle, Cripper, balls throughout. Exchange Lathe or ½H.P. Otto Engine.—ENCORE CYCLE DEPOT, Kirkwood-road, Nunhead, London.

**Gas Engine**, half-man-power. Exchange, Mechanical, Electrical, Lathe Chucks, or Apparatus suitable for 3½ S.C. lathe, or Planing Machine.—DISLEY, Blandford, Dorset.

"**Allen's Commercial Organic Analysis**" wanted, second volume; will take both if necessary. "Cameron's Oils and Varnishes" wanted. Offers.—J. W. S., 4, Brunswick-place, Leeds.

**Printing Press**, prints 9in. by 15in., cost £12. Exchange breech-loading Gun or offers.—R. GORNALL, Damside, Pilling, Garstang.

Exchange Vol. XI. "**Boy's Own Paper**," strongly bound, with extra parts; for small Printing Press.—J. RUDKIN, Crouch-street, Colchester.

**Dulcimer** and stand, large size, in good condition. Exchange small Table Lathe or Dynamo, or anything value 35s.—Below.

Silver Curb **Albert** and Locket, hall-marked; also Stamp Album, containing about 600 stamps. Exchange anything useful.—P. MUCKLE, 2, Bowles-place, Whetstone, N.

52 **Bicycle**, ball-bearings. Wanted to exchange for Lathe or Lathe Parts, or other offers. Tools preferred.—B., 3, Saville-place, Newcastle on-Tyne.

Pulvermacher Galvanic **Battery**, 120 cells, handles; also Water Decomposer, gives mild or powerful shocks or continuous current as desired, new, complete, splendidly made. Wanted, Engine Cylinder, Model Steam Gauge, pint Cells, Zincs, Carbons, Clamps, Terminals, or offers to 18s. value.—ADVERTISER, 14, Argyle-street, King's Cross.

Wanted, 1½H.P Vertical Boiler, complete, with fittings, guaranteed to 50lbs. pressure; ¾H.P. Vertical, guaranteed to 25lb., given in exchange with cash.—H. B., care of Hall, Broad-street Corner, Birmingham.

Model **Force Pump**, ⅝in. ram, 1½in. stroke, 10s., brass clacks and valve seatings, beautiful workmanship. See answer 72901, this week.—R. STOTT, Lostock, Bolton.

Wanted, a good full-toned Dulcimer in exchange for ROYAL ORGANETTE. Mutual approval.—W. BOYDELL, Euxton, Lancashire.

**Fretsaw**, in wood framework; cost 7s. 6d.; good as new. Offers in exchange wanted.—Address, H. J., 73, East-hill, Colchester, Essex.

Mahogany Photographic **Camera**, with ¼-plate lens, dry plates, chemicals, in exchange for Bottle Bichromate Cell in good condition.—A. Moody, Queen-street, Louth.

Wanted, 1 or 2 small **Arc Lamps** and Switches for 50-volt circuit, second-hand 7-18 cable, good gravity voltmeter, ammeter, speed indicator, and 3H.P. vertical boiler with fittings. Exchange.—V. Baughan, Charlbury, Oxfordshire.

Wanted, good Foot Lathe. Exchange white **Cockatoo** and Cage, value 55s.—A. E. Say, Bloxham, Midland House, Midway-street, Leicester.

Exchange **Magic Lantern**, 3in, double condensers, eight comic slipping slides, slide holder, for 50 or 60c.p. Dynamo Castings.—W. Holt, 8, Earl-street, Skerton, Lancaster.

**Printing Press** and **Type**, value 20s. Want Melodeon or offers.—Time Table Office, Daventry.

**Magneto Electric Machine**, size 5 by 3in. Will exchange for useful tools value 10s. 6d.—L. P. Brough, Chilcote, Ennerdale-road, Kew, W.

½H.P. Beam **Engine**, fitted with governors, throttle and slide-valve, &c., on iron bedplate. Exchange Singer's Sewing Machine or Printing Press.—John Pedley, 8, Stuart-street, Luton, Beds.

**Clarionet**, 13 keys, 2 rings, splendid instrument, value £3 3s. Exchange Detective Camera, Musical Box, or offers.—H. Marshall, 36, Buckingham-road, Stratford.

Lathe Castings wanted in exchange for ½-horse horizontal engine, new. Particulars, stamped and addressed envelope.—Thomas Clark, Rutland-terrace, Barlow, near Chesterfield.

"**Household Physician**," by J. McGregor Robertson, four vols. cloth, unsoiled, cost 30s. Exchange Laverne's Detective Lens, or Photo offers.—Below.

Rodger's treadle **Fretsaw Machine**. Exchange Walking-stick Tripod, or Photo Lantern Slides.—Davis, 30, College-road, Cork.

**Lantern Slides**.—Temperance and other sets, Life Models, Comics, Views, &c., for other good sets (temperance preferred.)—W. S. Price, Wellington, Somerset.

Four-wick **Lamp**, 1½in. wicks, and Lantern Slides offered in exchange for similar lamp, with 2in. wicks.—W. S. Price, Wellington, Somerset.

Beautiful model brass **Boiler**, 7 by 2½, complete, with safety-valve, water-tap, steam-tap, and union; offers.—F. Richards, 3, Larkbeare-road, Exeter, Devon.

Splendid **Engine**, Polished Brass Cylinder, ¾ bore, reversing gear parallell guides, &c.; no boiler. Photo 2d.; exchange 3½in. centre backgear Lathe Castings.—Gannon, Chelmsford.

12in. **Electric Bell** (Church Shape), Double Action, by celebrated electricians, weight 45lb., cost £4 10s. 7½in. ditto, as above, weight 8lb., cost £1 10s. Both bells as new, perfect working order. Offers for each.—E. S. Morley, Victoria-road, Diss.

For exchange, 120c.p. Jones's **Dynamo**, Bicycle Home Trainer. Full particulars, stamp.—John Hayward, 22, Redcliffe-hill, Bristol.

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**Drawings** for all Countries of the World prepared in accordance with the laws. Charges much less than usual

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Browning's **Pocket Spectroscope**, with comparison prism, &c.—J. W. Fleming, 24, Saltaire-terrace, Greatham, Durham.

**Pipe Improver**, new patent, guaranteed to improve the smoking qualities of any pipe; causes an even and easy pull, and prevents all waste of tobacco; post free 2½d.—Davidson, 32, Port-street, Stirling.

e English Mechanic
WORLD OF SCIENCE AND ART.
*FRIDAY, DECEMBER* 12, 1890.

# PHONES: THEIR CONSTRUCTION AND FITTING.—XI.

By F. C. Allsop.

of "Practical Electric Bell Fitting,"
Electric Bell Construction," "Practical
Electric Light Fitting," &c.

**Connecting Up.**—(*continued.*)

REE Telephone Stations with Three-Point Switch.—Fig. 59 shows use of the three-point switch, there three telephone stations, one of can communicate with either of her two by means of the switch. wire at the top runs to instru- No. 1, and is connected to the terminal of the switch S. The left- terminal is connected to instrument No. 2, and the right-hand one to instrument No. 3, an earth return being used for all the instruments. The switch S would be fixed close to instrument No. 2 or No. 3. When the handle of the switch is to the left, No. 1 instrument is connected to No. 2, but when moved to the right, No. 1 is connected to No. 3. This arrangement is very convenient where there are two offices at one end of a line, and it is desired to be able to communicate from either of them. Thus, when the person leaves the one office he moves over the switch, which he again moves back when he returns. For a medical man also this is very useful, enabling him to have one instrument in his consulting room and the other in his bedroom. In this case of course the wire to No. 1 instrument would be an exchange line. The small diagrams *a* and *b* show which terminals of the switch are connected together when the handle is in the two different positions.

*Two Telephone Stations with an Extension Bell.*—Fig. 60 is an arrangement similar to that just described, there being what is called an "extension bell," instead of the third instrument. This enables the bell to be placed at such a place where it might not be convenient to fix the telephone, so that the signals can be better heard. It is convenient also where the person who uses the instrument wishes at times to leave his office for another part of the building where the bell would be fixed. When the handle of the switch (which is a three-point one, as shown in Fig. 59) is to the left, the extension bell is connected to instrument No. 1; but when to the right, No. 1 is connected to No. 2. The handle of the switch must be put to the right during conversation, but returned to the left when finished. The extension bell shown is a magneto one, but the connections are similar for the battery form.

*Three Telephone Stations, with Extension Bell at One Station and a Four-point Switch.*—Fig. 61 shows how three telephone stations can be arranged by means of a four-point switch, so that No. 1 can speak with No. 2 or No. 3; but No. 2 and No. 3 cannot communicate with one another, an extension bell being used so that the station not in con-

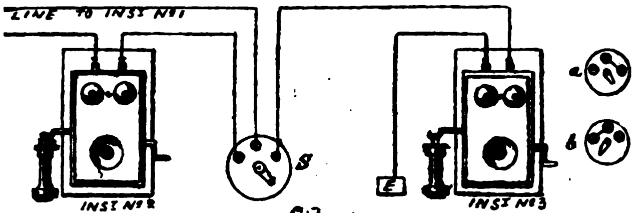


Fig. 59.

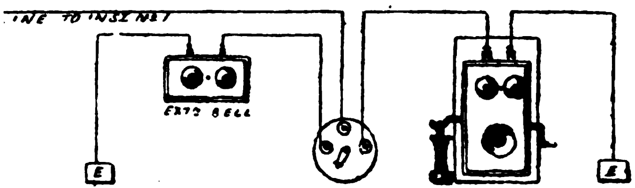


Fig. 60

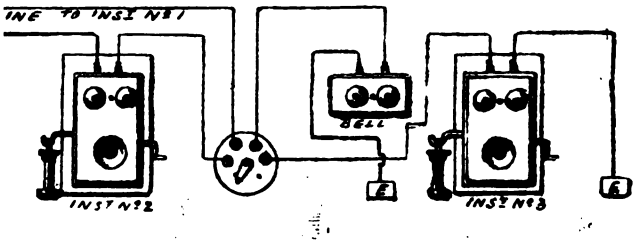


Fig. 61.

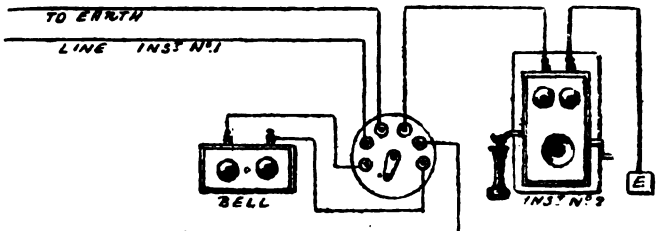
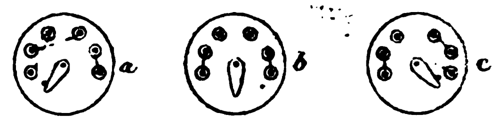


Fig. 62



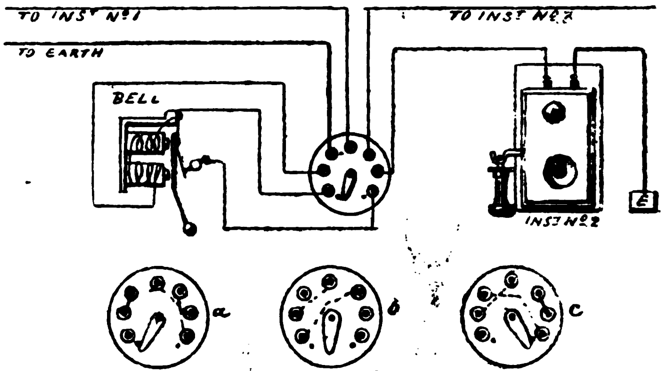


Fig. 63

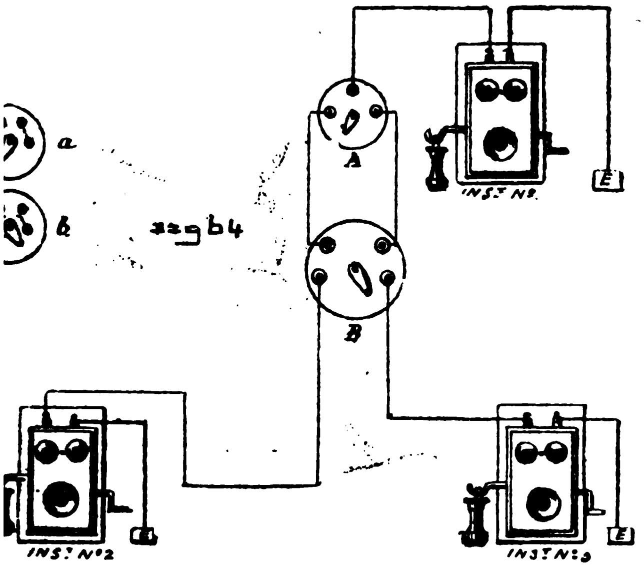


Fig. 64

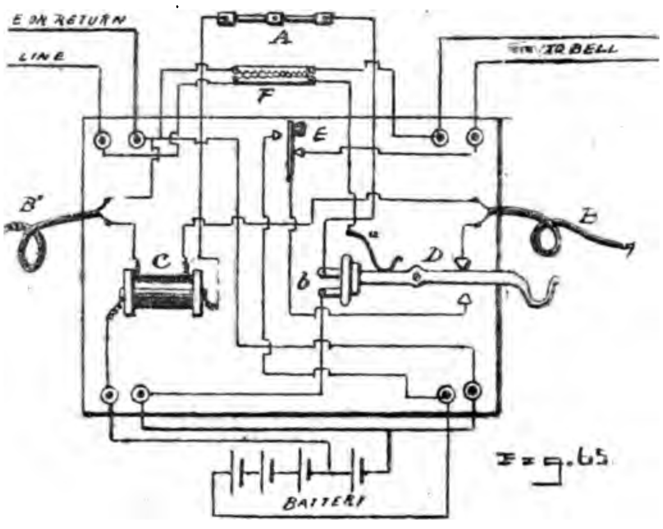


Fig. 65

nection with No. 1 can give notice of their desire to communicate. By means of the key diagrams *a* and *b* the connections inside the switch at the different positions of the handle can be ascertained. It will be seen, on referring to these, that when the handle of the switch is to the left, No. 1 instrument is connected to No. 2, and instrument No. 3 is in connection with the extension bell. When the handle is to the right, No. 1 instrument is connected to No. 3, and No. 2 instrument is on the extension bell. Both the switch and extension bell would be in the same room as instrument No. 2, and the normal position of the switch would be that shown in the figure—that is, instrument No. 2 connected to No. 1, and instrument No. 3 on the extension bell. If instrument No. 3 wishes to communicate with No. 1, he rings the extension bell, and the person at station No. 2 puts over the switch. This arrangement is generally used in connection with a public exchange system, in order to prevent the subscriber making an illicit use of his instruments. Thus it will be seen that if No. 1 instrument is the exchange, the subscriber is enabled to communicate from either of his instruments with the exchange, but yet cannot use instruments No. 2 and No. 3 as a private line, which he would not be entitled to do unless he previously arranged to that effect with the company.

*Three Telephone Stations with a Six-point Switch and Extension Bell at the Intermediate Station.*—Fig. 62 shows the use of the six-point switch in connection with three telephone stations, which may be either exchange and private, or wholly private lines. Key diagrams, *a*, *b*, and *c* are given of the connections of this switch for the different positions of the handle. When the handle is to the left, as shown in the figure instrument No. 1 (which would be the exchange line were the combination in connection with an exchange) is in connection with instrument No. 2, while instrument No. 3 is connected to the extension bell, the left-hand terminal of which is put to "earth." If the switch-handle is moved over to the right, instrument No. 2 is connected to No. 3, and instrument No. 1 is in connection with the extension bell, the right-hand terminal of which is put to "earth." When the handle of the switch is in the centre instrument, No. 1 is connected to No. 3, and instrument No. 2 is cut out of the circuit, the extension bell being looped in so that No. 2 station can be signalled to disconnect. As an illustation of the use of this arrangement, when No. 1 instrument is an exchange line, we will take take the case of a large suite of offices. No. 2 instrument with the switch and extension bell would then be placed in the clerk's office, and No. 3 in that of the principal. All calls are then received and answered by the clerks, who, if it is important, places the handle of the switch over to the right, and ask the principal if he will speak with the person calling. Should he wish to do so, the clerk moves the handle of the switch to the central position, and the clerk's office is cut out. When the conversation is finished, the clerk's office is signalled to put back the switch into its normal position, which is that shown in the figure.

*Three Telephone Stations with Seven-point Switch and Extension Bell, which is converted from Vibrating into Single Stroke.*—Fig. 63 shows how three stations are connected up, using a battery-extension bell, which is converted from vibrating into single-stroke, when the intermediate station is cut out, so as to avoid a possible break of the circuit when speaking through the contact-breaker of the extension bell. The arrangement it will be noticed is very similar to the one just described. A seven-point switch, however, is used, the key diagrams of which are shown in *a*, *b*, and *c*. A wire is taken from the frame of bell, so that when the switch is in the central position, and the intermediate station is cut out, the bell becomes a single-stroke; but when the handle of the switch is to the left or right, the bell is a vibrating one. This prevents the conversation being interrupted when station No. 1 is speaking to station No. 3 by anyone accidentally touching the hammer of the bell, which would cause the spring to break contact with the contact-screw, and thus break the circuit.

*Three Telephone Stations, Two of which are connected through at Night.*—Fig. 64 shows how, by means of a three and four-point switch, three stations may be connected up so that two of them may be looped through at night. A is a three-point and B a four-point switch, *a* and *b* being key diagrams to the switch B. When the handle of the switch B is to the left, instrument No. 1 can communicate with either No. 2 or No. 3; but if the handle is moved to the right, instrument No. 2 is connected to No. 3, and No. 1 is cut out.

*Connections for the Ader Telephone.*—Fig. 65 shows the connections for the Ader instrument. In the figure, A is the microphone, B and B′ the two receiver cords, C the coil, D the automatic switch, E the ringing key, and F the lightning arrester. The receivers are not shown in the figure. The current entering at "line" passes through the bottom plate of the arrester to the spring (*a*) on the top of the automatic switch. From there it passes (if the receiver is on the hook) to bottom contact, ringing key-spring, back contact of key to bell, and from thence to top plate of arrester and "earth," or return line.

If the receiver is off the hook, as shown in the figure, the current passes from spring (*a*) to top contact, receiver B secondary of coil, receiver B′, to "earth," or return line.

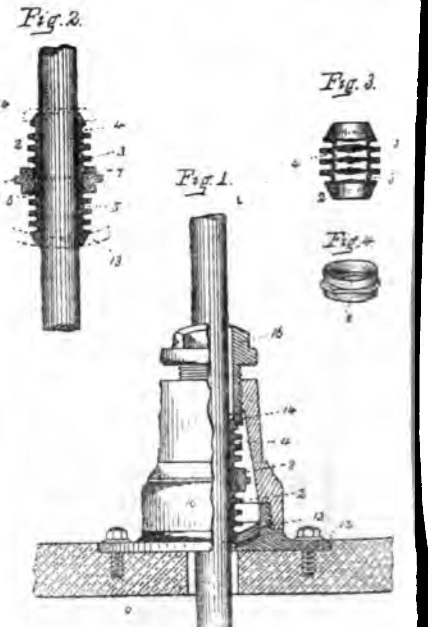
The "local" circuit runs from the positive pole of one cell of the battery to primary of coil, microphone, spring *b* (closed by the brass pieces on the end of the switch hook), and from there to the zinc of the battery.

The "ringing" circuit is when the key E is pressed, from the positive pole of the battery to bottom contact of key, key-spring, switch-hook, spring *a*, bottom plate of lightning arrester, to "line" other instrument, and back by "earth" or return line.

(*To be continued.*)

## PAGE'S METALLIC PACKING.

THE "improvements" in packings for valve-stems, piston-rods, or other places in steam, water, or gas-engines, where tight joints are required with the minimum of friction, are the subject of numerous patents; but perhaps the arrangement described below and illustrated in the annexed engravings is as good as any, if not better than most. It forms the subject of a patent granted in this country to Mr. W. J. Page, of Boston, Mass. The invention in brief consists of a single piece of Babbitt or other suitable metal cast or otherwise formed as follows:—A short cylinder is bored lengthwise or cast with a diameter to fit the rod or valve-stem, while upon its exterier surface are cut or otherwise produced a series of annular grooves, which extend some distance into the body of the metal, thereby reducing or crippling the metal at that point. When this integral ring is subjected to pressure, the metal at the bottom of the grooves, or at the weakest portion, yields its thrust inwardly upon the rod. Thus the enlargement of the bore of the packing consequent upon wear is compensated for and fresh metal is supplied. In this way a solid packing ring can be made, which has all the advantages of packings possessing elastic or yielding characteristics after the manner of fibrous packing in general use. Fig. 1 is a sectional elevation of a metallic packing embodying the invention; Fig. 2 a sectional view showing the packing adapted for multiplication; Fig. 3 is a longitudinal section of a packing piece after compression; and Fig. 4 is a perspective view of the compression ring. The object of the invention is to produce a solid ring packing which shall be capable of compression about the rod or shaft upon which it is applied in order to compensate for the wear, or in case it should become necessary to render the joint tight against increased pressure or for other incidental causes. The packing 2 is composed of some soft metal or alloy, such as is used for bearings—commonly termed Babbit. Its construction is as follows:—In general shape a hollow cylinder, the internal diameter being such as to fit the rod or valve-stem about which it is to be applied. The exterior surface of this packing is formed with alternate annular ribs 3 and grooves 4; the cross-sections of the latter are U-shaped, preferably oval or circular at the bottom, and cut of such a depth as to leave a thin web 5 of metal which interconnects the two adjacent ribs or rings 3. The purpose of such construction is to present the weakest portion of the web 5 centrally between the ribs; hence when pressure is brought to bear upon the packing 2 the rings are forced together and the metal forming the web is thrust against the rod or valve-stem. In this way a fresh packing surface is presented which compensates for wear and maintains the joint tight. These packing pieces 2 are adapted for multiplication upon a rod, in which event their ends are tapered or of conical shape, while the contiguous ends are termed respectively male and female. This construction is shown in Fig. 2, where the male end 6 is shown as fitting tightly to the rod, while the female 7 is slightly flared at this point and adapted to receive the male end, the latter crowding between it and the rod. In connection therewith the patentee employs a compression ring 8 of some hard metal which is reversely tapered interiorly to coincide with the tapered ends of the packing pieces 2. At the meeting of the tapers a flat surface is created which is adapted to prevent the metal of the packing from spreading outwardly, when pressure is exerted against the opposite ends of the packing pieces. Thus when the gland forces the pieces together the metal composing them and located beneath the compression ring is only thrust the more forcibly against the rod. By such arrangement the required packing surface may be made of any extent and continuous along the rod. Having thus created several packing pieces, 2, the patentee proceeds as follows:—To the end of a steam-chest or cylinder-head, 9, shown in part in Fig. 1, he secures a packing-case, 10, separately united with a flanged base, 12, rigidly bolted to the steam-chest. The interior central portion of the base is concave, and adapted to receive a bearing-plate, 13, which is coincident in curvature with the concave portion of the base; the bore both of the base and that of the bearing plate are of larger diameter than the rod which thus passes freely through. That portion of the bearing-plate contiguous to the packing, 2, is preferably cut away (or flared) to receive the tapered end of such packing, pressure from the gland at the opposite end serving to crowd the soft metal



cing snugly about the rod. A packing piece, now passed over the rod 15, a compression ; follows, and then a second packing piece, lly the follower 14 is added, and the gland 14 hen positioned, engaging with the other end :he casing 10. The gland is now screwed n until the desired pressure is obtained. It be observed that the follower 14 is adapted eceive the tapered end of the packing con-ous thereto after the manner of the bearing-e, while the bore of both follower and gland eds the diameter of the rod to permit of ral divergence of the reciprocating rod should occur.

## HOW BOOKS ARE BOUND.—XII.

By "Practical Bookbinder."

E come now to the artistic part of our subject —that which is commonly designated inishing." It is no figure of speech to say that k-finishing is an art. It has ever been so; museums and libraries plainly show that in ner ages neither time, trouble, nor expense been spared in the embellishment of book-rs.

book, be it never so well forwarded, will not much of an appearance unless it is well

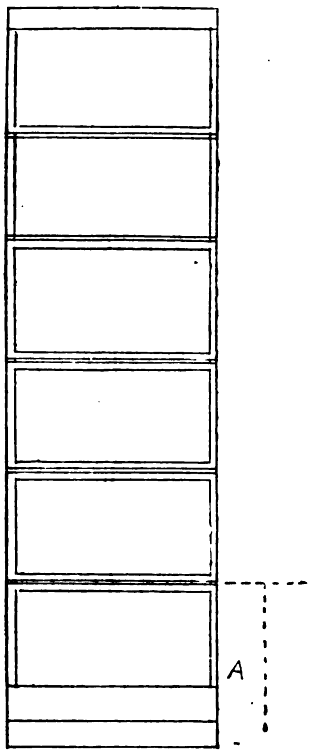


FIG 35.

hed. (The reverse of this is also true, how-; a book that has been finished in the highest e of the art is but a mockery if it has not been forwarded).

t the present day we are somewhat handi-ped for time to properly execute our work; the prices are so low that it is impossible in t cases to make any attempt at artistic work; nevertheless, we do put out some splendid nples, which are simply triumphs of taste and nt.

this were the place for such a thing, I would much pleasure in entering fully into the ils of this part of the subject; but I can do e more than merely glance at it.

recent years, since the introduction of cloth ling, a new branch has sprung up called king. The designs which appear upon cloth-nd books are in many cases unsuitable for her work.

designing the stamps, which are to appear n the sides of the books in gold and colours, best artists of the day are employed, and a large number of the most beautiful gns are brought into our homes, which, des adorning our book-shelves, help in a t measure to cultivate our taste for all that is stic.

wish it were possible in these articles to trate this point by giving a few examples; but, after all, it is really unnecessary, thanks to the display in the booksellers' windows.

I need not go into details of the blocking process, as few amateurs would care to go to the expense of providing the necessary machinery and blocks, which are very expensive.

The finishing of calf bound books is commenced

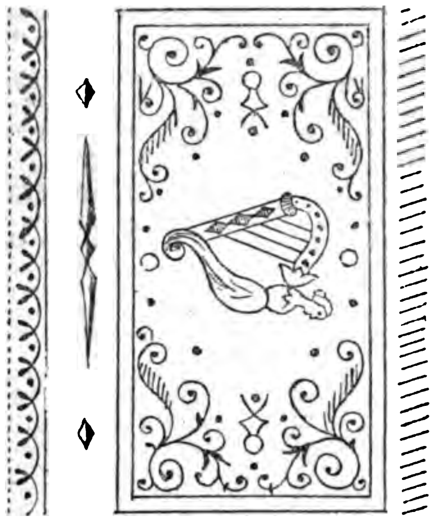


FIG 36.

in the following manner. We will suppose, for the sake of lucidity, that we are working upon a volume of Moore's "Irish Melodies." It has been bound half green calf—i.e, the back and corners are of green calf—and it is to be finished "extra."

As soon as the finisher gets it, he takes a little tool called a band-stick, which is simply a long piece of hardwood, 10in. by 1in. by ½in., planed

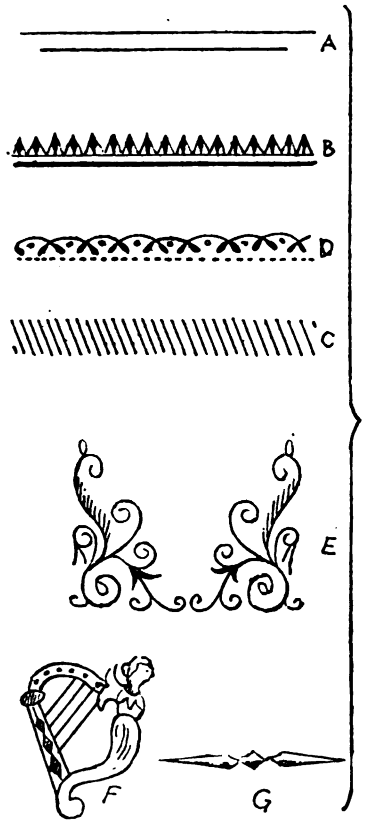


FIG 37

square, and rubs the leather close into the bands, of which there are five on the book. During this operation the book is held firmly in the left hand, the foredge resting upon the table. A little piece of red morocco, which has been pared very thin, is now taken and cut to the exact size of the first panel—i.e., the space between the first and second bands—and after having been pared with the knife neatly round the edges, is stuck on in this space with a little paste. This is for the title of the book, and the operation is called "piecing." Proceeding, the finisher "trims out" the books. The leather when put on by the forwarder is generally a little out of the straight, for obvious reasons; the finisher trims it nicely by making the back and corners square and of the same size and breadth upon both sides of the book. He now opens the board and tears out one leaf of the end-papers, and cleans the joint from little pieces of hard paste or glue which may have remained from the covering process. Both sides are treated in the same manner, and these leaves are laid aside for lining the inside of the board afterwards. From the next leaf of the end-paper an eighth of an

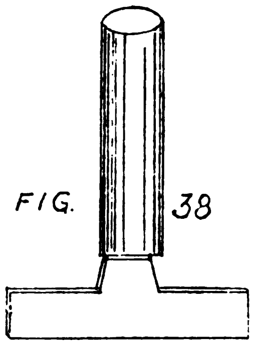


FIG. 38

inch is cut off each end, so that when pasted up to the board the inside square of the board will present an equal appearance all round.

The back of the book is now marked off with the folder, as shown in Fig. 35. These marks are for the guidance of the tooling; it is usual to tool each compartment between the bands with the same design having lines inclosing the design.

Calf is very porous, and before putting on the gold size it must be rubbed with paste to fill up these pores. Have ready a little paste-water (which is simply water in which a little clean paste has been mixed) and a clean sponge. Paste the back of the book with the brush and rub it carefully over with the folder, taking care that it is rubbed evenly, and that no marks are left upon it; wash the paste off with the paste water and allow it to dry. When it is perfectly dry, give it two coats of glair or size, allowing the first to dry before applying the second. Finisher's glair is simply the whites of eggs prepared in the following manner:—Break up a quantity of eggs into a wide dish, such as a bowl, carefully keep back the yolk, and allow only the white to

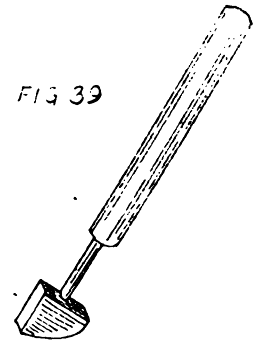


FIG 39

go into the dish; put one or two drops of vinegar in to each egg, and beat into a white froth; put aside to settle. A clear amber-coloured liquid will result, as thin as water. In coating large surfaces with glair, such as the back or side of a book, use a sponge; but for small surfaces use a camel-hair pencil.

When the glair has become perfectly dry, the gold is laid on. Proceed to do this in the following manner:—Take the gold-rag (a square of calico slightly oiled all through, kept for rubbing off the surplus gold after tooling), and rub the back all over lightly. Now take upon a small pellet of cotton wool a small piece of lard, which must be of the best quality, and rub the back, or portion of the back, where the gilding is to appear carefully with it; spread the gold leaf upon the cushion, and cut it to the required size and lift it carefully upon a pad of cotton wool; lay it down upon the back and press it evenly; the lard keeps it in sufficient contact with the surface to be gilded until the tooling is completed.

The next operation is the tooling; the book is put in the press, a small press which lies upon the table, with the back standing up at sufficient height to suit the finisher. The tools are placed upon a gas-stove and heated, and taken up one by one and pressed upon the gold, the heat causes the gold to adhere to the leather, and the pattern of the tool, whether it is a line or an ornament, is impressed thereon, and the surplus gold is rubbed off with the gold-rag.

Finishers' tools are made in brass and provided with a wooden handle; the ornamentation is cut on the face. In Fig. 36 I have shown the tooling of the bottom panel (marked A in Fig. 35) for the copy of Moore that we are supposed to be working upon. For this we require the following tools (see Fig. 37). A, a two-line pallet; B, a cat-tooth pallet; C, a cross-bar pallet; D, a tail-pallet; E, a pair of corners; F, a centre; G, a sprig, and small circles and points. These tools are all made in the same manner, and they are to be had in every conceivable shape and design. I have only drawn out those which we require for the book in hand. Fig. 38 shows a pallet with a handle attached.

After the book has been laid on and put in the press, the two-line pallet is pressed on up the side of the back, taking care to mitre each panel; the same pallet is now passed across the back to the lines which have been marked with the folder. The cat-tooth is then put on at the side of each band, then the tail-pallet is put on both head and tail, taking care to turn the pallet, so that the points are outward in both cases; then the corners, working from both sides of the book, and the centre may now be placed in position, finishing off with the sprigs, circles, dots, &c. When this has been done the surplus gold is wiped off, as already explained, and the lettering of the title proceeded with. A letter is chosen which will suit the space allotted for the title, and three lines are marked on the top of the gold with a fine thread. A mere touch of the thread will make a line that will show. If the thread is pressed tightly it will mark the leather, which is not desirable.

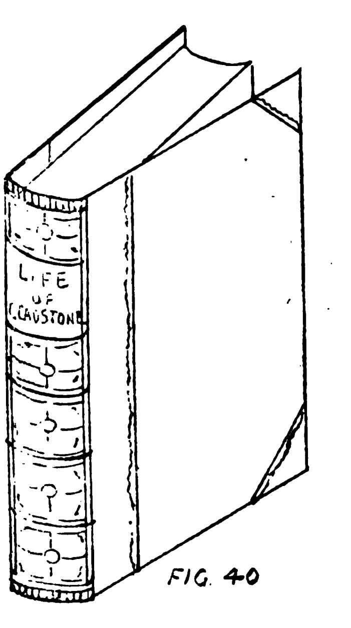


FIG. 40

The letters are heated, and taken up one by one and impressed evenly to the lines, taking care that they are spaced equally. After the gold has been wiped off, the back is rubbed over with a piece of soft flannel to take off all grease or small pieces of surplus gold which may still be adhering. The whole back is now polished with a hot polisher. Fig. 39. This finishes the back, and care must now be taken not to soil it in the after-operations. Fig. 40 will give an idea of a full extra back.

This description is easily written, and as easily read and understood; but for the amateur who wants to carry out the instructions in a practical manner, the matter is not quite so easy. However, there is nothing for it but try, and if you fail you must just try again and again until you become perfect. It takes seven years in the workshops to make a finisher, and a man must show some special smartness before he is intrusted with extra-work.

The greatest care and attention is necessary to get the proper degree of heat for the tools; if too hot they will burn the leather, and if too cold they will not make the gold stick. Even different colours of calf require a different degree of heat to perform the work successfully. This, of course, can only be found out by experience. The amateur, therefore, who wishes to succeed must keep his wits about him.

The treatment of morocco is somewhat different from that of calf; but I will reserve my remarks about it until my next article.

## PHOTOGRAPHIC AND OPTICAL NOVELTIES.

MESSRS. PERKEN, SON, AND RAYMENT are introducing two useful novelties. Fig. 1 shows their new "Optimus" magnesium flash lamp for photographers. A is the stopper of the spirit lamp; B, spirit reservoir; C, stopper of the magnesium reservoir; D, reservoir of magnesium powder; E, junction of rubber tube; F, spring tap for conducting powder to passage; G, pneumatic ball; H, stand or handle for supporting lamp; K, removable screw cap to allow cleansing; L, junction between pneumatic ball and tube. To use the lamp, remove the stopper A from the reservoir B, fill the reservoir B with as much spirit as the sponge will absorb, replace the metallic gauze as well as the stopper A to prevent evaporation. Remove stopper C from reservoir D, into which pour the magnesium powder, which should be perfectly dry. Replace the stopper C to prevent loss of powder. The lamp may be held in the hand or stood on a table or other support. The lamp being now ready, remove the stopper A and light the spirit reservoir, waiting until it burns well, press the pneumatic ball G to assure yourself that the air passes freely without extinguishing the flame. Press the spring tap F, which will allow the powder to enter the tube above it, and close again. Now on squeezing the ball G the air will force the powder through the flame and give a brilliant flash. By pressing the tap F two or three times, more powder can be burned, and a more intense flash may be obtained. To create a continuous light remove the pneumatic ball G from the rubber tube at L, and blow softly with the mouth, at the same time holding open the spring tap F, which will allow the powder to enter the passage whilst the wind you blow into the tube carries it through the flame. The screw cap K may be removed to enable the passage to be cleansed, which is very necessary to the proper performance of the little machine.

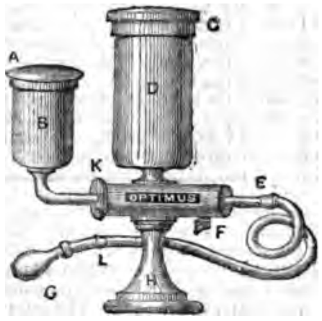


FIG. 1.

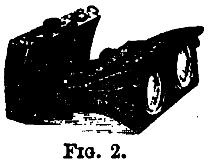


FIG. 2.

Fig. 2 shows their new "Optimus" "Ubique" binocular (Col. Cardwell's patent), suitable for military and naval use; also for the racecourse, theatre, and touring. The "Ubique" is very suitable for officers. It can be attached to the cross belt in place of pouch, and the regimental badge can be readily affixed. For racing
touring it is well adapted, being a
glass with a wide visual angle, as well
light and portable. It may be carrie
pocket like a cigar-case, and is, therefore
convenient form of glass for the op
theatre, requiring no bulky outside case.

## FARMER'S IMPROVEMENT
## PHOTOGRAPHIC FILMS

THE action of the chromic salts on
and other colloid substances is well
but Mr. Farmer, of the Polytechnic,
street, W., has discovered that similar
are effected when bichromates are brou
contact with silver surrounded by gela
he obtained a patent for the process. I
tine films are prepared in the usual
without, however, any hardening agen
picture being taken, the plate with t
image, preferably developed with iron
mersed in strong bichromate of amm
about a minute, and is then washed a
when it is ready for use in the printing
as follows:—The plate may be of co
may be etched; the etching fluid will
where the plate is most protected by
matter. A copper printing plate is thus
The plate or surface may be treated
water, and then used for printing by p
suitable ink on the surface, laying paper
and expelling the superfluous ink by
The plate or surface may be used d
printing by rolling a greasy ink upon
ink adheres to the insoluble parts, and is
by moisture which the unchanged parts r
the inked plate is then pressed against t
to be printed. The plate or surface
charged with greasy ink, and after was
image may be transferred to a lithograph
or surface, which may then be used in
in the well-known manner. In the pre
of the plate, chemically similar reagents
used in place of bichromate of ammon
organic bodies similar to gelatine can be
place of or in conjunction with it. The
mate or similar reagent may be placed pr
in the film or developer, and react on t
tine at the same time as the develo
free the metallic silver. In this proc
chemical reducing properties of silver
ployed, the silver image, acting with th
the bichromate, to render the gelati
insoluble, while the metallic silver form
image acts in the place of the light in
chemical change in the film.

## HOPS AND BITTER PRINCI

By CHARLES E. SOHN, F.C.S., A.I.

THE hop plant, so well known to the inh
of the south-eastern counties of Eng
account of the large area there devoted to
vation, is found wild throughout Europe a
of Asia, extending northwards as far a
dinavia, southward to Sicily and Gree
eastward to central and south Siberia. T
within which it can be successfully cultiv
brewing purposes are, however, more re
It grows to perfection as a rule a little ab
within the northern boundary of the w
ducing regions. England is the largest hop-
and hop-consuming country in the worl
follow Germany and Austria, the Unite
France, and Belgium. The total pr
of the world is roughly estimated at a
and a half cwt., and of this quantity
produces in a good year one third or ev

There are in this country at the pres
54,555 acres of hop land. The yield v
course, considerably; but the average
7cwt. per acre, giving in round
400,000cwt. Of the 55,000 acres above m
33,500 are in Kent, about 7,000 in Sussex
Hereford, 3,000 in Worcester, 1,900 in Sur
the Continent the most important hop-
districts are those of Bavaria, Wurtemberg
Bohemia, Alsace, Lorraine, Burgundy
France, and Belgium. In America,
grown largely in New York State, C
Oregon, and Washington Territory.

The hop belongs to the order *Cann*
which includes the common hemp. It is
producing annually long, roughish, twist
and coarsely-toothed leaves resembling th
vine, but much rougher. It is diœciou

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* Extracted from a paper read before t
London College Science Society.

ay, the male and female flowers are produced different plants. It is the female plant that we re to concern ourselves with, as the male is of no mmercial value; in fact, it is not grown at all, l whenever found in a plantation is removed. I l, therefore, merely remark concerning it, that flowers form in loose, drooping panicles, each ver having five petals and five stamens. The male flowers grow upon the angles of a zig- spike, the florets being protected by broad, rlapping, concave bracts, which, by their elopment, form the cone or strobile used by the wer. These bracts, which number 40 to 100 in cone, are curled inwards at the base, and enfold t Flückiger describes as a small lenticular ed fruit or nut $\frac{1}{10}$ of an inch in diameter. This t (popularly referred to as a seed), and also the and the base of all the leaf-like organs which stitute the cone, are beset with numerous ing, translucent glands, called Lupulinic grains Lupulin, and it is to them that the aromatic ar and the taste of the hop are principally due. ddition to this fact, which in itself renders them he greatest importance to the brewer, these ulinic grains are of great interest both to the mist and the microscopist. Inasmuch as these ds are formed upon the skin, they come under denomination of glandular hairs, although, in earance, they are very different to the true hairs. ure to yourself, says Dr. Braungart in his ription of their development, a sort of spoon- ped vessel, or a shallow circular basin, either do, because these glands are sometimes oval, at other times round. The vessel, whether the or the other, has a central depression. Imagine ther that it has a wide, flattish brim slightly ved, and that the base, instead of being smooth, a blunt point; that the colour is snowy white h a silvery lustre, and that the inner surface has ely lying upon it a very delicate, transparent mbrane. You have, then, a good idea of the puline gland in its earlier stage of development ore it contains any of that yellow resinous matter much valued. If we watch this little basin we ll see a minute drop of fluid appear in the centre the depression immediately beneath the above- ntioned transparent membrane, termed the icula. This drop becomes yellow, and increases tinually in size, until the cuticula is swollen up a hemisphere above the rim of the vessel; we ve, then, the Lupuline grain as it appears, if the retion be sufficiently abundant to fill the vessel; t it often happens that the secretion stops long fore; in other cases it does not take place at all. is is an important fact overlooked in the valuation hops, for the quantity of Lupuline apparent to naked eye is not always, though generally, a asure of the resinous matter or quality of the p, for many of the Lupuline grains may be f-empty in the case of a hop that has grown full vigour, and these half-empty grains would judged as full by the unaided eye. Dr. aungart has suggested that the microscope should used in the valuation of hops, but up to now h a precaution is quite unknown in the hop de, the amount of Lupuline as seen by the un- ed eye being still considered the best criterion of ality. The hop plant is propagated entirely from tings or "sets," which are pieces about 4in. to long, taken in the spring from the fibrous wth which forms at the upper part of the root "crown." These are put in a so-called ursery" till October, when they are planted out what are termed "hills," usually two sets to h hill, the latter being generally 6ft. to 6½ft. rt, so that there are about 1,000 to 1,200 hills to acre. Nothing is done to them then till March, n they are "dressed," which means that the d tips are cut off with a knife, and ground is ed up over them. Generally they do not pro- e much the first year, and it is not considered visable to stimulate them too much at first. ing takes place in the early spring after the ing" process. Two, three, or four poles are t to each hill; women and boys take the poles m the stacks where they have remained during winter, and men dig holes with an iron- ted bar, and ram the poles down into them. length of the poles varies from 10ft. to 16ft. this country; but on the Continent they etimes use poles as high as 40ft. The t process is the tying of the bine to the pole. is usually done by women and girls, and takes ce from April to May. Here I may draw your ntion to the peculiar revolving motion of the ng hop shoot. Darwin describes it as a "con- uous bowing movement directed successively to points of the compass." "When a young hop t rises from the ground, the first two or three ts are quite straight, and remain stationary, but next, whilst very young, may be seen to bend one side, and to travel slowly round towards all ts of the horizon, moving like the hands of a h with the sun. The revolving movement con- es as long as the plant continues to grow, but h separate internode, as it becomes old, ceases move." "When a revolving shoot meets with pport its motion is necessarily arrested at the t of contact, but the free projecting part goes on revolving." "Hence it is that the bines find the poles so quickly, and so soon encircle them." It can be experimentally proved that this twining motion only takes place if the plant receives certain of the rays of the spectrum, for the seedlings of young climbing plants remain straight when grown under glass shades of certain colours. As regards the various kinds of hops grown in England, or, in fact, anywhere, they are mere modifications of one single species, and differ one from another only in periods of maturity, productiveness, or aroma, size, and shape of cones. Goldings are the choicest in quality and aroma; the strobiles are moderately small, and grow, not in clusters like some other varieties, but more singly. They originated from seed grown by a Mr. Golding, of Mid Kent, and are largely cultivated in East, North, and Mid Kent; but not so much in the Weald of Kent or Sussex. Bramlings, named from a place in East Kent, are a modification of the Golding, not so fine in quality; but coming to maturity ten days earlier. Grapes, so called because they grow in clusters like that fruit, rank next to Goldings in quality; they are more prolific, and the strobiles are larger than those of the latter. Colegates, named after their introducer, are an inferior kind, having a somewhat unpleasant flavour; but they produce heavy crops, and are hardy. The differences in appearance, quality, and aroma between hops grown in different localities are in some cases very marked, though the localities be somewhat near together; for example, Weald of Kent hops differ considerably from East Kent, to which they are, as a rule, inferior, and Farnhams are quite distinct from either. Comparing hops of the various countries, we may say East Kent in England, Spalt and Hallertau in Bavaria, and Saaz in Bohemia, produce the most delicate in aroma and the richest in quality. Wurtemberg, Baden, Burgundy, and Alsace also produce fine hops. Those of the United States, when first introduced, were objected to, on account of the strong black-currant-like odour which characterises them; but they are now largely imported. The hops of California and Washington Territory are frequently most beautiful in colour and very fine in quality.

*Methods of Preparation.*—In England the hops after picking are dried upon the horse-hair floor of a kiln over a coke fire, in which is burned a small proportion of sulphur. The sulphur dioxide produced by the combustion acts as a preservative both to colour and quality, and retards fermentive processes. The drying requires very careful regulation, because if carried too far the hops will crumble to dust during the packing, or will acquire a burnt flavour; whilst if insufficiently dried the hops may become heated in the bales, whereby the colour, aroma, and quality are destroyed. After drying, the hops are pressed into bales, called pockets, weighing about 1½cwt. each.

*Hop Parasites.*—The hop is one of the most unfortunate of plants in being the hunting-ground of innumerable animal and vegetable parasites.

*Hop Aphis* (*Aphis humuli* or *Phorodon humuli*).—This is, perhaps, the most destructive of the hop parasites, belonging to the same family as the so-called "blight" which attacks rose-trees. The larvæ are frequently termed "lice." For many years its life-history was a mystery. Prof. Riley, of the United States, seems now to have proved that in the autumn the eggs are deposited upon the plum-trees, and not in the hop gardens, as previously supposed. The methods of propagation of the species are two-fold. In the first place there are wingless females, which lay eggs giving rise to wingless larvæ; these in their turn lay eggs producing larvæ like themselves; and this continues with great speed for from seven to eleven generations. Besides these wingless females, others which are winged appear, particularly in the spring, when the flight to the hop gardens takes place, and again in the autumn, when the hops are cut down, and the aphides are compelled to seek pastures new. The winged females always bring forth live young. The males (winged) appear towards autumn, and pair with the wingless egg-laying females, and the eggs laid by the latter then preserve the species for the next season. During the summer, however, the production of live young and eggs takes place parthogenetically—i.e., without the intervention of the males.

*Dilophus Vulgaris.*—One of the numerous species of *Tipulidæ*. The larvæ are found in the roots, and the fly in the cones of the hop. The male fly is black, and smaller than the female, whose colour is lighter. They sometimes appear in large swarms; in 1862, for instance, millions were to be seen upon the plants and grass in Norfolk.

*The Wire-Worm* (*Elator Lineatus*, or *Agriotes Lineatus*).—The larvæ of the parasite popularly known as the "*Click Beetle*," belonging to the family *Elateridæ*, is one of the most destructive insects known to agriculture. Eggs are deposited in the autumn on the stems and leaves of plants, in the grass, and upon the lower part of the hop plant; the larvæ (the wire-worms) proceeding therefrom devour the young shoots and roots with great greed, and as they live four or five years underground, it may be imagined that the amount of destruction effected is considerable. They are yellow and horny, and furnished with large mandibles.

*Frog Hopper* (*Euacanthus interruptus*, Linné), often confused with another insect of the same family (*Cercopidæ*), to which the name *Aphrophora Spumaria* has been given, because the larvæ are enveloped in a frothy liquid known as frog-spit (or cuckoo-spit). Both insects possess the power of springing, but they are entirely different species. The frog hopper does great damage by sucking the juices from the leaves and young shoots, which it pierces in all directions, and to such an extent that drops of sap can occasionally be seen to run out. The hind legs of the insect are very long and powerful; in colour it is yellowish, the wings being marked with brown.

The *Hop Flea* (*Haltica concinna*, or *Haltica humuli*) does injury occasionally to the young plant by perforating the leaves with its powerful jaws, which have two rows of teeth. It hibernates in its perfect form under bushes, &c., in the neighbourhood of the hop grounds, coming out in spring about the time when the hop plants are being tied to the poles; it immediately commences feeding. Pairing takes place, and the eggs are laid on the under surface of the leaves and upon the young shoots. Fortunately, however, the insect only lays one egg per day, so that it does not multiply very fast. The eggs hatch in eight or nine days, and the small white larvæ bore into the leaves. The hop flea is of a coppery colour, and is of the same genus as the turnip flea, *Haltica nemorum*.

*Ghost Moth* (*Hepialus humuli*, Stephens).—The larvæ of this parasite eat through the roots of the hop, and, being unnoticed, the damage which they effect is often attributed by the grower to other causes. The perfect insects appear in May or June, and soon commence laying eggs, which are hatched in about fourteen days. The larvæ feed until the following April, and then become chrysalides, from which the perfect insect finally appears as above stated—about May or June. The male moth has white wings, and is smaller than the female, whose wings are yellow, marked with orange.

Of vegetable parasites that attack the hop-plant, the most important are two species of fungus, or mould; the one, Fumago salicina, covers the leaves with a black deposit, and if this enters the cones their development is arrested, and they shrivel up. The value of a whole parcel of hops is enormously depreciated, even if there be but a few mouldy cones amongst them, for such hops are most carefully shunned by brewers on account of the danger of causing abnormal fermentations in the beer. The other fungus, Podosphæra castegnei, is a species of mildew which coats the leaves and cones with what appears to the naked eye as a greyish powder.

The chemical analysis of the hop is a work of peculiar difficulty, and hence, notwithstanding the laborious investigations of the chemists who during the last 100 years have attempted it, our knowledge of the exact chemical composition of the various constituents is far from being complete. The number of substances found from time to time in the hop is very large. I will only briefly refer to those of minor importance. Those of value in brewing are the bitter resins, the essential oil, and the tannin. In addition to these there are present: Glucose, 1½ to 3¾ per cent., gum, wax, cellulose, or woody fibre, acetic, malic, citric, and valerianic acids; phloroglucine and cyanogen (the presence of these two is disputed); trimethylamine—a volatile compound of ammonia, smelling like herrings; choline (found also in brain and nerve); asparagine—a nitrogenous body found in seeds of the leguminosæ and in certain roots; arabic acid—a constituent of gum-arabic; albuminoids—substances allied to white of egg; and phlobaphene—a decomposition product of tannin. In the ash there are chlorides, sulphates, and phosphates, silica, potash, soda, lime, magnesia, iron, &c.

Hop oil is one of the most important constituents of the hop, and it is one for which there is no substitute. It is not a single substance, but a mixture in which Greshoff found a terpene-like body and a oxygenated hydro-carbon, together with Valeric aldehyde. The latter is the cause of the cheesy odour noticeable in some old hops, as Valeric aldehyde readily oxidises to valerianic acid, which possesses the disagreeable odour in question. The fresh oil has an intense odour of hop, but after redistillation with potash the characteristic hop odour gives place to a pelargonium-like perfume A portion only of the oil is readily volatilised, the remainder being driven off with difficulty even after many hours' steam distillation. On oxidation it yields, as already mentioned, a bitter resin.

Tannin, the third of the more important constituents of hop, serves the brewer directly as a clarifying agent for forming insoluble compounds with the albuminoids of the malt extract, and indirectly as a preservative, because these albuminoids, which the hop tannin in great part removes, are the most readily decomposable bodies existing in the wort, and if left in solution would render it very liable to putrefactive fermentation. The tannin is accompanied in the hop by an oxidation product called phlobaphene, which yields sugar on boiling with acids.

*Bitter Principles.*—Here I must explain that the title of my paper may be a trifle misleading. I had originally selected "Hops and Hop Substitutes," but considering that there is *no real hop substitute*, I was obliged to use the words bitter principles. As, however, the number of bitter substances to be found in the vegetable kingdom is enormous, I shall only have time to touch upon a few of their general properties in groups, referring in detail only to two or three bitters that brewers have, rightly or wrongly, been suspected of using in the manufacture of beer. Vegetable substances which have the property of creating a bitter taste may be grouped into three classes. The first of these includes the alkaloids, of which there are at present about two hundred known, the number being added to continually. They form a group of substances containing nitrogen, frequently derivatives of quinoline or pyridine, and, like the alkalies of the mineral kingdom, form salts with acids in the same way as do metallic oxides. They include many valuable drugs and many violent poisons. The first discovered was morphine in opium, about the beginning of this century, by Derosne and Sertürner independently; then followed in quick succession strychnine (from St. Ignatius bean and nux vomica), veratrin (in sabadilla seeds), brucine (from nux vomica), delphinine, piperine, quinine, cinchonine, solanin, caffein, nicotine, &c. The second class of substances includes the glucosides, bodies which owe their name to the fact that they yield sugar on being split up by the action of acids or otherwise. For instance, amygdaline in bitter almonds splits into glucose, prussic acid, and benzoic aldehyde or oil of almonds. Potassium myronate from mustard yields sugar, potassium bisulphate, and mustard oil (allyl thiocyanide). The third class of bitter substances comprises those of indefinite composition not belonging to the alkaloids nor to the glucosides, and whose chemical structure is for the most part as yet unknown. They are termed simply bitter principles. It is from this group and from the glucosides that certain members have been selected to replace the bitter of the hop, but from the few facts which I purpose saying about them you will see that they can but very imperfectly act as hop substitutes. The most important is quassiine, the active principle of quassia, the wood of a West Indian tree, Picrena excelsa, which grows to the height of 50ft. to 60ft., and somewhat resembles the ash. It is intensely bitter, so that a pound of chips would equal in bitterness a good many pounds of hops. It is, moreover, very cheap, so that it might be a dangerous rival of the hop, but that the bitter is of a persistent nature, quite unlike what Dr. Matthew Adams terms the fugitive bitter of the hop, nor has it any tannin nor any aromatic odour whatever. Gentian root, obtained from a perennial herb found in mountainous parts of Middle and South Europe, contains a glucoside, gentiopicrin, very bitter, which splits up by the action of acids into gentiogenin and glucose. Closely allied to gentian are chiretta and buck bean. Chiretta, or Ophelia chiretta, is a plant of the same order as gentian, and grows in North India; its active principle, chirettin or chirattin, does not yield glucose on decomposition with acid. The common buck bean, or Menyanthes trifoliata, contains a bitter glucoside, menyanthin, which decomposes with acids into sugar, and an oil, menyanthol, having a bitter almond odour. Calumba is obtained from a diœcious perennial climbing plant growing in the forests of East Africa; it has a nauseous, bitter taste, due to the substance columbin, discovered by Wittstock in 1830, and separable in the form of rhombic crystals. To the same order as Calumba belongs Cocculus Indicus, a climbing plant from the East Indies, its active principle, picrotoxin, being a powerful poison; it may be separated from the berry in the form of radiating silky crystals. Cocculus Indicus also contains a large amount of fat, and an alkaloid, menispermin, but which, according to Pelletier, is not bitter.

## PRACTICAL DETAILS OF BLUING.*

THE brilliant blue, brought out by heat on a highly-polished piece of steel, certainly presents a beautiful appearance, which pleases all who behold it. It may be produced by various processes, but in order to produce the best results it is necessary, in them all, that the surface shall be made thoroughly clean. If a piece of highly-polished steel is simply touched with the uncovered hand, there will be an impression left upon it, which will show after it is blued, unless the imperceptible stain is removed before heat is applied. The blue colour is due to a certain amount of oxidation corresponding with a definite degree of heat. The temperature, as is indicated by the colours which govern in drawing the temper of tools, is given in the table which follows. The names of tools to which the different tempers are applicable are not given, as in these later days that is a thing to be determined by experiment on the special steel in hand.

425° F.—Colour starts pale yellow.

450° F.—Straw.
475° F.—Orange.
500° F.—Brown.
550° F.—Purple.
555° F.—Violet.
580° F.—Blue.
610° F.—White.
625° F.—Red.

In drawing the temper of tools, however, unless it is in some special lines, the colours are only observed for their utility, as indicating the proper temper, as the means for an end, while "bluing," technically speaking, is a process carried on for the specific purpose of causing the articles on which it is used to assume a blue colour for ornamental purposes.

The process of bluing band springs for the rifles at the Springfield armoury is thus given: "First, coat lightly with linseed oil; then sift dry hardwood ashes over the springs with a sieve, until they are covered; place them in a furnace, and heat them until the colour begins to change to a blue; after which they are cooled in the air, the ashes brushed off, and they are placed in a wire basket, and immersed in sperm oil; when taken out, they are washed in a solution of soda, to remove all oil. The linseed oil causes the ashes to stick. The process is called *ash bluing*." By coating them evenly with ashes they are not exposed to the direct access of air, and oxidation takes place slowly and uniformly.

Other small articles have from time immemorial been blued in sheet-iron pans, which, being provided with iron handles, can be shaken over the fire like a corn popper. The work is cleaned after it comes from the polishing wheel, by boiling it in soda water, washing in clear hot water, drying, and dusting with lime. Clean sand, which has been heated hot enough to drive out all smoky matter, is used in the pans. The pieces are put in, and shaken over the fire until they gradually come to the colour desired. It is to be noted that they must appear to be a little overdrawn when they are taken off, because when they casually appear to be of a full blue, before oiling, they are apt to develop a red tint after they are oiled. The process appears very simple to a person looking on, but when he tries it himself he finds it will not be successful if the work is not clean, the sand clean, and the entire operation conducted with due regard to securing the proper degree of heat, and bringing the work uniformly under its influence.

The arrangements for conducting bluing operations on a large scale consist of a shallow iron pan, mounted over a fire-box and grate. A good size is 2ft. wide, 6ft. long, and 8 or 10in. deep. Provision must be especially made for keeping up a steady heat. Hard-wood charcoal is used in the pan, and should be granulated, of a size to suit the work. As the necessary degree of heat required to produce the blue colour on the work almost verges upon red-hot, the charcoal slowly ignites, is gradually consumed, and this loss must be repaired. Before it is ready to receive the polished pieces it must be heated and well shovelled over, to detect any little lumps that smoulder, as the smudge from these would be likely to tarnish the work. The bright work is brushed off well with lime, to remove anything which would prevent the heat and air from acting uniformly upon its surface; otherwise it will have a mottled and dirty appearance, which cannot be corrected without repolishing. Pieces of irregular form, some parts of which are thicker than others, require a great deal of watchfulness and skilful manipulation to prevent the thin parts from becoming heated before the thick ones. The fire must be kept down, to prevent the thin parts from being overheated before the thick parts have come to their colour.

If polished steel is heated where it does not come in contact with the air, it does not oxidise, and therefore does not colour. In the hot charcoal the common air is kept out by other gases, and the work does not change colour while it is buried, but immediately upon its being withdrawn from the coal, or uncovered, and exposed to the air, the colours flush upon it with great rapidity, running the full regular gamut of the steel spectrum; for, although it may turn blue almost instantly, it becomes pale yellow first, and exhibits the other colours in regular succession, but in quick time.

Owing to the fact that the charcoal cannot always be kept at the proper heat to cause the articles to become blue when exposed, it is necessary to constantly bring them to sight, and change their positions, to secure their even heating, and when held by the tongs for this purpose, they are also carefully brushed with lime dust, to remove any foreign matter that may adhere to them. When they are judged to be of the right colour they are carefully placed where they will not come in contact with anything to mar their surface, and are allowed to cool, after which they are oiled, and wiped clean.

An arrangement which sometimes occasions trouble is that the light in the bluing-room is not sufficiently good for the purpose. It is not good enough to certainly distinguish a full blue in some part of the day, and if, by mistake arising from this cause, the work is allowed to cool before it is fully coloured, it becomes very difficult to run it down again, as its phases cannot be watched unless some spot is brightened to serve as a guide.

Iron and steel of all kinds can be blued by heat, as it is a natural property of iron to acquire colours by heat, which is not lost during any transformation through which it passes, but cast iron will not receive colour any better than it will polish. There is a crust on castings of iron which has not the same "molekel" as their interior, and with the same heat acting upon it, this crust will not exhibit the same shade of blue that is shown by the interior where it is exposed by cutting through the crust. Pieces of malleableised cast iron have the same fault, and even in a higher degree. During the Civil War, when the Government stood in need of guns, it allowed some of the private contractors of patent breech-loaders to make the butt plates of malleableised cast iron, and although they were cast very "true to pattern," yet, in finishing, more stock would be removed from some places than from others, and whenever this was the case, the part from which the most was taken would present the appearance of a lighter blue than the surrounding parts. It was said to look "milky," and the inspectors condemned some for this cause. If they had been cased and heated in an atmosphere of carbon, just long enough to change the structure skin-deep, they would possibly have taken a more uniform colour or shade; it might still have been light, but it would not have been clouded.

An excellent method of bluing has been introduced into the National Armoury at Springfield within a few years by Col. Buffington, the commandant. It has proved so satisfactory in every respect that it has since been introduced into a number of private manufactories. The apparatus required for bluing by this method consists of a rectangular cast-iron tank of suitable dimensions. This is made rounding at all corners to diminish the liability of its cracking by expansion or contraction. It is permanently set over a furnace. The tanks in use at the armoury are of sufficient size to hold a mixture of 20lb. of black oxide of manganese, with 180lb. of nitrate of potassium (200lb. of the mixture in the proportion of 1 to 9). When a fire is built in the furnace, underneath the tank, the saltpetre melts, and the manganese settles to the bottom in a thick, muddy sediment. When the workman is ready to commence operations, he stirs up the manganese, and then ascertains whether the bath is of the right temperature by throwing upon it a sprinkling of dry sawdust. If the conditions are right the sawdust will instantly sparkle and ignite, but if the bath is not quite hot enough the sawdust will glower for some time before taking fire.

If the bath is of the proper temperature, the work—which must be assuredly dry—is immersed in it, and allowed to remain there until it is heated to the same temperature. If it is tempered work, it is plunged for a few seconds into cold water to set the temper as soon as it is taken from the heating bath. In case the work is not tempered, this plunge is omitted. It is then dipped in boiling hot water for a moment, and then immersed in a tank of oil. When it is cool it is removed from the oil, allowed to drain, and subsequently wiped off; it is found to be of a beautiful dark blue, of greater depth and permanence than that obtained by other processes.

The Master Armourer, Mr. S. W. Porter, says that the results are more uniform, and are obtained quicker and with less expense by this process than by the old one. The same amount of work can now be done in one day which by the old plan required two and one-half days. Either iron or steel is thus blued. The iron guards and triggers are blued in this manner after they are assembled. They are not dipped in cold water.

Great caution is exercised to prevent the nitre from coming in contact with the fire, on account of its expansive and explosive nature. The tanks are removed as soon as any signs of cracking appear, and others are substituted in their place.

A modification of the old process, now in use, is to wipe the piece over with oil when it has nearly reached the full blue, and let it come to its colour while oiled. There is reason to suppose that the oil penetrates the steel to some extent, whether it is hot or cold, but to a greater depth when its particles are separated by heat.

As to the penetrability of steel, I will relate an incident: A friend once brought me a steel adjustable gauge 12in. to nickel-plate. He had made himself, and etched his name on the bar. He has also got a spot of rust on the bar with the acid, about as large as a house fly's wings, which he pointed out particularly. The gauge was polished and nickel-plated to his satisfaction, and not a trace of the spot could be discovered; but in two years after he called my attention to the fact that there was evident discolouration of the nickel over the spot.

Hardened steel takes a high polish, and on this the blue shows to excellent advantage. It should do the same on chilled cast iron, which takes a high

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* By B. F. SPALDING, in American Machinist.

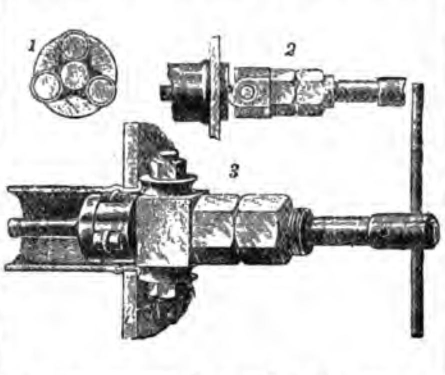
"speculum metal." There is a liability
teel cast to pattern may lie somewhat
same disadvantage as malleable cast iron,
e same reason; that is, on account of the
in the molecular structure of the crust,
nterior. There is something of this in
but not much, as the ingots are generally
enough, so that they are much reduced
the time they are shaped into bars, and
f the casting is proportionally thinner.
erence in the constitution of the various
on will be noticed in the polishing. The
m any form of the metal, containing
on in such a state that it changes its
with a slight variation of temperature,
while iron, low in carbon, or holding it
ombination, shows yellow, almost white
his subject was discussed in the *American*
some years ago. It may be observed that
which polishes with dark red sparks takes
de in bluing.

## MOON COVERED WITH ICE?

ticle on this subject in *Knowledge* for this
, Mr. A. C. Ranyard says that we may
ith some degree of certainty that there is
e area of water or smooth ice surface on
at all events, in the neighbourhood of
equator, which is the region of all others
should expect to find areas of water, if
d. After referring to the *albedo*, or light-
power, of the moon's surface, he proceeds:
were no evaporation on the moon, and
our was not continually being carried in
and deposited on the mountain summits,
expect to find the lunar snows accumu-
e valleys and plains, having descended, as
snows do, on the earth in the form of
o doubt more slowly than on the earth,
at the moon's surface is only about one-
ravity at the earth's surface. But the
wn of a great body of snow in the form
d take place as surely on the moon as it
though it would require six times the
ow upon the moon to consolidate it into
equired here to consolidate snow at a
perature.
the reasons which causes so large a
f snow to be deposited on the tops of
mountains is that the mountain-sides, as
lows over them, cause upward currents
the air in ascending expands, and as it
is chilled by its expansion and deposits
e water vapour which it was able to hold
on at a warmer temperature. No doubt
upward drift of aqueous vapour is con-
king place in the moon's rarer atmosphere.
terrestrial analogies we should expect that
the lunar surface would become unequally
nd winds would be set up as on the
face. The mountains will give rise to
rrents; expansion, and consequent chill-
take place, and the excess of water
ll be deposited more freely upon the
than over the plains. Possibly upon the
e is no general deposit over the plains,
the regions immediately around where
s and is chilled by its expansion.
he long lunar day, the air must become
water vapour to an extent that will
e weight of the lunar atmosphere. This
he air to be compressed in faults and any
ies of the soil which it can enter. During
ight, as the water vapour is deposited
, the pressure will be relieved; and we
ect the imprisoned air to return to the
d be chilled on its expansion, so causing
eposit, even at low levels, around the
which it issues.
ar glaciers must scrape out the valleys
down blocks as our terrestrial glaciers
will cause their lower ends to be formed
; and if in the regions which they reach
lownward flow the evaporation in the
he lunar month is greater than the de-
sh snow, the blocks and dirt contained
will be ultimately left upon its surface.
ration of the ice may take place below
g point.
le moon reflects light as if it were com-
light-coloured rock, which Sir John
as is well known, compared to the
sandstone-rock of Table Mountain. A
n of the moon's surface is mountainous
consequently the darker portions must ab-
ike comparatively dark rock; and if the
ns of the moon are covered with ice, its
st be very dirty and discoloured with
dark character. It seems more probable
lower regions we actually see the lunar
If the sun's action during the long lunar
he surface of the ice, the moisture will
y downwards, forming rills which will
treams and flow down on the surface of
till they come to a crevassed region,
will descend to the bottom of the glacier,
on the Mer de Glace, moulins or ice-wells. The streams, the water of which has been warmed by the sun's rays, will then tunnel under the ice as they do under our own glaciers, and appear at a lower level charged with the finer detritus abraded from the rocks, which will ultimately be carried to the plains, or as far as the water reaches; but it is evident that there can be no lakes of any appreciable extent upon the moon, or we should occasionally see the sun's rays reflected specularly from such water surfaces. Such streams may be absorbed into the lunar soil, or they may be spread out into deltas of rough ice. The surface of our terrestrial glaciers does not reflect specularly; it resembles snow rather than ice. This is caused by the breaking up of the surface by the solar heat, as Prof. Tyndall remarks in his charming book on "The Forms of Water":—"When you pound transparent rock-salt into powder it is as white as table-salt, and it is the minute fissuring of the surface of a glacier by the sun's rays that causes it to appear white."

## FARRIS'S BOILER-TUBE BEADER.

AN improved tool for fixing boiler-tubes by producing a bead on the inner and outer faces of the boiler-plate has been patented in the United States by Mr. B. B. Farris, of Rocky Ford, Georgia. Fig. 1 is a transverse section of the beading rollers, Fig. 3 showing the operation of beading with the device, and Fig. 2 the cutting off of the end of a tube. On one end of a hollow stem is a head carrying in suitable recesses in its rim beading rollers, which are forced outward to form the bead by means of a tapering spindle, which passes centrally through the stem and the head, the spindle being turned by a handle on its outer end to rotate the beading rollers and force them outwards. A block turning loosely on the stem has studs, on which are mounted rollers adapted to engage the outer projecting end of the flue, this block having a polygonal offset adapted to be engaged by a wrench, while a nut screws on the threaded outer end of the stem against the polygonal offset, to hold the beading rollers in contact with the outer end of the flue. To cut off the end of a tube or flue, one of the beading rollers is removed and a cutter put in its place, the cutter having a dowel pin to engage a recess in the block, thus holding it firmly to its work.



The Indian tea production of the current season is estimated at 110,000,000lb., and the proportionate consumption of Indian and Ceylon teas in the British Isles is expected this year to be 75 per cent. China is the great sufferer from these changes, present and perspective. The current supply to our own country is expected to be only 25 per cent. of the whole, and when the railway crosses from Bengal to Burmah she may bid good-bye to her brick-tea trade in Russia.

**Heights of Buildings in America.**—Lofty buildings are common in some of the larger cities of the United States; but the Auditorium at Chicago must be high enough. It is a vast building comprising theatre, hotel, observatory, shops, &c., under one control. Three million and a half dollars were subscribed and spent, but additions are constantly being made. The theatre contains permanent seats for 4,000 persons, and on special occasions for 8,000. A lecture-hall contains 500; the hotel has 400 bedrooms; the business portion contains 136 shops and offices, and the observatory tower of 19 stories of offices has at the top a United States signal station. The buildings cover an area of 1½ acre, and the total street frontage is 710ft. The height of the main building of ten stories is 145ft., and the tower has a height of 270ft. For comparison here are a few other tall buildings. Auditorium tower, 270ft.; Board of Trade tower balcony, 227ft.; Grand Central Passenger Station tower, 200ft.; Owings Buildings (14 stories), 158ft.; the Chamber of Commerce building, 200ft.; Tacoma building, 164ft.; Rookery building, 159ft.; Pullman building, 140ft.

# SCIENTIFIC SOCIETIES.

## LIVERPOOL ASTRONOMICAL SOCIETY.

THE third ordinary meeting of the society was held on Monday evening, the 1st inst., at half-past seven o'clock, in the Royal Institution, Colquitt-street, Mr. W. B. Hutchensen, F.R.A.S., President, in the chair. The Rev. Fred F. Grensted, M.A., gave a lecture on the airless and waterless condition of the moon, the first part of which was illustrated by numerous views, exhibited by means of the limelight. Equal areas of the earth and moon's surface were shown by means of photographs of Nasmyth's plaster cast of the lunar surface of an alto-relievo map of Asia, and the striking contrast of their configurations dwelt upon. The earth's surface being diversified by mountain ranges and river systems of drainage, exhibiting clearly marks of denudation and fluviatile erosion, the mountain upheavals, having been subject to great lateral pressure. On the moon's surface, on the other hand, there is nothing that really corresponds to our mountain ranges or river systems, and no evidence of denudation or fluviatile erosion—the most superficial investigation of the lunar surface pointing in the direction of airless and waterless condition of the moon throughout its entire history. The whole problem finds its solution in the difference of size, which regulates the rate of cooling, and hence determines chemical differentiation. The greater mass retaining free oxygen, which forms our water and air, the lesser mass using it all up in oxidising its crust, none being left free, and therefore no water and no air can be formed. Assuming the moon to be composed of similar material, and on precisely the same type as the earth—the moon being, roughly speaking, only one-fourth of the earth's diameter and one-eighth of its bulk—it has, therefore, a very much greater surface in proportion to its bulk, and would cool with a corresponding degree of quickness. By the pressure of gravitation a pure metallic nucleus would be formed, possibly of iron, when the heat was still above the point of disassociation—that is, the point admitting oxidation. Hence the nucleus would be pure metal, with an outer crust of oxidised metal, which would form as the temperature was reduced, and prevent any further oxidation inward. The earth having a density 5½ that of water, while its surface rocks only equal about 2½, must have a nucleus of 7¾ times the density of water, and have an oxidised crust one-sixth of its radius in depth, while the moon, having a density of 3¼ times that of water, must be oxidised to nearly a half of its radius from the surface, and to have used up all its oxygen, so that none is left free to form water or air.

**Lagging for Steam-pipes.**—Waste products resulting from the manufacture of paper can be used as cheap and efficient lagging for steam-pipes. The waste products in question are chiefly those coming from the different cleaning and sorting machines, and which are of a fibrous nature. These, when dry, are to be mixed with potter's earth in the proportion of four to one, enough water being afterwards added to form a plastic compound. This is spread by hand over the surfaces to be protected in thin successive layers. When dry, the coating is said to adhere firmly, and is not easily broken. Its cost is practically no more than the cost of mixing and applying it.

**Egg-hatching in Egypt.**—The United States Consul-General in Egypt, in a report recently published, describes the system of hatching eggs by artificial heat pursued in that country from time immemorial. One establishment visited by the Consul-General was wholly constructed of sun-dried bricks, mortar, and earth. It was 70ft. long, 60ft. wide, and 16ft. high, and was provided with twelve compartments or incubators, each capable of hatching 7,500 eggs, or altogether 90,000 at one time. The season begins in March and lasts until May, and three batches of eggs are hatched in this time, each taking an average of three weeks. The fourth week is given to removing the chickens, and preparing the incubators for a new batch of eggs. The number of eggs treated at this establishment in a single season was, therefore, 270,000, from which 234,000 chickens are usually obtained. The percentage of chickens would be greater but that the eggs are in some instances procured from long distances and in large quantities, and are therefore liable to damage. The price of eggs is 2½d. per dozen, and chickens just issued from the shell are sold at 7½d. per dozen. The loss of chickens after incubation is comparatively small. The whole staff of the place is a man and a boy, who keep up the fires to a temperature of not less than 98° Fahr., arrange the eggs, move them four or five times in the 24 hours, look after the chickens, and hand them over to the buyers. The number of chickens hatched in this manner throughout Egypt is estimated at 75,000,000, and would, under ordinary circumstances, require 1,500,000 mothers.

# SCIENTIFIC NEWS.

ON p. 289 we mentioned that the number of known asteroids amounts to 300. It appears now that the number should have been 301, as Dr. Palisa, of Vienna, had discovered another on Nov. 16, which has since been verified. In consequence of the increasing number of these bodies, the directors of the *Berliner Astronomisches Jahrbuch* will, in future, give data for observing only those asteroids which are of special interest —e.g., those which approach near the earth or Jupiter; those having remarkable periods, and those of value in photometric work.

Dr. Bischof gives the following position to Zona's comet on Dec. 12, Berlin midnight: R.A. 3h. 8·7m., N. Dec. 33° 36'. M. Bigourdan, of Paris, says it looks like a little white speck, round, about 1' in diameter, with a central condensation, diffused, and of little size.

The Christmas lectures to juveniles at the Royal Institution will be by Prof. Dewar, who will deliver six on "Frost and Fire." The following arrangements for lectures before Easter have been made: Prof. Victor Horsley, nine lectures "On the Structure and Functions of the Nervous System" (Part I.—"The Spinal Cord and Ganglia"); Mr. Hall Caine, three lectures "On the Little Manx Nation"; Prof. C. Hubert H. Parry, three lectures "On the Position of Lulli, Purcell, and Scarlatti in the History of the Opera": Prof. C. Meymott Tidy, three lectures "On Modern Chemistry in Relation to Sanitation"; Mr. W. Martin Conway, three lectures "On Pre-Greek Schools of Art"; the Right Hon. Lord Rayleigh, six lectures "On the Forces of Cohesion." The Friday evening meetings will begin on Jan. 23, when a discourse will be given by the Right Hon. Lord Rayleigh "On Some Applications of Photography." Succeeding discourses will probably be given by the Right Hon. Lord Justice Sir Edward Fry, Prof. J. W. Judd, Prof. A. Schüster, Dr. E. E. Klein, Mr. Percy Fitzgerald, Dr. J. A. Fleming, Dr. Felix Semon, and Prof. W. E. Ayrton.

The effects of London fogs on cultivated plants are to be investigated by the Scientific Committee of the Royal Horticultural Society, under the direction of Dr. R. H. Scott and Dr. F. Oliver. The Royal Society awards a grant of £100 in aid.

It is said that plants grown in a confined atmosphere abstract nitrogen from the air to the extent of as much as 30 cubic centimètres—which is rather indefinite. M. Laurent has, it is also said, succeeded in cultivating the microbe which fixes the nitrogen.

In the central hall of the Natural History Museum there is now a temporary exhibit which should receive much attention from visitors, as it is a set of highly-magnified drawings of Bacteria, by Dr. W. Migula. The drawings include the now famous Bacillus tuberculosis of Koch, the bacillus of chicken cholera, called by Burrill Micrococcus gallicidus, &c.

Several demonstrations with "Koch's liquid" (paratoloid) have been made in this country; but in France some physicians have refused to try it, as it appears the law prohibits the use of a remedy the composition of which is not known. Before long, however, a full description will be published under authority, and probably some further startling announcements, for researches have been carried on in the Hygienic Institute of Berlin, which will be of great benefit to man.

Sir Joseph Lister, like all scientific men, is cautious in making announcements of discoveries; but speaking at King's College Hospital the other day, he said the effects of Koch's liquid, which he had himself witnessed, were simply astounding; and he subsequently stated that he saw, in the case of two of the most virulent infectious diseases to which man is liable, that the injection under the skin of a small quantity of a material, perfectly constant in character—an inorganic chemical substance as easily obtained as any other article in the materia medica—cut short these two formidable diseases in the animals in which they were performed. These same animals were rendered incapable of taking the disease under the test of the most potent inoculations. It is still uncertain, however, whether the results would be the same in man, and no definite information will be given by Prof. Koch until trial has been made. The diseases specially referred to are understood to be diphtheria and tetanus.

In a paper read before the Pathological Society of London last week, and also before the Medico-Chirurgical Society of Edinburgh, Dr. W. B. Russell intimated that he had secured the parasite in a number of cancer cases. In the course of his investigations he found things which could not in his opinion be explained on the principles of ordinary tissue growth. He tried to differentiate some of these by special methods of staining. The result was that an organism was differentiated. These organisms Dr. Russell found in all the cancer cases he examined, between forty and fifty, but under no other disease conditions. By tracing the life-history of the organism he found it to be a fungus of the yeast type. He pointed out that his experiments had to be tested by others before his discovery could be accepted.

It seems, from a memorandum issued by the Fishery Board for Scotland, that the secretary for scientific investigations, Dr. T. W. Fulton, finds from a review of his notes that the shore fisheries, especially for crabs, lobsters, mussels, and oysters, are declining; that the number of fishermen, and consequently fishing boats, is decreasing; that the number of beam trawlers is increasing, many of the English trawlers having resorted to the Scottish grounds.

Recently, before the New York Electric Club, Prof. E. L. Nichols, of Cornell, lectured on the artificial light of the future, and after pointing out the results of tests for efficiency with arc and incandescent lights, gas flames, and other illuminants, he stated what must be considered their limiting efficiencies. Referring to some other and little known sources of artificial light, to which he and his colleagues in Cornell University have recently given considerable attention, he said the most important he considered to be magnesium, and he mentioned some promising results as to its efficiency which he has recently obtained. In the discussion, Mr. Tesla called attention to experiments which he had made by the mixture of a solution of chloride of magnesia with finely powdered carbon. The resulting paste was pressed into a pencil suitable for an arc light, and gave good results when burned. He had also experimented with incandescent carbon filaments, in the structure of which the same material had been intimately incorporated.

It is stated that the Whitechapel Board of Works have resolved to introduce the electric light. It is proposed to employ the waste heat from the local destructor to generate the steam required for the engines. Paddington is, it appears, to be supplied by a company, but Hampstead opposes all applications from companies, and has empowered the Electric Lighting Committee to expend as much as a hundred guineas on a plan and estimate to be prepared by an expert for the guidance of the vestry.

There is a possibility that the electric sub-railway in Southwark will be repeated in Vienna, as the Austrian Minister charged with such matters is going to send engineers to study the working of the City and South London line.

Bell's telephone patent has now expired, and the receiver is open to user by any one. When the patent on Blake's transmitter expires, the two most useful instruments will be available for public use, and there are already several schemes for developing telephony. Long-distance telephony will probably receive a great impetus when patent restrictions are removed, and it is understoood that the Postmaster-General has in consideration a plan for facilitating telephonic communication for the public.

Despite many complaints and not a few difficulties, the New York elevated railroad continues to prosper, and to carry many millions of passengers yearly. It is probable that before long Boston will also have an elevated railroad, but whether it will be worked by steam or by electric locomotives remains to be seen.

A steel bridge is to be thrown across the Columbia River at Vancouver. It will be 6,000ft. long, with a double set of rails and a roadway on the top for vehicles. It will be erected on pneumatic piers. The bridge, which rests on a foundation of coarse gravel, will be built 10ft. above the high-water mark of 1876, when the river was flooded, and 40ft. above low water. It will cost over a million dollars, will employ hundreds of men in its construction, and will probably be ready for traffic at the beginning of 1892.

The Verein Deutscher Eisenbahn-Verwaltungen, Berlin, offers about £1,500 in prizes for inventions and improvements relating to railways. The competition is limited to improvements and inventions made between July 16, 1883, and July 15, 1891, by which latter date drawings and description must be sent in to the Verein, from which the conditions of the competition can be obtained.

In a letter to a New York paper, Mr. Hiram Maxim, of automatic gun fame, states that he is studying the problem of the flying machine. He has made numerous experiments with a view to discover the supporting power of a plane driven through the air at a slight angle with the horizontal, and has devised special apparatus for this purpose. He has also experimented with motors, and states that he has succeeded in obtaining one horse-power from a motor weighing 6lb., and with this expenditure of energy 133lb. may be supported. It is, he states, necessary to drive the plane at a speed of at least 30 miles an hour, and one of 50 miles is still better.

Herr Gerhard, of Düsseldorf, describes his invention of a new vehicle in painting. His method is to use a mixture of wax and caseine instead of oil; and it is stated that, so far as can be seen at present, the result is highly satisfactory.

# LETTERS TO THE EDITOR.

*[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]*

*All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

*All Cheques and Post-office Orders to be made payable to* J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

## A TALE OF A COMET—THE SPECTROSCOPIC PROPERTIES OF DUST—A GERMAN ESTIMATE OF THE METEORITIC HYPOTHESIS—A FEAT OF ALMS—THE "JOURNAL" OF THE BRITISH ASTRONOMICAL ASSOCIATION—EYEPIECE FOR A 2in. TELESCOPE—THE "COMPANION TO THE OBSERVATORY" FOR 1891—THE NEW DEARBORN OBSERVATORY—CALCULATING OCCULTATIONS—APPARENT CONTACT OF JUPITER AND A SATELLITE—STAR DIAGONAL—AN IMPERFECT OBJECT-GLASS.

[31856.]—THE report of Mr. Eddie, F.R.A.S., of the appearance of an alleged comet at Grahamstown on the evening of Oct. 27 (to which you refer shortly in your Scientific News on p. 289) is of such an altogether astonishing character as to necessitate the furnishing of much more minute detail before any opinion can be formed concerning the nature of the marvellous phenomenon witnessed by him. For, if we are to credit the printed account of Mr. Eddie's observation, the tail of this apparition was 90° long (or would have reached from the horizon to the zenith had it been vertical), while the comet itself, within 47 minutes, travelled over an arc of, "at least, one hundred degrees"! If we suppose it to have been only a single million of miles from the earth, this would give it a velocity of 619 miles a second—very nearly, indeed—our own earth travelling in her orbit round the sun less than 18½ miles during the same interval. Of course, if the comet were further off, its speed must have been greater still. Now, a body coming out of space, and falling into the sun by the action of gravity, would only acquire a velocity of some [illegible] miles a second at the time of impact—a consideration which sets us wondering what conceivable power or force can have operated in causing the comet (if, indeed, it were a comet at all) seen for such a brief interval at the Cape to fly past our world at such an appalling speed. The velocity of uprush of the solar prominences entirely pales before it.

I do not know if any (or how many) of my brother-readers were present at the Royal Society hursday week to hear the paper by Profs. ng and Dewar on "The Spectroscopic Proper- Dust"; but such as were will bear me out ing that yet another nail was then driven into ffin of the moribund "Meteoritic hypothesis" two eminent Cambridge physicists. Those ar with the literature of the subject know t has been asserted that the spectrum of the and the principal ray in the spectrum of are due to meteoric dust; and it was to test at Messrs. Liveing and Dewar set themselves ertain, by actual experiment, whether suf- ly minute solid particles would act like s molecules in an electric discharge, and e luminous with their characteristic special ion. I do not propose here to describe the , but most effective and ingenious, apparatus yed to show that they would *not*. Suffice it , that the conclusive and incontrovertible of this that it furnished, are summed up by perimenters in these concluding words:—"It rs, then, not only that dust, however fine, ded in a gas will not act like gaseous matter oming luminous with its characteristic spec- n an electric discharge, but that it is driven xtraordinary rapidity out of the course of the rge. If, then, the spectrum of the aurora be ot to the ordinary constituents of our atmo- , but to adventitious matter from planetary we conclude that such matter must be in, or e brought into, the gaseous state, or at least its properties entirely altered from those it ses at ordinary temperatures, before it becomes ous in the electric discharge." Alas! for the ouse of the much be-puffed and advertised nificent theory," which, under the hands of tent and impartial investigators, has tottered ftly to its fall. [Since this was written I have r. Monck's most interesting "Further Note r. Lockyer's Meteoric Theory" in the ber number of the *Journal* of the Liverpool omical Society. As an example of cogent, t reasoning it presents a most remarkable st to the dogmatic style of mere assertion in that hypothesis has been advanced. I may at the part of the *Journal* in which Mr. 's paper appears is otherwise well worth for the generally interesting nature of its ts.]

, in connection with this same "magnificent ," Dr. J. Scheiner's able work published lately pzig, "Die Spectralanalyse der Gestirne," preface by Prof. H. C. Vogel, may be studied dvantage by all who read German. The t of the new revelation can scarcely be con- or the want of honour paid to it in his own y, by the contemptuous way in which it has eceived in America and in Germany. Experts tral analysis and physicists generally (unlike orant multitude, who accept any sufficiently t assertion as gospel), are on all hands de- ng *proof* of the truth of the hypothesis, and, ow, the proof is not forthcoming. At present ypothesis seems well on its way to joining on the terrestrial origin of the solar corona, departed this life within the memory of so who will read these lines.

ing the summer of the present year an can lady, Miss Bruce, made the munificent hrough Harvard College, of 6,000dols. (say ) for aiding astronomical researches; and a of the manner in which that sum has been uted was issued by Prof. Pickering about the of last month. Fifteen recipients of various ts, for equally various purposes, appear in ; and a study of the end proposed in each be attained, in almost every instance im- one with the conviction that a wise dis- n of the fund has been made. But I confess did rather blush when I read the name of the institutions which has been content to s dependent upon American liberality for its instrumental appliances. It figures in thus:—"29, Prof. J. C. Adams, Director Cambridge Observatory, England. Spec- e for the 27in. telescope of the Cambridge atory." What! has it come to this, that a and wealthy body like the University of idge cannot afford a spectroscope without eal to exotic (I was going to say "charity," vill substitute) liberality? Surely it is not in rit that the University of Oxford deals with ritchard?

British Astronomical Association may, I to think, well be proud of the editor of its dings, if we may judge from the first r of its *Journal* now lying before me. It -in fact is—but, comparatively, a few weeks ce the establishment of the association itself der discussion; and now we find it issuing lication which, for fulness in subjects of to astronomers generally, is surpassed by no th which I am acquainted, and is equalled few indeed. After dealing with the incep- d ultimate formation of the society, giving a f its initial meeting, a list of its officers and , and its by-laws *in extenso*, it proceeds to two current astronomical questions of the importance; to notice and give an admirable précis of the contents of all the chief English, American, French, and German astronomical publications, to furnish reviews of books, and correspondence; while it concludes with notices of the association itself. What, however, are chiefly remarkable in this list are two articles; one by that delightful writer, Miss A. M. Clerke, on the rotation periods of Mercury and Venus; and the second, by the editor himself, on the chief Nebular line. Miss Clerke's paper gives full details, with illustrations, of those observations of Schiaparelli's, from which he draws the conclusion that Venus rotates on her axis during the same time that she occupies in performing her journey round the Sun. This, Miss Clerke seems to think, he has rendered probable; while she treats the coincidence of the periods of rotation and revolution of Mercury as fairly well established. One shrinks from expressing difference from a lady; but I must confess that I am not a thorough convert yet. At any rate, so charmingly does Miss Clerke write, that she makes one *wish* that her conclusions may be correct. Mr. Maunder's paper, also illustrated, gives a most able, exhaustive, and judicially impartial account of the observations of Mr. Lockyer, Dr. and Mrs. Huggins, and Mr. Keeler; and points out that although the weight of evidence is distinctly against the hypothesis that the chief nebular line is merely the remnant of a magnesium fluting; yet that, under certain—more or less credible—circumstances, it *may* be so. No one who wishes to investigate this burning question in a thoroughly unbiased manner should omit to read this able essay through, from beginning to end. The section on "Astronomical Publications" which follows it is excellent too, consisting, as it does, of a catalogue raisonné of the contents of the R.A.S. *Monthly Notices*, the "Proceedings of the Royal Society," "The Observatory," "The Journal of the Liverpool Astronomical Society," "Publications of the Astronomical Society of the Pacific," "The Astronomical Journal," "The Sidereal Messenger," "Comptes Rendus de l'Academie des Sciences," "L'Astronomie," and "Astronomische Nachrichten." The remaining contents of the number call for no special remark, but it is worthy of note that every member of the British Astronomical Association will annually receive, gratis, ten numbers of this excellent and interesting serial; which, if purchased in single numbers by a member of the outside public, would cost fifteen shillings. I am, of course, assuming (as I have every right to do from the editor's antecedents) that future parts will be equal to that to which I accord such ungrudging praise.

Were I "Q" (query 73030, p. 299), I would neither waste my time nor my money in an attempt to fit an astronomical eyepiece to a 2in. object-glass of only eight times its own diameter in focus. It would perform infinitely better were it sixteen times its aperture in focal length. But, if your correspondent chooses to try, a Huyghenian eyepiece (composed of two plano-convex lenses with their convexities turned towards the objective) might be constructed; the focus of the field-glass being ·36in., that of the eye-glass ·12in., and the interval separating the lenses ·24in. This would give a power of something like 90 with his object-glass, and, assuming it to be worth anything, enable him to see the lunar craters, the chief belts and the satellites of Jupiter, &c., and to observe occultations.

It is scarcely necessary here to do more than merely note the appearance of Messrs. Turner and Common's admirable little annual, the *Companion to the Observatory* for 1891, as presumably every observer of the heavens will hasten to supply himself with it. If its editors would only give the sidereal time at mean noon for every day in the year, instead of for weekly intervals, I really do not know what fault could possibly be found with it.

Yet another illustration reaches me of that extraordinary private munificence which seems to reign "hic et ubique" on the American continent, in the shape of an account of the new Dearborn Observatory, erected entirely by the liberality of Mr. Hobbs, of Chicago, at a cost of some £5,200. The building appears to have been designed with every regard to the comfort and convenience of the observers, and is furnished with all the most modern and improved appliances in the shape of shutters, apparatus for rotating the dome, &c. It is erected in the grounds of the North Western University, a comparatively isolated spot near Evanston, and possesses the advantage over the old building of occupying a site free from the smoke and dust of the great city of Chicago.

Of course, the moving from the one building to the other has caused a considerable interruption to the observations; but Prof. Hough has, *malgré* this, contrived to continue his work upon the planet Jupiter, with the former results of which all astronomers are familiar. It will be remembered that no less than 94 new double stars were discovered (to a great extent by that famous observer, Mr. S. W. Burnham) with the 18½in. refractor of the Dearborn Observatory, these discoveries having been made on the site of the old observatory in Chicago itself.

"J. A. C." (letter 31854, p. 315) is entirely right in his supposition that the method of calculating occultations of stars by the moon for any given locality is very much too operose to be exemplified in these columns. One method occupies five pages in Loomis's "Practical Astronomy"; another (that of Bessel), nine pages in the same work. The moon is so very close to the earth, that a very small geographical shift notably alters her place in the sky; and hence the occultation of a star is not like (say) an eclipse of one of Jupiter's satellites, a phenomenon visible at the same *absolute* moment of time wherever the planet is above the horizon. I would refer your correspondent to your XLIInd. Volume for the description of a graphical method of predicting lunar occultations as most likely to suit him. His next question is quite unanswerable—dependent as the apparent contact of Jupiter and a satellite is upon the aperture and aplanatism of the objective, the eye of the observer, the atmospheric conditions, &c., &c.

"Tel" (query 73133, p. 322) had better obtain a right-angled prism for his star diagonal, the width of the face of which may be equal to—or rather exceed in size—the diameter of the field-glass of his lowest eyepiece. Or, if he does not mind a constricted field, he can obtain a cheaper contrivance by mounting a little prism of the same kind outside of one of the eye-caps which hold dark sunshades, and slipping it over his eyepiece.

If "A. T.'s" object glass (query 73155, p. 323) is a simple convex lens, he need go no farther for an explanation of his defective picture of the Moon. To do the slightest good in celestial observation, an object glass *must* be achromatic.

**A Fellow of the Royal Astronomical Society.**

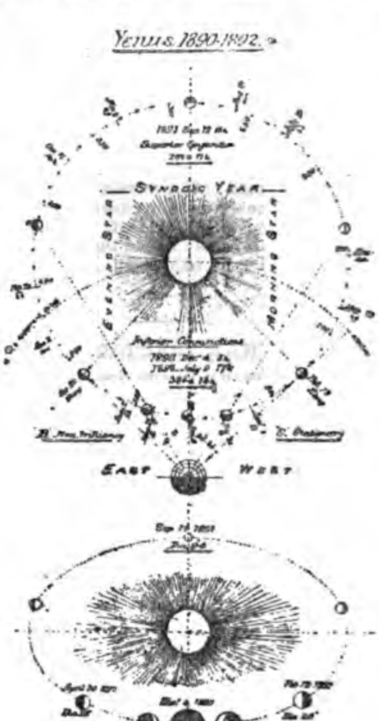
## PATHS OF URANUS AND VESTA.

[31857.]—If "H. S." (letter 31842) will give a map of the paths of Uranus and Vesta during 1891, as suggested by him in "E. M." of Dec. 6, many, I am certain, will appreciate them, being so useful to possessors of small telescopes.

H. A. K.

## A SYNODIC YEAR OF VENUS.

[31858.]—In this diagram, which is intended to approximately represent a synodic revolution of Venus, the earth is supposed at rest in its orbit, but making its diurnal revolution on its axis, whilst the sun, in its apparent annual orbit, describes 1·6 year, carrying Venus with him through the star sphere.



The effect of this apparent combined epicyclic motion is that Venus, at inferior conjunctions, when nearest the earth, is at the bottom of her apparent loop. Two half-loops are here represented—one for 1890, the other for 1892, six-tenths of a year in star-sphere apart. Owing to the eccentricities of the real orbits, the apparent orbit of diagram is not re-entrant, and the time from inferior conjunction, Dec. 4, 1890, to superior conjunction, Sept. 18, 1891, is 288d. 11h., whilst from this to inferior conjunction of July 9, 1892, is 296d. 3h., making in all 584d. 14h. for her synodic year.

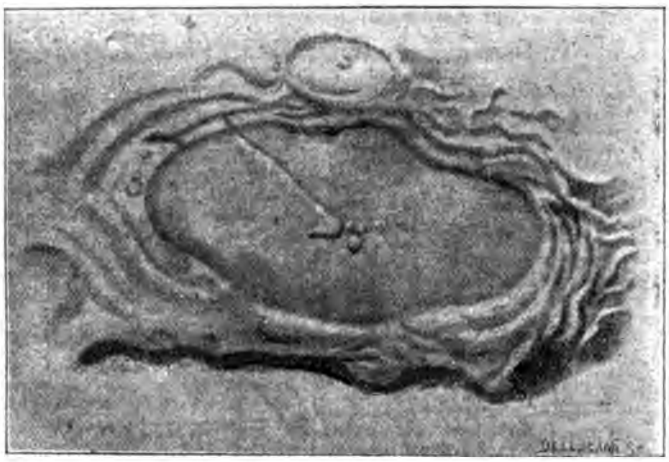
It will be observed that Venus passes through her ☊ Dec. 6, 1890, 1d. 17h. after inferior conjunction, thus narrowly having escaped a sun transit. Five periods of 1·6 year = 8 years, and as 1874-1882 were transit years of eight years interval, she has just performed that cycle; but no transit will occur till 1882 + $\frac{243}{2}$ = 2004 – 2012.

The dots on diagram represent 10-day intervals, and the phases are approximately marked, and also shown on an elliptic projection underneath.

The daily revolution of the earth causes us to meet, first the sun, and then Venus on her approach to the earth, showing her as an evening star. In her recession from the earth, first Venus, then the sun, showing her as a morning star, as represented on the diagram.

Liverpool, Dec. 4. **W. S.**

### PETAVIUS.



[31859.]—I inclose a reduction of a drawing of Petavius, made Oct. 29th, 9.12 p.m. On that evening the great rill was finely seen, the step which it makes over the east wall being very distinct. From its south end a well-defined line of shadow ran in a southward direction, apparently corresponding in position to the short rill shown on Neison's map; its character, however, could not be properly made out. West, and slightly south, of the great central peak appeared a small depression, possibly one of the two craters drawn in Mädler's map; but as it was only well seen in occasional glimpses, one could not be certain of its real nature. The ridge on the south-west part of the floor, close to the wall, was quite evident, its eastern slope being considerably whiter than the rest of the floor. The instrument used was a 3⅛in. Dollond; powers, 120 and 240.

Edinburgh, Dec. 3. **J. B.**

### LUNAR RADIATION.

[31860.]—I should like to draw the attention of Mr. Peal, and of those who are interested in his "Theory of Lunar Surfacing by Glaciation," to those measures of lunar radiation by Mr. C. C. Hutchins made by means of a new thermograph. According to the report of them in *Nature*, Nov. 13, p. 44, "the inference drawn from these observations is—that all but a minute portion of the rays, from the lunar soil and rock, are cut off by our atmosphere; for it seems impossible to conceive that a surface like that of the moon, upon which the sun has been shining for many days, should suddenly cease to radiate when the sun's light is withdrawn."

The observations here spoken of were made during a total eclipse of the moon, and to those who, like myself, accept Mr. Peal's theory in the main, they are not surprising in their result, although the absence of radiation during the eclipse is, to our thinking, due to the fact that the moon's surface is normally very cold—even in sunshine—and not entirely to the fact that the lunar radiations "are cut off by our atmosphere," as Mr. C. C. Hutchins concludes from his experiments.

Shanklin, I. W., Dec. 6. **H. G. Dixon.**

### JAPANESE PAPER FROG.

[31861.]—In your issue of the 13th Dec., 1889, you printed an article having the above title. My mother and myself have spent some hours in trying to make the frog according to the directions given; but have not as yet been able to do so. There must be something wrong about the description, or else we are a couple of stupendous duffers.

If any reader of the "E. M." has made one according to the directions, or in any other manner, I should like him to write a letter showing how he did it. **J. G. Bartel.**

Collingwood-street, Nelson, N.Z., Oct. 28.

### ETHER.

[31862.]—In letter 31855, "G. J. B." has given us an interesting contribution to the discussion on this subject, probably the best which has yet appeared from the etherialist side; but his arguments are not so conclusive as he thinks. In the first place, we cannot accept his postulate, on which he says his argument depends—viz., that "energy must occupy space."

We can only conceive energy as motion; not the pure motion some theorists like to talk about, but which is unthinkable, but motion of something which resists. Of course motion involves space to move in, but that is very different from the idea that energy itself occupies space: we must apply to his postulate the same laws and reasoning which "G. J. B." applies to electric capacity, and trace a quantitative relation between energy and space. None such exists. As a general rule, it is true that energy, at all events as heat, causes expansion; but then the same quantity of heat causes entirely different quantities of expansion in different substances; therefore the relation of space is not to the energy, but to the specific properties of different forms of matter, which bring us to the same lines of thought as those I am maintaining as to the relations of electricity to matter. But what disposes of the postulate is the well-known fact in nature, that the addition of energy in many cases *reduces* the space occupied—the fact exactly opposite to the postulate. Water gives us the simplest proof, for we know that ice-cold water is reduced in volume by the addition of heat, until it reaches the temperature of maximum density, when it begins to expand on the further addition of heat.

I will now examine the separate arguments of "G. J. B.," and shall claim the rights of his concluding sentences, and especially of the words "if any phenomenon can be shown to be due either to a known agent or to an unknown agent, it is assumed to be due to the known agent, the unknown agent being treated as non-existent." It is true "G. J. B." states that the energy of an air condenser must be stored in the ether or some unknown medium; but I propose showing that he has not disposed of the known agent—the air.

In the case of a hollow sphere condenser, where is the energy stored? We agree that it is in the space between the surfaces of the spheres. Two arguments are given why it is not the air which contains it. (1) If the air is blown out by a stream of fresh air, the charge is not affected. Let us admit the fact, and deal with the statement that, "if a body contains energy in any form, it carries its energy with it." That I dispute. It does so in some forms, especially as heat, but not in all forms. If we mount a flat iron ring so that it can rotate between the poles of a magnet, the lines of force of the magnet are completed through the iron, and this involves a redistribution of energy. If we now rotate the ring so as to continually interpose fresh iron, the lines of force and the energy they involve are not carried away with the iron; fresh iron molecules take them up. It is true that energy has to be applied to effect this, because the molecular changes in the iron involve heat, which is carried away. Now, I consider that the cases are identical in principle; the fresh air streamed into the condenser corresponds to the fresh iron taking up the magnetic lines. I do not know whether it has been tested; but I am pretty clear that it would require more energy to pass a stream of air through the charged space than through the apparatus uncharged. The excess would be very small compared with the magnetic case, because the relative charge of energy is very small, and the internal friction of air is trifling to that of iron.

The second argument is that "the capacity of the air-space is not sensibly affected by the quantity of air it contains." Now the asserted fact is not true. If we increase the air-space by employing larger surfaces with the same distance apart, we do increase the capacity proportionally: if we increase the air-space, either by reducing the inner sphere or enlarging the outer, we *reduce* the capacity. But this is true whether the energy is stored by air or ether—the same argument applies to both. We have no right to apply the laws of one form of energy to another form. We cannot argue from the quantitative relations of heat to matter to those of electricity; we might with equal reason insist that because a unit quantity of heat raises a pound of water one degree, it ought also to equally increase a pound of anything else, which we know is not the case. We must take Nature's own facts. Now Nature's facts as to induction show us that while some effect must occur upon the whole stratum of the dielectric, the storage of energy occurs only in a very thin stratum adjoining the conductors; the intermediate space, be it ether or be it matter, is not a storer, but a resistance. We can prove it in solid dielectrics; in the case of air we can only reason. We need not go to the ether for explanation, because the almost irremovable film of air which coats all surfaces, and which is not affected by blowing air through the space, gives us all the explanation we need. But, again, if we vary the quantity of air contained in the space, either by exhaustion or compression, we do alter the capacity. If we remove air, we reduce it; if we add air, we increase it—not much, it is true, but the evidence, just so far as it goes, is in favour of the air theory, as we cannot suppose the infinitely elastic and incompressible ether to be altered in quantity. The fact is that the relation between the insignificant quantity of electric energy in a charge and the countless myriads of air molecules, even in the best vacua, is such that we can expect only a small apparent result from any variation of air density.

The analogy is very strong between an inductive circuit and an electrolytic one: in both the main action is at the surfaces, while the intermediate space offers resistance, and the relation to energy is not that of quantity, as with heat, but to the number of lines of force which can be formed in that space, and the stress upon them. The magnetic analogy is also strong, but is apt to be overlooked, as "G. J. B." appears to have done. In old times the charge was attributed to the surfaces of the conductors, and I have done my share in exploding that notion. Now it is attributed to the dielectric, and the real function of the conductors is apt to be overlooked. But the charge is not in the dielectric alone: it involves, just as the magnet does, a complete closed circuit. In the present case of spheres, as in all electric charge, there is a reverse outside field, essential to the charge in the dielectric. That is why blowing air through the space, even leaving the air films out of consideration, would no more carry away the electric charge than the moving of the iron ring between the magnet poles would carry away the magnetic charge. Though the surfaces of the spheres do not contain the stored energy, the lines of force in the dielectric space are closed upon them; they act as the attachments of a strained spring do, and enable the stress to exist. They can be removed from a solid dielectric and replaced by others, because the structure of a solid enables it to close its external lines through the air. They cannot be removed from an air-condenser; and if they were, I am pretty sure they would carry the charge with them.

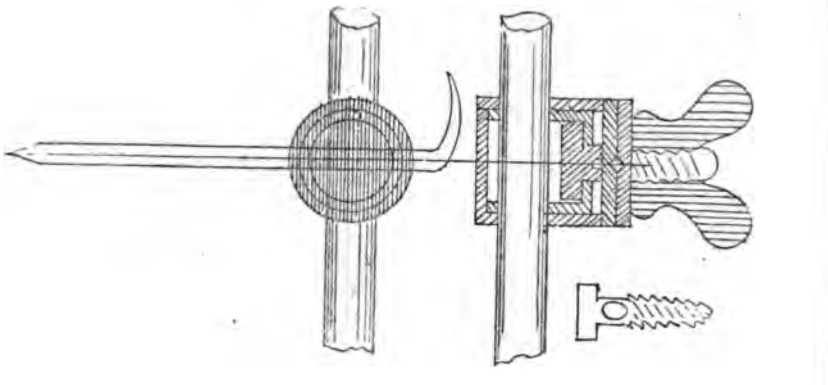
However, granting the whole of the argument of "G. J. B.," it would only go to show that the ether may play some part in the electric phenomena, and have an induction capacity of its own, though less than that of air. That proposition I should not attack; to do so would be to commit the same error for which I oppose the etherialists—it would be making an assertion about a thing of which neither I nor they know anything. I confine myself to maintaining that ordinary matter is the effectual agent in electric phenomena, and that the agency attributed to the ether as the real acting agent is imaginary. "G. J. B." has given us the best evidence in favour of its having some action, and I think the evidence is not valid.

I had intended to continue my own arguments this week; but have mislaid some necessary memoranda. **Sigma.**

### OUT-OF-THE-WAY TURNING.

[31863.]—It appears to me that an article or two on out-of-the-way and bizarre turning would be acceptable to those who, like myself, are interested in what may be called the "by-ways" of turning. "Eos," with his large experience of Eastern workmen, would, no doubt, be well able to write on this subject. He has certainly sent some letters on Indian turning, but I do not think on the particular kinds alluded to above. **J. G. Bartel.**

Collingwood-street, Nelson, N.Z., Oct. 28.



## ADJUSTMENT FOR SURFACE GAUGE.

4.]—Seeing a sketch of a surface-gauge week's "E. M.," I send you a sketch of one I think is a great improvement on it, which about three or four years since; the only ice is, instead of the scriber going through of the washers, this goes right through pin shers, thereby getting a better grip. Now turn the scriber any way you like, and it l be as tight as ever. **Piedmont.**

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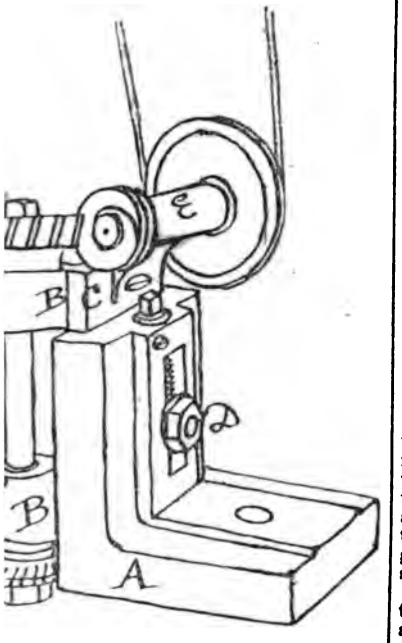
## MILNES' NEW GEAR CUTTER.

5.]—I send a sketch of a wheel-cutter which lnes has just brought out, and one of which good enough to send me to see.

band of an overhead must run fast if it is to t any power; a wheel-cutter must run the speed may be transformed into power



ing, but unless it is very well cut it will very disagreeable noise. A worm and ay, in theory, absorb a little more power aring, but I have for some time thought ld be a case where its smooth action would eciated. I have taken this cutter spindle examination, and find it has hard necks in hard collars, the surfaces finely polished, fit very good. The worm-wheel is of gunnd the worm is case-hardened; the whole e looks very strong, and as if would never . The worm-wheel has twenty teeth, and the 3in. diameter. In the drawing A is an acket to bolt upon the tool-plate of rest; lugs cast on to the slide C, which gives the adjustment by means of a small screw, the which is seen at the top of A; D is a nut cures C to A when the height adjustment made; C carries an arm, E, which is bored to form the bearing for the spindle, which one end the pulley, and at the other the This spindle is soft, and runs in the casthen driving off my flywheel it takes 2¼ turn the cutter-spindle. When placed e work on my 5in. lathe, the cutter can be ck far enough to cut a wheel 3¼in. diam.; ned quarter round to the right, so that the es the work, then a wheel 8in. diameter ut. By this arrangement the slight band overhead drives with no noise, and with er; indeed, I think the size of the spindle increased. **F. A. M.**

## ECCENTRIC CUTTING FRAME.

[31866.]—I would balance C. C. Ellison's eccentric cutting frame (see letter 31852) as follows:—Take the screw out of the frame and turn down the outer ring of micrometer head to the solid, fit a piece of brass to this of sufficient weight, tin them both carefully and sweat them together; turn down to correct balance and mill the edge. By this plan you would loose the square for the key, but would save the micrometer.

Another plan:—Turn down both rings to the solid, drill a piece of brass to fit this, tin and sweat them together; then turn down to balance and re-mark micrometer. **W. P. W.**

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## LATHE MATTERS.

[31867.]—It may be of interest to your readers to know that similar work to that of the reproduced photo may be done on a double-barrelled rose engine, using a *side* quasi-square rosette on the first barrel, and a No. 12 deeply cut half diamond *face* rosette on the second barrel, which can be worked to the required design independently of the rosette on the first barrel. The ornament, "in zigzag," may be produced either in deep intaglio or in high relief, as desired by the operator. It is a remarkable coincidence that two men, so many thousand miles apart; should conceive the same idea almost at the same moment, as during this year I have been experimenting to ascertain what can be done in the way of ornamenting wood, ivory, and metal by the aid of the rose engine. Ample space for rocking and pumping motions is most necessary for this kind of work. **Norman Maclean.**

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## SPEECH OF LOWER ANIMALS.

[31868.]—It is well known that if the number of light vibrations per second be increased beyond a certain limit, the nerves of the normal human eye being insensible to these exceeding rapid movements, the light becomes consequently invisible to us. Also that such invisible rays can be rendered visible by reflecting them from a surface impregnated with stramonium or æsculine, by which their vibration speeds being reduced, they are brought within the sensitory compass of the optic nerves; and that, although the human eye is not sensitive to the ultra-violet rays, it is otherwise with a photographic plate, upon which visible images of such spectra have been produced for years past.

Similarly, if the number per second of the vibrations of the air which produce a musical note—and all speech consists merely of combinations of such notes--be increased, the note is sharpened, and if this increase be carried beyond a certain point the sound becomes no longer perceptible to the normal human ear, as the ultra-violet rays are not to the eye.

Now, it is quite easily conceivable that just as many animals can smell and distinguish odours imperceptible to our olfactory nerves, so lower animals may use for purposes of communication between themselves sounds too high in musical pitch to be audible to us. If the speed of such vibrations could be sufficiently reduced in the same proportion throughout, it is clear the sounds could be made audible to us as to them.

My purpose in writing this is to suggest to some of those who possess the apparatus (or means of procuring it) and the leisure, neither of which are mine, to experiment in this direction, and to propose a plan which appears to me worth trying.

Let a very delicate microphone be connected up in the usual way, with a small battery and a telephone as receiver, and let the diaphragm of the telephone carry a stilus, and be fixed so as to impress by this stilus the surface of a phonograph. The animals to be experimented on being confined near the microphone, the phonograph is to be driven at full speed by electricity, clockwork, or any arrangement with a good governor. The back of the telephone is then removed and the trumpet substituted. If now the drum (having, of course, been stopped and set back) be rotated more slowly, the vibrations will be reproduced at longer intervals, and will form an exactly similar combination of lower notes, which may be made low enough to be within the compass of the human ear. If the speed were one-half as great, the words (?) would be spoken an octave lower; if one-fourth, two octaves lower, and so on.

**Sidney Bolton Kincaid.**

Woodbridge, Dec. 2.

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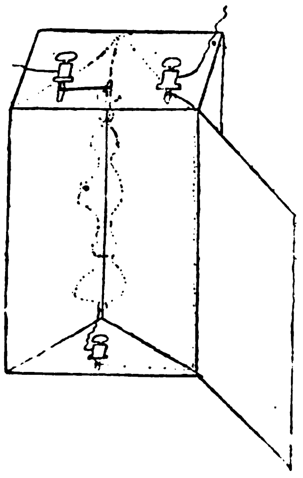
## VACUUM TUBE MULTIPLYING PLANE.

[31869.]—A very inexpensive little apparatus may be constructed in a few minutes, the effectiveness of which is out of all proportion to its cost if home-made. If purchased at an instrument dealer's, the box would probably cost ten times the sum for which it might be quite efficiently made at home. Take any ordinary cigar-box measuring 10 × 4½ × 4. With a little care, one of the ends can be taken off by scraping away the paper round the edge and easing up the small nails. Upon the inner side of the end piece cut two grooves about an eighth of an inch deep inclined towards each other at an angle of about 40°, with the apex at that part of the end-piece which fits the bottom of the box. Procure from any glass-dealer two pieces of thin silvered glass, each measuring 9⅝ by 3¼. Place these at an angle like a V inside the box with their faces towards each other in such a manner that the grooves in the end piece will fit down upon the glass. Fix the glass with two small brass pins knocked into the front and back of the box, so as to keep the glass steady. Replace the end-piece, taking care that the grooves fit accurately over the pieces of glass, and gently



nail the end piece down. Now stand the box on end. The effect will be to look into a reflecting glass V. Take two of the smallest size terminals, which are to be screwed into the outside of the uppermost end of the box. Take a very small brass screw hook, such as are used by jewellers, screw it from the inside into the same end, so that it projects downwards to form a hook from which to suspend the tube. Carry a thin strip of brass, or even a bit of copper wire, from the hook to one of the terminals. Now attach a piece of insulated copper wire to the base of the other terminal, and carry it along the top of the box and downwards to a spot on the inside of the bottom end of the box (the end upon which the box is standing upright). Attach the end of the wire to a third terminal, which should be screwed into the inside of the bottom end. The apparatus is now complete. Attach a vacuum tube to the top hook, and, by means of a short piece of wire, fix the bottom end of the tube to the bottom terminal. Carry the wires from the induction coil to the two terminals at the top of the box, and the tube will be lit up. The effect is to multiply the tube so that five tubes are seen instead of one. The total cost of the apparatus is about one shilling. It will take any tube up to 9in. long. **H. Brocklehurst.**

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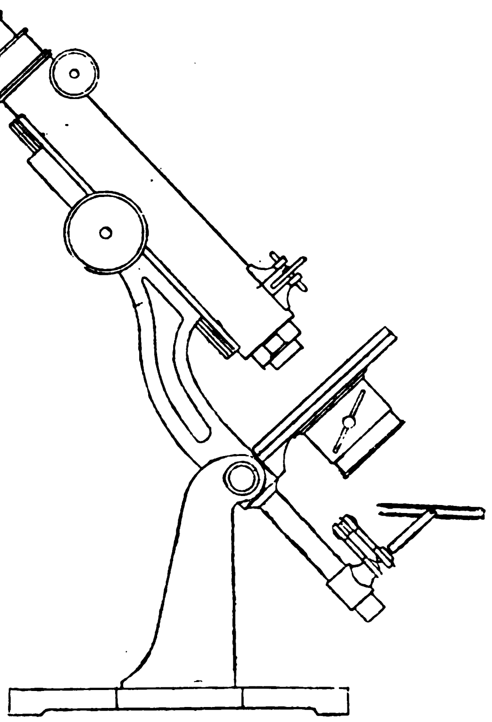
## STUDENTS' MICROSCOPES.

[31870.]—In connection with recent letters on students' microscopes, I have sent an outline drawing (half size) of a form of stand which I some years ago designed for my own use. The idea was to combine the good points of the more costly forms with the simplicity and portability of the cheaper patterns, and this was done in a manner that was then, and to a great extent still is, a somewhat peculiar one.

As regards portability, it will be noticed that the upper portions of the standards are bent over so as to throw the points of support outwards. By so doing the stage can pass underneath them, thus allowing the body to become horizontal when turned sufficiently forwards. In this position the



instrument will go into a comparatively shallow flat case of no greater depth, in fact, than that required for Smith and Beck's "Popular," with its collapsible stand.

The body is carried in a long slide with rack-and-pinion, as usual; while the slow motion is given by a differential screw and lifter arrangement.

The stage is square, but with a (removable if preferred) revolving circular upper stage. This upper stage has two parallel dovetailed grooves, in which slides a square, fork-like object-carrier with ledge to receive the slide, and a light clip-spring. This part is, in fact, like the carrier of the original S. and B.'s students' microscope.

There is a removable substage fitting attached by screw or by a kind of bayonet-joint catch. This fitting consists of a stout tube, in which an inner tube is moved up and down by a pin working in a spiral slot in the outer tube—the inner tube carrying a condenser, &c.

The drawing shows the prism-box of a binocular instrument, also the drilled head of the draw tube movement. The mirrors are carried on double-jointed arms for very oblique illumination.

As I see the date of the original drawing is March 1870, Mr. Nelson with his spiral slot-movement in the substage fitting, and Mr. Campbell with the differential screw fine adjustment, are both some years (nearly 20) behindhand with their inventions, one and the other being alike first proposed by

**A. S. Lukin.**

## OPTICAL MATTERS.

[31871.]—A number of letters have recently appeared in the "E. M." in reference to the making of lenses. It seems to me that there has been a vast amount of information given as to their manufacture, but not much has been written on the subject of mounting them, &c. In my opinion, if a writer could give a few articles embodying the following points, he would confer a benefit on all amateurs interested in the production of optical work:—

1. Method of screwing cells for lenses.
2. Method of burnishing lenses into their cells.
3. How the body-tubes of microscopes, &c., are fixed when cutting an inside or outside thread on them?
4. Cleaning lenses after removal from chuck holding them.
5. Whether single-point tool is used for cutting threads, or whether a screw-cutting lathe be employed?
6. Whether glass for small lenses is first cut circular, and if so, how, or left simply square?
7. Removing lens from chuck.

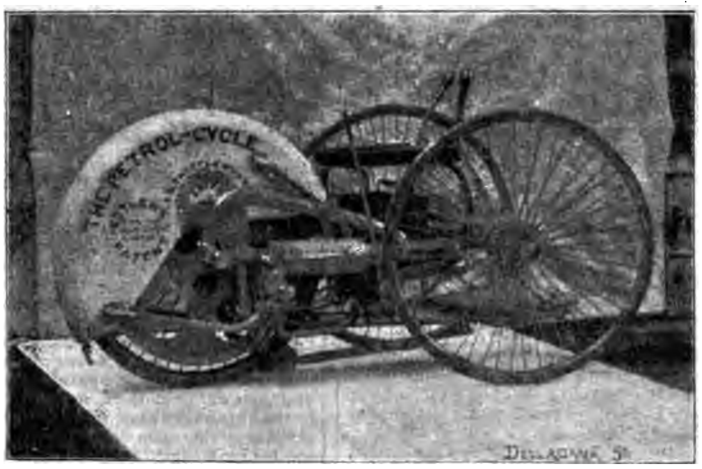
It is always stated in books on optics that the fewer the reflections or refractions, and the thinner the lens or lenses, the brighter and purer the image will be; yet most microscopes have three achromatic combinations—in all six lenses—for the objective. I think that there is room for investigation as to whether it is possible to make objectives better than those now made, yet with fewer surfaces. If the glass used is not perfectly homogeneous, which it is hardly possible to be, errors must arise in consequence of irregular refraction.

**G. Bartel.**

Collingwood-street, Nelson, N.Z. J Oct. 28.

## AUXILIARY POWER FOR TRICYCLES.

[31872.]—My attention has been drawn to the interesting controversy *re* Auxiliary Power for Tricycles. As this has been the subject of much of my thought and time, and having produced a "self-propelling machine" (a photo. of which I beg to inclose), I have presumed in taking this liberty that some particulars of it would be useful.



The machine has applied to it a pair of cylinders which actuate the rear wheel; stopping and starting is effected by lifting this wheel off the ground by a foot-lever.

The motor cylinders are actuated by the explosion of petroleum spray and air by a small electric apparatus. Cooling is effected by water circulating in a radiating hood over the wheel. Speed is governed by a throttle valve-handle at the side. Steerage is by a new arrangement with open front and side rocking handles. The machine is mounted on 32in. wheels, and weighs complete with engines, $\frac{5}{8}$ power, 280lb.

I have ridden it only on experimental runs, as the authorities do not countenance its use on the roads, and have abandoned in consequence any further development of it.

**Edward Butler.**

31, Ashburnham-road, Greenwich, S.E.

## MODEL ENGINES.

[31873.]—All our amateur engineers must feel grateful to "J. H." for his articles on Model Locomotives, but I venture to say that for one who is likely to require such engines, there are a dozen who would find a fixed engine far more useful. I notice that one contributor requests "J. H." to undertake a further series on Model Traction Engines. If "J. H." will give us some more information of this kind, might I suggest to him that the subject should be a $\frac{1}{4}$H.P. beam engine, or a compound vertical of the same power. Just as much skill would be required in fitting u these as for the locomotives, whilst when co they would be capable of performing usef I should prefer the beam engine as bein more out of common than a vertical. " might describe two classes, as in his loc articles, one a high-class condensing engi parallel motion, jet condenser, air-pump, & the other a simple non-condensing. A co condensing beam engine would be someth an amateur engineer to be proud of.

**Scarlet T**

## RAILWAY TRAVELLING.

[31874.]—The appearance of an extract fr *Lancet* in your last issue, with reference to n affections of railway travellers, is my exc writing on this important subject.

I am inclined to agree with the French m practitioner in that many nervous affectio produced by much railway travelling, but not, says, due entirely to "reading in the train." common a thing it is for business men of years' standing to consult their medical ad their great symptom being, they feel comp knocked-up; and how often does that well-m practitioner go into questions of family or bu anxieties; and is often satisfied one or oth these is at the root of the "knocking up"? wisely—very wisely, I may suggest—recomme complete change to his patient, a long sea voya few weeks in the country or on the Continent. patient, if fortune has favoured him, goes, returns very much improved in health.

Now, one important cause of many of these obscure nervous disorders one meets with is, I convinced, the constant and regular mi travelling done by men who live some miles their seat of business—men who have a journe say, 12 miles or so, with some five or six statio between. It is the constant jolting of the carri over the numerous points at these stations, numerous stops, the anxiety one unavoidably lest an alighting or new passenger should trea one's toes, knock one's gouty knee, or newsp from one's hands, and, above all, the unne slamming of the carriage doors, either of you compartment or one in the same coach. On more or less used to these things; but, li dropping of water on the rock, they leav impression, and, from my own experience, c to dread certain or all stations where thi slamming is so enthusiastically practised, more than the proverbial lady with her nu packages arriving at the door of a smoking partment. Now cannot something be d deaden the sound—rubber stops in the door- or a pneumatic check appliance?

I should be glad of C. E. Stretton's, or d and guards' own experiences as to symptoms these latter often experience after years of t ling. The many minute concussions a receives on his engine must tell upon his syst

Finally, let there be light in the carriages average print of daily publications, referre the *Lancet* extract, is not nearly so much at f the average light in many evening business t

**Etag**

## DRY BATTERIES.

[31875.]—Mr. H. Leitner says in hi 31815 that the current of a dry cell is very stant, and the internal resistance is high. this depends very much on what purpose th made for and how it is made. Some dry c more constant than others, and some have a resistance than others, but, as a rule, the i resistance of most dry cells is *low*, no ner's, Mehner's, Wolfschmidt-and-Brehm's, 'arman's are all noted for their low internal ance. Smee's cell is frequently used and nmended for plating; is this cell constant? ell's cell is recommended for plating; has this a low internal resistance? I do not say, and not said, that dry cells are the best for plating; do say, as I have said before, they are very ly for small, occasional work.

I that can be said about the 3½ volts is this: I e up a dry cell that gave an E.M.F. nearly two , which fell after a week or so, although cell but little used. I then regenerated it by ent, when, to my surprise, it for a short time e 3½ volts and a larger current than at first. y this should be I don't know; but I am inclined hink the extra voltage was due to the accumu on of gas at the electrodes, being unable to escape ckly through the exciting mass. Mr. Leitner nks this idea ridiculous: it may or may not be. are but little which; but at present I think it usible, and partly for this reason: We know y well that the accumulation of H at the nega electrode of, say, the Smee cell, *decreases* the .F., so why should not the accumulation of O *ease* the E.M.F.? I have not studied this matter h, as it is not worth while, as this extra voltage ains with the cell but a short time; but can Mr. tner offer a better explanation? I should be to hear it. Take the Gassner, for instance. ontents gives 1·60 volt, but on being regen ed it gives over two volts; can Mr. Leitner tell ow this happens? For my part, at present, I no other explanation than the gas theory. I e thought that it may be owing to a little rochloric acid being set free; but this idea does seem to fit when the alkalies are used instead of chlorides.

he last few lines of Mr. Leitner's letter are not argument. It is obvious that with the zinc and we should get local action, so we should not get two volts; but, taking the gas theory, uld we get local action between the H and the ? Mr. Leitner, in the first part of his letter, aks of dry cells being made for advertisement sale. Well, I believe there is a lot of truth in and many people would buy a "dry" cell for novelty of it; but there seems to have been a of rubbish sold under that name, cells that end entirely on their zinc surface for their lives, whose internal resistance can never be restored h all the regeneration) to their original standard. egards my own cell, if I don't produce some g that will do more work and remain in action *er* than the Leclanché, it shall never see the ket. I may add that I have not had over teen months' experimenting and discovered hing.

ec. 1. A. E. Ball.

### PITCHING CLOCK WHEELS.

31876.]—I AM afraid the plan illustrated last k would not answer. The errors arising from e fitting, and other imperfect construction, uld together amount to much more than the ersonal" error resulting from the use of com ses. Further, supposing the apparatus to be *rfect* in fitting, lining-up, &c., it seems to me t it would be a matter of great difficulty to termine when the depth was correct, owing to nt of rigidity of the wheel and pinion.

F. J. Garrard.

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EVERY year a layer of the entire sea, 14ft. thick, aken up into the clouds. The winds bear their rden into the land, and the water comes down in n upon the fields, to flow back through rivers.

**hree Christian Tests.**—Under this title Mr. A. Fawkes, of Chelmsford, has written a little k which cannot fail to interest thinkers. He : "If analysis is so advantageous in obtaining truth in natural science, certainly analysis not be less advantageous in the infinitely more portant field of Christian science." The three s are the "germ" test, the "colour" test, the "brotherhood" test. Mr. Fawkes holds "the universal brotherhood of man is not a onary Utopian impossibility, but something to striven after and looked forward to." The k is published by Mr. B. T. Batsford, 52, High lborn, W.C.

**leaching Fluid.**—Ozonin, a bleaching fluid, ented by L. Schreiner, is made as follows: parts resin are dissolved in 200 parts oil of pentine. To this solution is added a solution of parts potassium hydrate in 40 parts water, 90 parts hydrogen peroxide. The resulting y exposed to light changes in two or three days a thin fluid called ozonin; this same change es place in the dark, but then requires some ks for its completion. An emulsion of one mme ozonin in one litre water acts as an ener bleaching agent on fibres, wood, straw, cork, er; also on solutions of gums and soaps. The ching effect is as energetic in acid as in alkaline tion.—*Chemiker Ztg.*

# REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[72319.]—**Marine Engines (U.Q.)**—The gear usually employed is the ordinary link-motion, and sometimes the eccentric is made to slip on the shaft. There is also Clements' single eccentric gear. What is your difficulty? Query is too vague as it stands. Do you, perchance, mean the gear in which the valves are actuated by the oscillations of the cylinders? A. F. SHAKESPEAR.

Maternistrasse 3, Dresden.

[72393.]—**Magic Squares.**—It may be well, for the sake of accuracy, to correct a slip in my reply, Oct. 31. The writer on Nasik squares to whom I referred, should have been the Rev. A. H. Frost, instead of William Frost, as printed.

T. S. B.

[72400.]—**Proportional Galvanometer.**—To S. BOTTONE.—Owing to the fact that "H.H.M." had placed the number 72400 before his new query, this query got placed among the replies, and escaped my notice last week. In asking queries, correspondents should never place numbers with them, otherwise they go into the Reply column, and remain unanswered. The galvanometer described by me is exquisitely sensitive, and would give quite a large deflection with the current set up by a square of zinc and copper 1½in. in size, separated by moist blotting-paper. But the resistance of the human body is very great, say from 3,000 to 4,000 ohms on one square inch of surface, so that little or no current would pass through the body if exposed to the influence of so weak a couple, certainly not more than $\frac{1}{1000}$ of an ampère. The pivot is a small cone drawn out of glass tube over a spirit-lamp. The magnetic needle has a hole in the centre into which the pivot is glued. The graded cord is a misprint for graded "card." Read Thompson's "Electricity and Magnetism," and my "Elect. Instruments." S. BOTTONE.

[72549.]—**Analysis of KOH.**—Of course "Sutton" does not give determination of organic matter, because its processes are volumetric. Carbonaceous matter may be estimated by ignition, either alone or heated with $H_2SO_4$ and $C_2O_3$, and the gas passed through potash bulbs. If the organic matter cannot be separated by filtration, it will probably be set free by evaporation to dryness after neutralisation with HCl. There is no universal method—one has to judge according to circumstances. Since strong KOH has a solvent action on certain forms of organic matter, particularly cellulose, you must in this case set it free by means of acid. I should then evaporate and employ the wet combustion—the same as is used for carbon in iron. SM.

[72658.]—**Electric Lighter.**—There is no necessity to hold the "lighter" about "2in. above the jet," as implied by "F. G. LL." (p. 316). "Holding properly," means holding so that the spark passes through the issuing stream of gas—that's all. "Hathaway's" statement was that his "lighter" gave sparks, but not "strong" enough to light gas. I say simply that any electric spark will light gas, and that "strength" has nothing to do with the question. Possibly my critic's servants may be able to light the gas more easily by holding the lighter about 2in. above the burner; but it does not follow that it is impossible to light the gas whilst the sparking points of the lighter are actually lying on the burner. The query itself was essentially silly, and was perhaps scarcely worthy of an answer, because the querist, having the appliance, could easily have tried for himself, or at least have asked a definite question. M.

[72678.]—**Pellets.**—I mean the pellets of very small size. It is known that the manufacture is made by letting fall from a tower molten lead into a basin full of water. But perhaps there are more recent and better methods of manufacturing?

ETIMOMACHOS.

[72685.]—**Yew.**—I am surprised to read so many disparaging remarks on this really valuable wood. It made England the most formidable nation in war for many centuries, until the discovery of gunpowder as a projectile force. Cressy and Agincourt were won by British yew in the strong arms of our native archers. This slow-growing tree was grown and protected by Royal decree. Some venerable specimens still exist, though few and far between, in this age of steel. *Taxus baccata* is oue indigenous species, from the Greek *Toxon*, a bow, and the word yew is supposed to be a derivative of Celtic *Yw*, signifying verdure. There are two varieties, known as Irish yew, preferred for bows. Very far up in the Himalayas I found large trees closely allied to our European Taxus, and also to *T. nucifera* of China. I selected some fine wood, which I used for fishing rods and ramrods, finding it hard and elastic. Nottinghamshire was always celebrated for its yew trees. There was an old saying in the New Forest, Hampshire, that "a post of yew will outlive a post of iron." Some of those in Norbury Park are recorded in Domesday Book. Some giants still exist in the Lake District. When I was a boy many of our churchyards contained grand specimens. There were two reasons for planting them in those melancholy inclosures—first, to insure the safety of the trees; secondly, to guard them from cattle, the leaves proving fatal if eaten. I burn all the clippings of my yew hedge as a matter of precaution. I like the wood for turning. The burrs resemble the Kiaboscεæ of the Tropics. The choice pieces are good for cabinet work, also for chair-making and walking-sticks, being very springy and nice coloured. Tool-handles, too, I have made—very neat things. Amateur archers like a good yew bow, and a "lady's carriage whip" might do. EOS.

[72743.]—**Engine.**—"Joe" can find several illustrations in back numbers, and can see models in the shop-windows, or diagrams in the dealers' lists. For so small an affair, the ordinary A standards would do, I should think: but querist must please himself. E. M.

[72744.]—**Phosphor Bronze**—This was a patented alloy, particulars of which will be found in the back volumes or in the specification. See p. 216 in the number for Nov. 13, 1874.

NUN. DOR.

[72747.]—**Incubator.**—"No Sig." should refer to the indexes, which will guide him to places where he will find a variety of incubators. Let him try Feb. 17, 1888, or Oct. 30, 1885, as well as July 25, 1884. EGG-HATCHER.

[72756.]—**Aid for Propelling Chairs.**—"Invalid" cannot do what he requires in the way of storing power—that is, not to any advantage. The chair must be pushed up the hills.

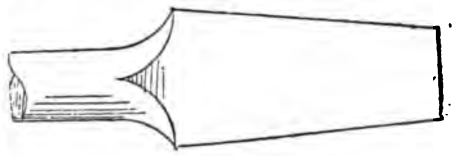
NUN. DOR.

[72767.]—**Margarine.**—I would recommend "W. G." to look through the indexes under heads of Butter, artificial; Butterine; Oleo-margarine; Bosch butter, &c. Several patents have been taken out, and the specifications could be found at the Patent Office. It must be undertood that margarine can be made profitably only on the large scale with what is really a rather expensive plant.

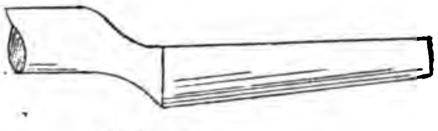
NUN. DOR.

[72789.]—**Diamonds.**—Those of your readers who are interested in the question of the production of diamonds by artificial means should refer to the article on p. 2, Vol. XXXI. (March 12, 1880), where they will find an account of Mr. Hannay's experiments, and in March 19 following, some comments by Mr. Wenham. See also an article in July 23, 1880. MacTear's process is briefly described in the number for August 13, 1880. In short there is a lot of information about artificial diamonds in Vol. XXXI. NUN. DOR.

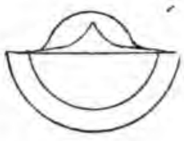
[72953.]—**Boring Taper Holes.**—I inclose a rough sketch of boring ends of taper D bit, which is similar to the ordinary D bit, except that the sides are turned to the required taper, and do all the cutting. To use it, first bore a parallel hole the same size as the smallest end of taper-bit to the required depth, in this case 1½in., and then use the taper-bit, which must be fed very slowly to its work. As regards the clearance, there is practically none, for the bit has to be forced into the hole the same as



PLAN



SIDE VIEW



END VIEW

a taper-reamer. There is another tool which I prefer, but it would hardly pay for making if you have only a few holes to bore: it is a steel cone of the required taper, fluted similarly to a reamer.

SNOWBALL.

[72805.]—**Water-tube Boilers.**—To "VOLCANIC.—I would advise "Volcanic" to expand his water-tubes into steel or iron forgings if possible (preferably the latter, as they are easier to work), and not into castings at all.

Brymbo. T. G. L.

[72960.]—**Equation.**—I am obliged for replies; but they appear incorrect. The object is this: We have a mixture of potassium and sodium chlorides, and convert them into sulphates. Required, proportions of K and Na, based on the following:—

$$\begin{array}{llll} K = 39{\cdot}04 & Na = 22{\cdot}99 & K_2 = 78{\cdot}08 & Na_2 = 45{\cdot}98 \\ Cl = 35{\cdot}37 & Cl = 35{\cdot}37 & SO_4 = 95{\cdot}82 & SO_4 = 95{\cdot}82 \\ \hline 74{\cdot}71 & 58{\cdot}36 & 173{\cdot}9 & 141{\cdot}8 \end{array}$$

Let $x$ = K, and $y$ = Na. A = mixed chlorides.
Then— B = ,, sulphates.

$$A = \frac{74{\cdot}41}{39{\cdot}04}x + \frac{58{\cdot}36}{22{\cdot}99}y.$$

$$B = \frac{173{\cdot}9}{78{\cdot}08}x + \frac{141{\cdot}8}{45{\cdot}98}y.$$

—(Roscoe and Schorlemmer.)

By experiment—

$$A = 2{\cdot}177. \quad B = 2{\cdot}43.$$

By the equation of "Assoc.N.S.S."—

$$x = \frac{3{\cdot}084\,A - 2{\cdot}538\,B}{{\cdot}225}$$

$$x = 2{\cdot}43,$$

which is absurd. By the accompanying equation—

$$y = \frac{2{\cdot}227\,A - 1{\cdot}906\,B}{{\cdot}225}$$

$$y = {\cdot}96,$$

which is more reasonable, except that it has the wrong sign. The second answer to this question gives—

$$x = \frac{39{\cdot}04}{16{\cdot}05}B$$

$$x = 0{\cdot}6.$$

It is manifestly wrong to make A = B. I have always solved the question before by estimating the chlorine in the mixed chlorides, which is an easier method. Perhaps the errors in above will be kindly corrected. I do not see why $y$ should be negative; they ought, from the question, to be both positive.

Q.

[72995.]—**Fluid for Writing Zinc Labels.**—A very good preparation for writing on zinc labels is a solution of platinic chloride. J. R. T. P.

[73017.]—**Hard Steel, to Drill.**—Get some silver-steel wire and fit it to a pump drill; file the point long and triangular; make it hot and plunge it into a wet bar of yellow soap; next, touch upon an-oil stone short at the point, and drill with raw linseed oil or camphor and turps. The wider ones you may punch upon sheet copper, but you must not play with it; you must be sharp and decisive, as I have punched very delicate watch hands out of blue steel that way. JACK OF ALL TRADES.

[73023.]—**Pianoforte Dampers.**—The twanging sound in your piano is most likely caused by the dampers, the felt of which is too hard and put on in a wrong way—i.e., it is put on the wool facing the strings flat, instead of endways. Take a needle and prick the damper on each faulty note in front, so as to soften the felt. If that does not answer, have new felt put on in the manner indicated above. J. H. SCHUCHT.

[73027.]—**Harmonium.**—As no one has yet answered this query, I send a reply. The cost of a pedal action would depend on the material used, and the character of the workmanship. Fifty shillings would be the price of a thorough good action, containing 29 or 30 reeds, 16ft. pitch. I will send a sketch of a suitable plan of construction if the querist will advertise his address. The sketch would be sent free of charge, or I am willing to send a drawing for insertion in the "E.M.," if requested. G. FRYER.

[73066.]—**Electro-Plating.**—I don't see how it can affect the temper, seeing the metal is not heated. For coppering and gilding the baths are warmed, but it is not sufficient to affect the temper.

A. E. B.

[73071.]—**Marine Boilers.**—IT is quite impossible to obtain 1,000 or even 500 revs. per minute in such a small engine. With 50lb. pressure 150 to 200 revs. per minute will be about as much as you will obtain, supposing the engine does not go to pieces. If you have a reliable pump on engine, make boiler to following dimensions:—shell 11in. long, 7in. wide, 6in. deep, bottom to be rounded with a radius of 3½in.; the firebox to be 6½in. wide, 4¼in. high, leaving $\frac{5}{16}$in. in water space at sides and bottom. ⅛in. is not enough. You can run firebox right through if you don't mind risk of fire. Put a steam-chest, 1½in. high, 2¼in. diam., at forward end of boiler. Height of water level above firebox crown ¾in. Thickness of plate $\frac{1}{10}$in. Pitch of stays 1½in. Furnace is not large enough for Field tubes. A boiler made in above style will raise steam to 50lb. pressure in about 25 minutes, starting all cold. You can use brass if you like, but it is inferior to copper; in any case keep all corners well rounded, or there will be a smash.

A. F. SHAKESPEAR.

Maternistrasse, 3, Dresden.

[73081.]—**Ancient Clock.**—I write to correct a curious error in my reply last week to this query. The reply, written in haste, stated that if a half-seconds pendulum were used, a wheel of 16 would be required to drive the hour-wheel. This is obviously not so. It would require a pinion of 4, which is of course out of the question. A seconds pendulum had therefore better be adopted, and a pinion of 8. F. J. GARRARD.

[73087.]—**American Laundry Work.**—The perfection "Star" mentions is obtained by the American method—a process different to that which we employ here. The "starching" is different; they also use a different polishing-iron to that which we employ. There are so many little details, that it is impossible to describe them all in this column. JIM, Ex-American Laundryman.

36, Red Lion-street, Clerkenwell, E.C.

[73090.]—**Glow Lamp.**—Premising that it is not the volts or pressure at which the current is delivered that injures the lamps, but the amount of current that those volts can force through the filament, I may point out that your first calculation is correct, provided, as you say, the resistance of the mains is so small as to be practically negligible. But your second example is wrong, since you have overlooked the fact that the resistance in a circuit cannot be less than the point of highest resistance. Hence the current from the eight cells in parallel is reduced by the resistance of the 16 cells in series. The best results will be obtained, in the case of two lamps, by using 30 cells in series, as shown below:

$$\frac{30 \times 2}{30 \times 1{\cdot}5 + 15} = \frac{60}{60},$$ or 1 ampère for the two lamps, or 0·5 per lamp. As you increase the number of lamps, so must you increase the number of cells in series. S. BOTTONE.

[73091.] — **Curious Pictures.** — Cylindrical mirrors with distorted pictures such as you described can be obtained from any optician. They are sold as toys. SM.

[73091.]—**Curious Pictures.**—You will find in Volume V. pages 57 and 58, of Cassell's *Popular Educator*, last edition, a full and interesting description of distorted pictures; also full instructions how to draw, with illustrations. If you live in a large town, you will have no difficulty in getting access to the book if you have not a copy of it yourself.

Barrow. J. E. B.

[73091.]—**Curious Pictures.**—The restoration of the distorted pictures on the boards to their true proportions by the cylindrical mirror is termed "Anamorphosis" (to form anew). It is a well-known effect, described in most works on optics and popular science. Of course, the drawings are not drawn at random, as the inquirer seems to imagine, but distorted to that degree which the reflecting cylinder is capable of correcting.

G. G. B.

[73092.]—**Wimshurst Machine.**—I think you would get more satisfactory results from a machine with a pair of plates 12in. diameter than from one with two pairs 8in. in diameter. The two inside plates can be driven off one pulley with two grooves in it, but, of course, the bands must be crossed to get contrary motion. The uprights which carry the spindle of the plates must be increased in length till they reach a few inches above the rims of the plates. A cross-piece of wood connects the two uprights, and the upper neutralising brushes are supported by wires from this top cross-piece, and are connected to the lower brushes by a wire encased in indiarubber tubing running down the outer of the two uprights. So says Mr. Gray, and he is an authority on these machines. The length of spark depends, to a great extent, on the distance of sectors from each other. Your three-armed ball arrangement will do very well for the collecting rods. A single pair of 6in. plates with 25 sectors will easily charge your pint jars. The machines with buttons are not Wimshurst's, but Voss machines. I prefer the Wimshurst.

S. BOTTONE.

[73092.] — **Wimshurst Machine.** — "New Sub." will, no doubt, receive his answer from our friend, Mr. Bottone; but, if he will accept a few volunteered remarks, they are as follows:—He will find the better way to carry the neutralising-rods is to fix each of the four sets of rods to a piece of wood extending across the case from side to side—in such manner that either of the woods may be easily removed and the brushes adjusted or renewed; care must, however, be given to make metallic connection between each and all of the neutralising rods. The two inside plates
by one boss; hence they are driven by th
and the one central pulley. He may ex
length of spark from 8in. glasses; four
8in. diameter will rapidly charge four
Leyden jars. Ebonite is by no means
glass for the purpose. Ebonite warps,
changes its character with age. The roun
upon the sectors do not increase the pow
machine. Their sole use is to save th
scratching the varnish upon the plates. T
are so fitted as to touch the round buttons
the plate surfaces left free from touch.

[73095.]—**Black Figures for Silver**
—Use black sealing-wax. Lacquer with
wine, coloured slightly with a little shell
like. C. A.

[73095.]—**Black Figures for Silver**
—You cannot do better than use either g
sealing-wax, or good lampblack and c
when finished, give it some good transparen
JACK OF ALL T

[73096.]—**Manchester Dynamo.**—I r
you to my book, "The Dynamo," sixth e
illustrations of this pattern of dynamo, a
full details of mode of winding and quanti
required. S. Bo

[73097.]—**Greenhouse Construction**
are two useful little guides in the series of "
for the Many," which were published at t
*nal of Horticulture* office in Fleet-street. Th
"Greenhouses for the Many," "Heating M
sixpence each. I have not yet seen a gl
erected by an amateur, or put up to his
that was ever a satisfactory concern;
which, aspect, situation, shelter from pr
winds, and last, but not least, all the light
given to the plants within—all these poi
to be considered before erecting a structure
from a score to hundreds of pounds! Th
improvements in greenhouses are almost i
able: frame-work, glazing, light-giving f
interior fittings, and heating are all o
scientific principles. Iron framework has
advantages over wooden. I speak as a suff
the light timber bends and warps, though fre
painted, and when a heavy fall of snow l
these curves, destructive drip is freque
result. Nearly every portion of the new
machine made, so that one can be set up in
period. Then there is the "glazing
putty," which is condemned by some hortic
and praised by others; of this inve
have had no personal experience. Th
mistake in the construction of all greenh
this—they are made too lofty, and at too
angle in their roofing, by which error the p
kept too far from the light. The new s
projecting side walls greatly remedies th
besides adding to the internal and external
the building when filled with flowering
Overheating is another usual blunder of
ing. I have seen a huge stove and bulk
which would have sufficed for thrice as ma
feet of interior; result, shrivelled veget
every kind of destructive parasite on the fo
maximum temperature of 60° in winter
suffice for the health and beauty of a
collection. "Tropical houses" are speciali
their contents only adapted to the manag
skilled horticulturists. The selection of
house will depend entirely on the purse and
ments of a man. It is wise to make a to
spection among existing designs before de
the outlay, and class of plants particularl
to be grown.

[73098.]—**Quantivalence.**—Univalent
Br, I, F, K, Na, Cs, Rb, Li. Bivalent:
Te, Ba, Sr, Ca, Mg, Gl, Zn, Cd, Cu, Hg.
rivalent: Si, Ti, Zr, Th, Y, Ce, La,
Quinquivalent: Nb. Univalent × Trival
In. Bi- and Quadri-valent: C, Sn, Pb, N
Mn, Cr, Al, Pt, Ir, Pd, Os, Rh, Ru,
Quinqui-valent: Sb, As, P, Na, V, Bi. Se
W. Quadrivalent and Sexivalent: U.

[73098.]—**Quantivalence of the Elem**
While giving the following table, in w
valency of the elements is indicated b
numerals placed above them, to the rig
symbol, I would warn "Quantivalence"
placing too much reliance upon the
character of the valency attributed to th
elements. In the following table, hydrogen
as the standard element of comparison
valency is therefore taken as unity; in oth
hydrogen H$^{i}$ is monovalent. Aluminiu
antimony Sb$^{v}$, arsenic As$^{v}$, barium Ba$^{ii}$, bis
boron Bo$^{iii}$, bromine Br$^{i}$, cadmium Cd$^{ii}$, cæ
calcium Ca$^{ii}$, carbon C$^{iv}$, cerium Ce$^{vi}$, chl
chromium Cr$^{vi}$, cobalt Co$^{vi}$, copper Cu$^{ii}$, d
D$^{ii}$, erbium E$^{ii}$?, fluorine F$^{i}$, gallium Ga$^{iii}$
glucinum Gl$^{ii}$, gold Au$^{iii}$, hydrogen H$^{i}$, ind
iodine I$^{i}$, iridium Ir$^{iv}$, iron Fe$^{vi}$, lanthanu
lead Pb$^{iv}$, lithium Li$^{i}$, magnesium Mg$^{ii}$, m
Mn$^{vi}$, mercury Hg$^{ii}$, molybdenum Mo$^{vi}$, ni
niobium Nb$^{iv}$? (or $^{v}$?) nitrogen N$^{v}$, osm

O$^{ii}$, palladium Pd$^{iv}$, phosphorus P$^{v}$, Pt$^{iv}$, potassium K$^{i}$, rhodium Rh$^{vi}$, Rb$^{i}$, ruthenium Ru$^{vi}$, scandium Sc$^{vi}$ (?) Se$^{vi}$, silicon Si$^{iv}$, silver Ag$^{i}$? (or $^{iii}$?) sodium ntium Sr$^{ii}$, sulphur S$^{vi}$, tantalum Ta$^{iv}$ (?) llurium Te$^{vi}$, thallium Tl$^{i}$, thorium Th$^{iv}$, tanium Ti$^{iv}$, tungsten W$^{vi}$, uranium U$^{vi}$ (?) V$^{v}$, ytterbium Yt$^{ii}$? (or $^{iv}$?) yttrium Y$^{ii}$ (?) nc Zn$^{ii}$, zirconium Zr$^{iv}$. There are some or believing that the chlorine group Cl, F, may be trivalent. The same may be said tals of the alkalies K, Na, Li, Cs, and Rb. the production by Carey Lea and others subsalts of silver, it is also possible that y be triadic. This is, however, denied by

S. BOTTONE.

]—**Jibbing Horse.**—When the horse lock the wheels, tie the horse up, and for three or four hours. Try again. If ibs, leave him to himself again, giving no vater. Thorough cure in two or three Do not whip him. W. MORTON.

]—**Oxygen Cylinders.**—If the gas is not understand how the cylinders can be- y. SM.

]—**Oxygen Cylinders.**—If they want to protect them, do as follows: Take 2oz. asphalte and a gill of oil. Powder the nd boil; dissolve all you can of it. Next of raw linseed oil, and dissolve ½oz. roll in powder; now take pure rubber, and bisulphide of carbon to the consistence of ix equal parts of each well together, make ers warm, and paint with it; then stove or between 300 and 400, and you will ing little superior to vulcanite.

JACK OF ALL TRADES.

]—**Oxygen Cylinders.**—Dry oxygen action on steel, and the cylinders should ically for ever. The makers of the gas y time test the cylinders before filling for charge, and reserve to themselves the o so in case any cylinder appears to be or in any way doubtful. The safety of ylinders may be taken for granted. A as very badly frightened once for about ds when he saw his fully-charged cylinder e top of his cab and fall on the granite at his feet; but he soon recovered him- would not be frightened the next time it

T. F.

]—**Microscopical.**—1. The distance the lenses must be half the sum of their ths; hence, in your case, 1 + 2 = 3, and ½in. 2. The diameter of the stop should at an eye placed at the eye-lens can just edges of the field-lens, and no farther. n image projected by an objective when s seen fairly flat and free from colour.

S. BOTTONE.

]—**Microscopical: "A" Eyepiece.**— s must be placed at a distance asunder half their focal length—i.e., in present 2in. field-lens and 1in. eyepiece at a f 2in. Put a diaphragm, say $\frac{3}{16}$in., in the eye-lens, or midway between. As the on will be equal to a single lens 1⅓in. power will not be great. By the way, ece will serve for the astronomical tele- often referred to lately—the paper tube

J. D. M.

]—**Steaming Timber.**—To have it under you would want a wrought-iron cylinder. you know what an ordinary steam trunk u not wedge them in one to keep them e while steaming, then open trunk to dry f you have a drying-room with a strong might fix it up against there with struts— d be quickest. A couple of hours steam , and better if you had a superheater.

JACK OF ALL TRADES.

]—**Flint Glass.**—Do you find a difficulty of it down? Try about 1 or 2 per cent. d nitre with carbonate of potash well on a warm Wedgwood mortar, put into a l corked to keep it dry. Try a sample of rial with a little of this, and don't forget e told you that a little of this goes a great e reducing of these materials.

JACK OF ALL TRADES.

—**Flint Glass.**—To "MONS."—So far ather from his brief description, the whole of "Baryta" lies in the fact of his not ficient heat—either quantity or intensity, mbined. In order that there might be no bout the formula I gave "Baryta," I ated the experiment with most satisfactory sing exactly the proportions given in and regulating the heat to rather under, the temperature of our ordinary furnaces. er, "Baryta" cannot, from any cause, eat sufficiently high to fuse this mixture, rhaps attain his end by substituting an amount of potassium carbonate for half carbonate given. The proportions would then be—Sand = 560, Barium carbonate = 276, sodium carbonate = 95, and hydrated potassium carbonate = 156. This, of course, will add to the expense, as the potassium salt is something like three times the price of the sodium, besides having to use 50 per cent. more of it. As I am desirous of helping "our" friend, I will with pleasure forward him a small piece of the glass I have made, if he will advertise his address. MONS.

[73106.]—**Mechanical Similitude.**—"Paddle Wheel" asks a question in mechanical similitude, which is not so simple as geometrical similitude. Froude introduced a great simplification into the theory, by comparing the performances of the steamer and its model at corresponding speeds, as the square root of the lengths, or the sixth root of the displacements. "Paddle Wheel's" model is on a scale of $\frac{1}{48}$th, say $\frac{1}{50}$th, the square root of which we may take as $\frac{1}{7}$; and now if the full-sized steamer is 250ft. long, his model should be 5ft. long; and if the steamer is intended for a speed of 14 knots the model should be run at 2 knots; the steam pressure of 50lb. on the sq.in. in the steamer should be reduced to 1lb. on the sq.in. in the model; and the 44 revolutions per minute should be increased sevenfold, say to 300 revolutions. The power developed by the steamer will be $7^7$ times the power of the model, so that "Paddle Wheel" will see that he can reduce his boiler power or heating power in scale to a great extent in the model. Let "Paddle Wheel" calculate the dimensions and design of a similar steamer to go 20 knots. A. G. GREENHILL.

[73107.]—**Hard Steel to Drill.**—Harden drills in mercury. C. A. JONES.

[73108.]—**Chemical.**—The substance you refer to is an alkaloid obtained from Conium maculatum (wild hemlock). Coniine is correct name. I am also chemical student, and would like to correspond with you for mutual benefit in studies. If you care to write direct, advertise address.

Barrow. J. E. B.

[73108.]—**Chemical.**—Coniine ($C_8H_{15}N$) is the poisonous alkaloid in the hemlock, Conium maculatum. It is volatile. "B." should get the *Journal* of the Society of Chemical Industry, 30s. per annum, or if he joined the Society, 21s. The *Chemical News* is also an excellent weekly, price 4d.

INCA.

[73108.]—**Chemical.**—To "SM."—There is no such thing as conine; but coniine is the alkaloid from *Conium maculatum*, or spotted hemlock. No one can familiarise himself with the entire ramifications of organic chemistry; but for a general outline you might get "Watts"; "Miller" is a larger work. I know of no *best* periodical. You can't do wrong to take the *Analyst*. The *Journal* of the Society of Chemical Industry is also good. The *Chemical News sometimes* contains interesting papers.

SM.

[73112.]—**Contents of Cylinders.**—Multiply area of base by height. Area of base is $\frac{22}{7}$ times the radius; one gallon is ·16046 of a cubic foot.

SM.

[73112.]—**Contents of Cylinders.**—Multiply the square of the diameter of cylinder by ·7854, and the result will be the area. Divide this area by 277·274 (the number of cubic inches in a gallon), and the quotient will be the area in gallons. The area in gallons multiplied by the depth of the vessel will give the total content, or, multiplied by the depth of the liquid, will give the number of gallons contained in cylinder. Example:—The diameter of cylinder is 50in., what is the area in gallons? 50 × 50 = 2,500, which, multiplied by ·7854, gives 1,963·5000, and this divided by 277·274, gives 7·08gals. to the inch. Then if the liquid is 15in. deep in vessel, the quantity contained will be 15 × 7·08 = $106\frac{2}{10}$gals.

EXCISE OFFICER.

[73112.]—**Finding Contents of Cylinders in Gallons.**—If the querist is really what he signs himself, he cannot be ignorant of the slide-rule extensively used by the Excise for gauging. The simplest plan I know of other than the slide-rule is as follows:—Take internal diameter of cylinder in *inches*, multiply it by itself—i.e., square it—multiply the product by the height of the liquid in *inches*, divide this last product by 353·035; result content in gallons. For all practical purposes, dividing by 353 alone, without the decimal fraction, will be sufficiently accurate. Example: A cylinder 15in. diameter, with the liquid in it 30in. deep, 15 × 15 × 30 = 6,750, which, divided by 353, gives $19\frac{1}{10}$ gallons; or, instead of dividing, you may use the decimal multiplier ·00283, with a like result.

THOS. J. LENEY.

[73112.]—**Contents of Cylinders.**—To find cubical contents of cylindrical tank, you must multiply the area of the head of tank by the depth of liquid (in inches, say): that will tell you how many cubic inches of liquid you have. Now there are 277·274c.in. in an imperial gallon, so all you have to do is to divide the above product by 277·274; your answer will then be in gallons. I will take, by way of illustration, a tank with inside diameter of, say, 18in., and depth of liquid 60in. From the diameter we must get the area of surface of the liquid—in fact, the area of a circle—which is equal to the square of radius multiplied by 3·1416. Radius = ½ diameter = 9in.; square of 9 = 81in.; and 81 × 3·1416 = 254·4696sq.in. We have now the area of surface in square inches; multiply that by 60, and we get 15268·176c.in. 15268·176 ÷ 277·274 = 55·06 gallons, approximately. I have worked it out so that I could explain process as I went along. Or course, when you see and understand the rationale, you will be able to work out the sum much quicker by proportion and cancellation.

Barrow. J. E. B.

[73114.]—**Hand Dynamo.**—To MR. BOTTONE. See reply No. 73096. For a hand dynamo, the Siemens H form is undoubtedly the best. The pole-pieces are better cast in one piece with the field-magnets. All joints are wasteful, by interfering with the goodness of the magnetic circuit. It is better to drive by hand than by gear.

S. BOTTONE.

[73115.]—**Lacquering Instrument.**—Have your lacquer in jar, with wire across top; this is to squeeze all surplus from brush on; this must be rubbed clean now and then to keep from clogging. Do not make brasswork hot, but warm till the steam or sweat disappears. The rich colour is got by putting on successive coats and warming between each. Perhaps you are trying to do this in one operation, and so laying it on too thick. Hold brush between finger and thumb of right hand, and apply lacquer by light feather strokes. Suitable holders should be made for round work, terminals, &c., whereby they can be twisted round between finger and thumb of left hand. If you make work too hot, lacquer will turn brown, and have to be washed off; this can be done with spirit, or work left in strong solution of soda overnight. Brushes should be of soft camel hair, flat, and trimmed on a board with sharp knife to a thin, straight edge. A good brush is half the battle. If these get hard, press on hot iron plate, and then dip in lacquer, when they will be in nice working order.

Cheshire. H. S. C.

[73118.]—**Blackening Zinc Surfaces.**—A weak solution of sulphate of copper, and then with a decoction of logwood. JACK OF ALL TRADES.

[73119.]—**Angling.**—I do not think that "Nero" would do any good by using inacndescent lights or light of any sort with which to fish in fresh water at night. I have, I think, on three different occasions suspended a candle over a pool to see if anything could be done, and got nothing; in fact, it is seldom too dark in the end of May or in the month of June. What is wanted is a fine fresh, mild night. If you find flies buzzing about then, you are in luck; but any mist or fog hanging over the water, and it is of little use to try and catch trout. Choose still, deep water and cast up, drop the point of your rod low, and pull your cast downwards so that you can, by stooping, just see its motion on the water. If a trout rises to your fly or worm (I prefer to fish the latter), you will see its ripple, and if fishing fly, give it just as much time as you think would allow it to descend twelve inches into the water, then give the point of your rod a twitch, just sufficient to fix the hook; next straighten your back, raise the front of your rod and find where your fish is, and get out at the bottom of the pool. If you are fishing with worm, give your trout from fifteen to thirty seconds to gorge it. In fishing worm at night, drag it on top of water exactly as you would a fly. The end of May and the first few days of June you may try a large imitation May-fly, especially if you have a large sheet of water and plenty of wood round it; you will be astonished at the size of the fish that rise to it. PETROTRYKE.

[73121.]—**Carbon.**—"J. P." can make small carbon ball by powdering coke, making into a paste with tar or syrup, pressing into a bullet-mould; wire the two cups together, heat to redness, dip into tar or syrup, and again heating. By repeating this process he will get a dense ball such as are used in gas analysis by Bunsen's method. INCA.

[73123.]—**Banjo.**—As to what kind of instrument is best, it is according to what "Benje" wishes to go in for. If he wants it for accompaniments, a six-string is best; if only for solo work, then a five-string is certainly preferable. A rather fuller accompaniment is obtained from a six-string, on account of its having the bottom G string, whereas C is the lowest note on the five-string, though a good accompaniment can be got from the latter. I myself prefer a peg far before a machine-head for the banjo, the latter being of no advantage in tuning, and a disadvantage on account of costing more, and by being much more troublesome in putting on strings, that process occupying more time with the machine than the peg head. Metal rims are the best, having a better tone and a much better appearance. The five-string banjo is a great deal more in use now, on account of its being used more as a solo instrument than formerly. PEO.

[73123.] — **Banjo.** — The five- and six-string banjos are the only ones worth thinking of, the sphere of usefulness of the seven and nine-stringed varieties being very limited. My own experience leads me to believe the five-string to be the best for all purposes, the six-string merely having the extra bass G, useful in accompaniment playing, but desperately in the way for anything else. I would recommend "Benje" to get a really first-class instrument with nickel rim and peg head at the very outset. The nickel rim not only adds to the appearance, but imparts a metallic tone to the banjo, and also adds to the carrying power of the instrument. The usual "tum-tum" style of playing that many people delight in can be acquired in a few hours; but it takes both patience and perseverance to become a good player, but the results to be obtained are thoroughly well worth the trouble taken in obtaining them. "Benje" had better not attempt to teach himself, as he will be certain to get into bad habits of fingering and style, which he will find very hard to get rid of afterwards. Let him go at once to the best professor he can find, and get lessons from him, practise hard, use his brains as well as his fingers, and he will find it pay. Some years ago, when I was learning, I used to work three or four hours daily for months; now I feel pretty well at home with the instrument, and can do very much as I like on it. When "Benje" has had some experience, and feels inclined to launch out into something showy, let him get some of the American banjo music arranged by Baur, of New York, Armstrong, Lee, Huntley, and others. They are all written in the American notation; but the transposition is easy enough. Let me give "Benje" one important "tip," and that is to learn where to find his notes on any string and in any position, because sometimes a string will break, and it looks very foolish to have to put your banjo down and tell your friends you are unable to proceed, as a string has gone. BANJOKER.

[73125.] — **Powerful Coil.**—Your proportion will do very well. Insulate every layer, both of primary and secondary, with good demy paper, which has been soaked in melted paraffin wax and drained. The primary should be separated from the secondary by four layers of the same paper. You must not use gummed paper for the condenser, but sheets of paraffined paper as above. See my book, "Electrical Instrument Making for Amateurs," for full account of method of making these coils, &c. S. BOTTONE.

[73126.]—**To Mr. Bottone.**—Yes; the carbon has sucked up all the solution. Let the carbon stand in water for a week before you make it up again, and see how it behaves then.
S. BOTTONE.

[73128.]—**Cement for Iron and Glass.**—Gelatine and glycerine, or coagulum and acid, glue, and treacle. JACK OF ALL TRADES.

[73132.]—**Zonal Railways.**—"Zero" will get a good description of the Hungarian zone system from a pamphlet published by the proprietors of the *Evening Citizen*, St. Vincent-place, Glasgow, who sent a special commissioner to inquire into the system. The price of the pamphlet is 6d. P.

[73133.]—**Star Diagonal.**—Is this for viewing stars when the telescope is nearly vertical? If so, get a small right-angle prism and fix it over the hole in the cap of eyepiece as close as possible to the lens. The size is immaterial, so long as it embraces the cone of rays. A diagonal for the sun is for preventing the heat striking the eye. It is really a prism of a very small angle, practically a plate of glass with the sides not quite parallel. It is inserted in the eye-tube at an angle of 45°, and the lens is carried outside at right angles, so that the image of the sun is reflected off the first surface of the glass; the image from the second surface does not reach the eye, owing to the want of parallelism. The greater part of the heat and light pass straight through the glass. The reflected image is, however, still sufficiently bright to render necessary the use of a coloured glass wedge or cap. SM.

[73134.]—**To Mr. Bottone.**—Seems as if the whole place, comprising the leads, was very damp, so that there is considerable leakage. If you like to send me the galvanometer by post, I will examine it, and tell you if it is in good order or otherwise.
Wallington, Surrey. S. BOTTONE.

[73135.]—**Gas Generator.**—These are made by Fletcher, to use with his foot blowers. SM.

[73136.]—**Compressing Air.**—Your question is unintelligible. The rule is: "The temperature remaining the same, the volume of a given quantity of gas is inversely as the pressure which it bears." If you put in water, you reduce the capacity of your vessel. SM.

[73136.]—**Compressing Air.**—You are not going to get much into an ordinary barrel; but if you are going to have a barrel, you can make it to hold any number of cubic feet, 2 or 3,000 if wanted. It is only a question of strength of material, say steel boiler plate.
JACK OF ALL TRADES.

[73138.]—**Effect of Glycerine on Metal.**—If lead pipe be covered with oxide, the glycerine will dissolve that. MICA.

[73141.]—**Induction Coil to give 2in. Spark.**—1lb. of No. 18 d.s. for the primary, and 2lb. No. 39 for the secondary. S. BOTTONE.

[73142.]—**Diamonds.**—Can it be said that even diamond-dust has been made? Those experiments by Hannay fell somewhat flat upon the chemical world at the time. Can anyone say why? Hannay sent a note to the Royal Society, but it did not appear conclusive. Was there any independent examination of this diamond-dust? INCA.

[73142.]—**Diamonds.**—I do not think it possible to state the pressure in Mr. Hannay's tubes. As they were heated in a reverberatory furnce, the temperature must have been near 1,500° Centigrade, and I should say the pressure at that temperature would be at least five tons to the square inch. But this is mere guess-work. I would communicate with Mr. Grey, but have no time at present for experiment, and could give him little information. I tried one or two experiments last year with bisulphide of carbon, but with negative results, and my family protested, with much reason, against the awful odours raised in the process. But I always have a hankering after $CS_2$ as the source of the diamond, owing to its marvellous refractive power, which, after all, may be owing to the same cause as that of the diamond, whatever that cause may be.
T. PRESTON BATTERSBY.

[73145.]—**Phonograph.**—"Phono" cannot be a reader of the ENGLISH MECHANIC, or he would have seen questions similar to his own very recently replied to. However, I may tell him that the ingredients of the cylinders of the phonograph are equal parts of oleate and stearate of lead, with the addition of sufficient gum damar to harden it. "Wax is," as Edison informed his agent in this country, "out of it." "Phono" might try a compound of paraffin and finely-precipated chalk, thoroughly amalgamated: it appears to possess a surface and consistency very similar to Edison's, and can be very easily made. Does "Phono" propose trying one diaphragm alone, with its recording and repeating point, or two diaphragms with their respective points? In the latter case the fine gouge-shaped cutter may be attached direct to the centre of the mica or glass diaphragm, and a fine blunt point connected with a delicate spring to bear on the other diaphragm. If "Phono" advertises his address, I will forward him a little of the above-named compo., also a piece of a stearate-of-lead cylinder. G. F.

[73146.]—**Pea Lamp.**—1. About 4 volts and 1c.p. 2. Six cells; the light would last about 20 minutes at a time, when the cells must be allowed to recover themselves. 3. Two cells of the bichromate form. I consider the Leclanché excellent in its place, which is for short intermittent currents, at intervals extending over six to eight months.
S. BOTTONE.

[73147.]—**Averaging Stocks.** — This is an operation very much resorted to in times like the present, when prices have suffered a heavy fall. Broadly speaking, averaging may be described as buying a stock of goods at an unusually low rate to mix with, and compensate for, an equal quantity bought at an unusually high rate. "V. W." asks for figures. To properly and fully work out an actual case would entail an elaborate table, which would occupy more space than could be spared, probably. The following illustration in round figures is safe enough, and, I think, quite clear. I bought 100 Milwaukees at 60. They fell to 42. I want the money for another purpose, but cannot afford to sell out at present low price, neither can I afford to wait till they climb back to 60, for it may be a year ere they see that price again. Therefore I "average" by buying 100 "Mils." at 42. My account, therefore, stands thus:—100 at 60 = £6,000; 100 at 42 = £4,200, or a total of 200 shares at an outlay of £10,200. This gives the average price of each of the 200 shares at £51; therefore, I can afford to sell out at anything over that figure. Now for the benefit. By risking another purchase I have bought stock at a price much more likely to show a profit than it was before, and at the same time I have brought nearer to me the price and the time at which I can sell out without loss. If I had not risked my second outlay, I should have been compelled to wait until "Mils." climbed back to 60—a figure a long way off at present. It is nearly always safe and wise to average when you have bought at the top of the market and the fall is over three points. Of course a dealer must be able to take up his stock; otherwise he would be swamped by contangoes.
BLACKBURN.

[73148.]—**Self-Acting Fountain.**—"F. E. A." does not seem to have got the principle of this quite right. He speaks of water bulging in sides, but as bellows is surrounded by strong metal cylinder, I do not see how this could happen. For table fountain I suggest that he proceed as follows: Procure a case of suitable metal (galvanised iron,
for instance, or even tin for experiment
bottom. Have jet with regulating tap fix
make hole in top near the edge, and solde
screw-plug with leather washer attached
used for filling model boilers; this woul
trouble to construct than valve. Bellow
guttapercha or indiarubber sheet, with
seam. Top and bottom of bellows thic
discs, top one to slide easily up and do
case, the other to fit watertight when
attached to form bottom of metal case.
sheet fixed to discs with cement, and
leather tacked round edge of each to hol
Cord should be fastened to top disc an
through hole in bottom one, this hole lar
to act as air valve for bellows, and spr
height of bellows) inclosed before this is
should think sofa-spring rather strong,
to lift case and all unless rockwork is ve
though shape would be good. Fix case
stand with axle for cord. Now wind dow
fill case with water through plug, and sc
on again, release bellows, and turn on
Your method with valve at the bottom w
good one. I merely offer this plan
interested in fountains, and have not mys
structed one, though I see no great diff
the way.
Cheshire. H

[73149.]—**Organ Query.**—Mixture and
altera stops are not mechanical stops; but
are known as compound stops. A sesqui
only a special kind of mixture. The latte
of two or more ranks of pipes such that, w
key is depressed, a chord, and not a single
sounded. This chord is almost always pa
major triad or common chord on the note
For instance, in a mixture of three ranks,
ing DD, the notes sounded would probabl
F sharp, A, and D above middle D. A
should never be used by itself, but only in
tion with a good foundation stop, or s
with a double. Its effect is to add brillia
power. ASSOC.

[73150.]—**Discount.**—The reason wh
worked in two steps appears only to av
greater amounts of figures in the workin
ordinary way would be $\frac{62\,.\,\frac{1}{2} \times \text{£1 4s. 6}}{100}$
would give the discount, and $\frac{37\frac{1}{2} \times \text{£1 4s.}}{100}$
amount left. In the way quoted, 5 is used
then 20, which comes to the same thing. I
advantage that in the second part it is s
divide sums of money by 20, owing to our
money tables, that one can do it mentall
inclined to think that in countries using th
system they would not find any advanta
method. R.

[73150.]—**Discount.**—

$$\overbrace{\text{£100 : £1 4s. 6d.}}^{\text{Full prices.}} : \overbrace{\text{£100} - 62\cdot5 :}^{\text{Discount price}}$$

$$\text{£100 : £1 4s. 6d. : £37 5s. : } x \text{ whenc}$$

$$= \frac{\text{£1 4s. 6d.} \times 37\cdot5}{100}$$

$$= \frac{\text{£1 4s. 6d.} \times 37\cdot5}{5 \times 20}$$

$$= \frac{\text{£1 4s. 6d.} \times \frac{37\cdot5}{5}}{20}$$

Which last is the formula you have ad
sincerely hope you must be in error in sta
such a clumsy method is in frequent use,
so much simpler must, one would think, b
at a glance, viz.:—

$$\frac{\text{£1 4s. 6d.} \times 37\cdot5}{100} = \frac{\text{£1 4s. 6d.} \times}{8}$$

$$= \text{9s. } 2\tfrac{1}{4}\text{d.}$$

PERCY W. ST

[73151.] — **Bunsen Battery.** — Prob
more than a day or two, because of the pe
of the nitric acid. S. Bo

[73152.] — **Lithanode Accumulators**
remain charged a considerable time if w
and well insulated. The exact time depen
deal on their size and perfection of interna
tion. Two or three days is very good for s
6in. by 6in. by 2in. S. Bo

[73153.]—**Pole Finding.**—The pole th
off bubbles of gas, which bubbles expl
match is held over them, is the negative;
is the positive. S. Bo

[73154.]—**Piston Rings.**—Hammer th
inside with the ball pane of a hand-hamm
smooth anvil. JACK OF ALL T

[73155.]—**Astro. Telescope.**—The que
to get a clear picture of moon if his d
cuts off the "ragged edge." But does h
telescope with a single unconnected o.
single 1in. lens for eyepiece? Seeing t
achromatic, 2in., 2½in., and 3in., 40in. focus
be had from London houses, with sets of s

achromatic eyepiece, at very low rates, f time to construct instruments with the s.
J. D. M.

–**Astro. Telescope.**—A single-lens lin. focus cannot possibly give a clear atever the definition of the object-lens [t is almost like looking at an image prism. The spherical and chromatic are too great. Make an eyepiece with convex lenses—Ramsden or Huyghenian the latter, let the focal lengths of the re-lens be as 3 to 1, and their separation ocal sum, and you will much improve the
A. CAPLATZI.

–**Astro. Telescope.**—Bad definition ue to—1. Dewing of o.g. 2. Reflection ior of tube. 3. Bad adjustment of Imperfect make of same. 1. May be to a large extent by dew-cap; and 2 by e interior of tube a dead black. If the properly adjusted, an out-of-focus star be circular in outline—not elliptical; king down the tube from o.g. end, so s of eye and draw-tubes appear con- e centres of these orifices will appear with centre of object-glass. When these been attended to, and no improvement n observed, the fault must be put down a bad object-glass. Of course, if, as I e, your o.g. is non-achrom., there will a colour-glare around bright objects; rom this, you should get a clear image. a lin. eye-lens is sufficient; but you do liam. of o.g. If, as I judge from the , it is 3in. aperture, you will get the by stopping down to 2½in. or less, o state of atmosphere, and using a two- ece giving a power of 60. Lenses for d be plano-convex, with plane surfaces eye, of lin. and ⅜in. focal length, latter e, and ⅝in. apart. With an instrument I have had many interesting views of ts. I have seen (with power 60) on clear valley of the Alps, the valley north of , pointed shadow of west wall of Plato, of like dimensions, during the past
S. S. R.

–**Grindelia Robusta.**—Probably you ask your adviser where he obtains this ll as how to use it when it is got.
B.Sc.

–**Liq. Extract of Grindelia Ro-** he adult dose of the liquid extract is 10 ims, and can be conveniently taken o a teaspoonful of glycerine. The dose extract is 1 to 3 grains, and can be taken t covered with flour.
J. E. B.

–**Koumiss.**—The real koumiss is made l and fermented mares' milk. An imita- e from asses' and cows' milk. I under- not easy to make an imitation of it in y, probably owing to variety in the
B.Sc.

–**Burst Boiler.**—I believe glycerine is ut am afraid it would cost a good bit.
SM.

–**Gelatine.**—The gelatine must be chro- the dark or under non-actinic light. light then causes it to become insoluble.
SM.

–**Gelatine.**—Did you expose your gelatine to the sun afterwards? This is necessary, in order to harden it.
S. BOTTONE.

–**Gelatine.**—It is the action of light on omated gelatine" which causes its and insolubility in water. Have you the dark-room and then exposed it to f light?
B.Sc.

PONCET, the father of engine-drivers in had the Cross of the Legion of Honour him by M. Carnot for long and meri- vice. In 1832 this veteran drove the tive made in France over the line from ne to Rouen, and also conducted the on the railroad from Paris to Saint Poncet, who is seventy-five years of rty-eight years of engine-driving.

**ing Tin from Dye-waters.**—The iety for the Encouragement of National ve given the prize allotted for the utili- orks' residues to M. Martinon, for his ecovering the tin contained in the wash n silks which have been treated with f tin, for the purpose of giving weight. milk of lime to the water, and by itating, the tin settles down in a few state of oxide, which can be readily d disposed of.

# UNANSWERED QUERIES.

***The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.***

Since our last, A. F. Shakespear has replied to 72319.

72526. Gas-engine Governor, p. 131.
72535. Polariscope Construction, p. 132.
72538. New L. and Y. Engines, 132.
72547. Available Sulphur in Spent Burnt Oxide, 132.
72550. Making Batteries, 132.
72558. Air Surface Condenser, 132.
72560. Razor—To "Eos," 132.
72562. Musical Pitch, 132.

72755. G.W.R. Locos., p. 214.
72771. Nitrate of Soda, 214.
72775. Wig, 215.
72777. Flexible Metal Tubing, 215.
72783. Weights, 215.
72795. "Jenny Lind" Locos., 215.
72798. Geological, 215.
72807. Electrical, 215.
72813. Colorimeter, 215.
72814. Cropping Machine, 215.
72815. Refractometer, 215.
72821. Diffraction, 215.

# QUERIES.

[73161.]—**High-Speed Steamers.**—What is the highest-speed it is possible to drive a boat by steam 5ft. long, 8in. beam, 6in. deep? How long can the speed be maintained? What type of boiler? What size? What working-pressure? What fuel? What kind of engine, the diameter, the stroke? What sort of propeller? How many blades? How many revolutions? What size? I do not want mere theory or guess-work, but that which can be asserted as a fact from actual practice. Distance measured, time taken, &c. Nor do I wish to adhere strictly to the dimensions given, but within a 5ft. limit. I should like "Jack of All Trades" to be one of those who will kindly reply, because I am under the impression that it is he who is responsible for the statement that a vessel 3ft. long may be driven at the rate of eight or nine miles an hour.—MODEL STEAMER.

[73162.]—**Lamp for Telescope.**—Can anyone kindly inform me the best description of small light lamp for illuminating the field of a 2¾in. refractor? Also the kind of oil most suitable. Those I have tried have a tendency to boil or bubble over, heating the lamp to a very detrimental extent, and they become filled in the upper part with soot, which drops off and renders the whole concern exceedingly messy. Moreover, they go out at the shortest notice. I throw the light through a small hole in the telescope, which was originally used to fasten a table tripod stand to the instrument, suspending a small piece of cardboard in the centre of tube, so adjusted as to catch the light and send it down to the eyepiece. Should be glad of any hints on these subjects from those experienced in them.—E. E. M.

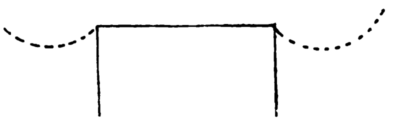
[73163.]—**Waterproof.**—I happened to drop a new cashmere waterproof on a muddy road and am unable to get the stain out. Can any reader kindly tell me how to do so? I have tried sponging it.—H. A.

[73164.]—**Gravity Clock.**—I shall be glad to read details of a good seconds clock. Sketch, with Editor's permission, will greatly help. I have means for cutting wheels and making lantern pinions. Sizes of wheels and pinions in inches, and spaces between teeth will greatly oblige, and why are lantern pinions preferred?—DOOIT.

[73165.]—**Clinkers.**—Can these be prevented from forming in a slow-combustion greenhouse boiler? I use ordinary coke and house cinders, and often a large mass forms on the grate and prevents access of air, and the fire goes out in the night. Should be glad if I could avoid this, as the plants are likely to be injured.—J. C. S.

[73166.]—**Equatoreal.**—Could any of your numerous astronomical readers give me instructions for attaching home-made circles to a simple equatorial telescope stand that I have, or say if such a matter has ever been described in "E. M.," and where to find it. My telescope is a 3¼in. refractor, and is nicely and steadily mounted on a portable equatorial, but without circles. I could send a sketch of stand if necessary.—J. L. PARK.

[73167.]—**Spinning Metal.**—I have been trying to spin a disc of No. 22 gauge brass to the form of the inclosed sketch, but can only get it to the shape of the dotted lines.



After that the edge cockles into waves and splits. I annealed it continually. What is the cause and cure?—URSA MINOR.

[73168.]—**Spoke Grip for Cycles.**—What is the best way to make one of these? I have bought a good many, but always find them break after making up two or three wheels. Most of them seem to be worthless for real work.—A. F. SHAKESPEAR, Maternistrasse 3, Dresden.

[73169.]—**Hydro-Electro Motor.**—I should be much obliged if "Whooroo," who wrote a few weeks ago in your columns, would give all particulars relating to his electric lighting and his Thirlmere water-motor, as I think it would be of advantage to me, as I am desiring an arrangement he suggested.—HYDRO-ELECTRO.

[73170.]—**Blackening Oxide of Lead.**—Could any of your readers inform me how to make oxide or white lead black without injuring its weathering qualities?—BOB.

[73171.]—**Lithanode Plates.**—Please tell me how to attach conducting wires to these plates. I have some with two holes in each, but do not know what the holes are for, or how to fasten the copper wires on.—PEROXIDE.

[73172.]—**Soldering Brass.**—I wish to close one end of brass tube, 4in. diameter, 1-16in. thick, with sheet brass—must be neat. Has to be highly polished and lacquered. No room for lugs or rivets.—A. W. G.

[73173.]—**Mending Books.**—Will the writer of "How Books are Bound" kindly give us an article on mending books before he closes his series? There is no doubt a right and a wrong way of setting to work to fasten in a loose sheet, to strengthen a book coming out of its cloth case, to freshen a faded cloth back or improve a cloth binding spotted by wet or otherwise; to mend, freshen, or reletter an old leather-bound book that looks shabby on the bookshelf, but is hardly worth rebinding, to refasten a cloth or leather back split down one edge, and otherwise to cure the various ills that bookbinding is heir to.—NOMAD.

[73174.]—**Gassner Dry Battery.**—I have a Gassner battery, and have charged it twice with a Bunsen battery. After it has rung an electric bell about twice there is not enough power to ring it again. What shall I do to it? Is there any solution I can put into it to make current permanent?—J. T.

[73175.]—**Glass, to Stain.**—I have a lot of lamp squares of opal glass to letter. Up to the present time I have embossed the letters in with acid, and then filled them in with Berlin black. There is a way of writing them and baking or burning them in an oven same as glass staining. Can any of our readers tell me what to use for writing, and what sort of oven I shall require?—W. P.

[73176.]—**Induction Coil.**—Will Mr. Allsop please say how much wire to wind on coil for primary and secondary, as I have no means of measuring current? Will single-covered wire do, as I have plenty of it. How large is core? The coil is for a transmitter.—W. P.

[73177.]—**Iceland Spar.**—I have two or three crystals of this as got from the quarry. How should they be cut and polished so as best to show the phenomena of double refraction?—A. T.

[73178.]—**Ratio.**—I have two high numbers (of five or six figures each) A and B. I require to split both of them into factors, but find that one or both contain large and unwieldy prime numbers. How can I find a quantity, whole or fractional, $x$, by which to multiply the numerator and denominator of the fraction $\frac{A}{B}$, such that the quantities $Ax$, $Bx$ shall bear to one another a ratio identical or closely approximate to that of $\frac{A}{B}$, and capable at the same time of splitting into small integral factors?—C. D.

[73179.]—**Cracked Hands.**—I suffer with these, which are very uncomfortable and painful. The skin seems to get hard and dry inside palm, and then cracks. I have tried vaseline and camphorated oil, &c., but it does not appear to be of any use. Can anyone kindly suggest a remedy? I may add I use best and purest soaps for washing.—J. C. S.

[73180.]—**Electrical Work.**—I am wanting to cast small brass parts for electrical work, only small quantities at a time—say, about one pound. Would some kind reader tell me what is required, and cost of same, and say what heat is necessary to melt brass? Is a blower required?—IGNORANT.

[73181.]—**Tile Steel.**—Could any correspondent please give any information of the method usually adopted in Sheffield for making tile steel? There is a great quantity of Bessemer converted into cast steel for tiles. Would Bessemer bar ends in quantities of 44lb. and 4lb. spiegeleisen work, and if so, where is it procured, and what is the best flux?—STEEL.

[73182.]—**Small Electro-Motor.**—I am wanting to make a self-starting electro-motor for driving models (small). What is the smallest size armature to wind for the purpose? Kindly say the smallest possible size, and allowing space for necessary wire. Would Mr. Bottone or other kind reader assist me?—SELF-STARTER.

[73183.]—**Equation of Curves.**—Will someone solve the following problem:—A and B are two given points, a link $Ac$ of known length is attached to A, and another link $Bc$ of known length to B. These links are joined at C. Now let A and B move along fixed parallel straight lines. If A moves a distance $p$ from its original position, and B a distance $q$, then find the equation of the curve described by C when $p$ and $q$ are connected by the following relation, $p = \frac{q}{m + nq}$, where $m$ and $n$ are constant.—H. C. L.

[73184.]—**Pocket Accumulator.**—I am anxious to construct a small pocket accumulator to light about 4 volts. Will you kindly inform me how to make the plates, and their shape, and also how to join the sides of ebonite case together? Drawing would oblige.—PUZZLED.

[73185.]—**Flag-staff.**—Will some reader kindly give me information? I want to erect a flag-pole to be made in two pieces, so as to be able to lower the top-mast and yard-arm. Please say how the parts are to be joined—pole altogether to be about 30ft. A sketch of rigging would oblige if convenient.—SLIEV DONARD.

[73186.]—**Benzole and Benzoline.**—Will one of our correspondents kindly explain the connection between these two fluids? Benzole and benzine are, I believe, identical—the former being sold at a high price (1s. 6d. a pint), the latter, as benzine collas (whatever the latter word may mean), at a still higher price to ladies for taking out grease from their dresses. Benzoline is very much cheaper, as sold for burning; and if it would answer as a solvent and for cleaning purposes it would be most useful. For example, a charitable institution I am acquainted with can hardly make glove cleaning pay owing to the high price of the benzole used. Would benzoline answer the purpose? I think the names are often confused—thus in query 73169 of current number the new Munich car are said to be propelled by gas generated from benzine.—NOMAD.

[73187.]—**"Fresh" Photographic Solutions.**—Will Mr. Bottone or some other qualified correspondent tell me whether when "fresh" solutions are enjoined, it means recently made or not previously used—in other words, say, with hypo.? Is it safe to keep a stock solution, and use from it; not, of course, returning to the bottle any solution once used, or must the actual salt be freshly dissolved each time? Pyro and iron sulphate solutions no doubt deteriorate with keeping, but do such salts as oxalate potash, the bromides, citric-acid, alum, pure carbonate, sulphite, or hyposulphite soda? —NOMAD.

[73188.]—**Oil-Stoves or Lamps.**—Is there any advantage—economical or otherwise—as regards heating purposes in an oil-stove over an oil-lamp, with the same extent of wick? For example, if instead of putting a stove with two 3in. burners into a room to dry or warm it, I burn 3 Duplex lamps (1in. burners), do I not get the same heating effect at the same cost, but get the light in addition? So far as I can see, the combustion in a stove is generally more wasteful and imperfect than in a lamp, because it is not so easily watched as it would be through a glass chimney.—NOMAD.

[73189.]—**To Mr. Bottone.**—I have an induction coil, wound with four layers of No. 16 as primary, and about 1,000yds. of No. 38 silk-covered for secondary. What would be the best kind of battery to use, or how many Leclanché cells should I require to get the full effects of such a coil?—B. W. B.

[73190.]—**Fret-Sawing Machine.**—Can any reader kindly inform me how to make a fret-sawing machine, to be fitted to a sewing-machine table?—W. A. S.

[73191.]—**Enamel.**—Will someone please inform me at what heat enamel similar to that used for street name plates, &c., melts, or tell me from what book or other source I can get to know how to make this kind of enamel? L. L. B.

[73192.]—**Accumulators.**—Will Mr. Bottone or Mr. Allsop kindly give me some information on the following: I have one 6-volt 2½c.p. incandescent lamp which I wish to light from accumulators. How many, what size, and sort should I want to light it for two hours at a stretch? I may add I intend to charge them from a dynamo giving 6 ampères, 30 volts at full load.—SWITCH.

[73193.]—**Electric Light.**—Will some kind reader tell me how I can fit up a 5c.p. incandescent lamp? I have two square Bunsen batteries, quart size; what am I to charge the cells with, and what kind of wire is best to use? I want the light for about six or seven hours a night.—A NOVICE.

[73194.]—**Plated Teapot.**—I have a silver-plated Britannia metal teapot, which I had thickly replated last year by a good and reliable firm. My reason for replating was that the teapot had been packed with a paper of sulphur by an unscientific person, and the plating ruined. Since its replating, it is very hopeless. The most careful cleaning scarcely brings out the proper silver lustre, and after a day or two, it looks like a pewter pot. Can anyone explain the mystery? Surely the Britannia metal cannot have absorbed sulphur? And yet I cannot otherwise account for it, as it certainly has no chance of late of coming in contact with any sulphur or sulphide. If I cannot hear of a remedy, I shall have to get another teapot, and recover what I can of the thick silver deposit; but as a chemical problem, it puzzles me.—T. PRESTON BATTERSBY.

[73195.]—**Volt and Ammeters.**—In using these instruments to measure comparatively strong currents, I presume the ammeter should be placed directly in the main circuit; but how about the volt-meter? If it were likewise so placed, would not the fine wire of which it is mainly composed be overheated and damaged by the current? Should it not rather be placed as a shunt between the terminals?—J. M. K.

[73196.]—**Arc Lamp.**—TO MR. BOTTONE.—As an amateur, it has always puzzled me as to the actual working of an automatic arc lamp. An illustration would greatly oblige. And also could not the short ends of carbons be utilised for any purpose, say, for instance, in primary batteries? Where I am working, there are hundredweights of arc-lamp carbon ends thrown away in a year. And lastly could you tell me how to charge a small 8-volt, 4-cell accumulator, from 53 E.P.S.L., 31 cells connected in series? My plates are 4in. by 2in., two negatives and one positive to a cell. If I connect on to 6 cells positive to positive, they do not seem to charge at all; but if I connect positive to negative, they seem to charge splendidly, only to find that the negatives are turning positive, *vice versâ*. I may add that my cells are connected up properly; the two negatives of one cell being joined on to the positive of the next cell. An explanation will greatly oblige one—ANXIOUS TO LEARN.

[73197.]—**Model Boilers.**—Would "J. A." or other correspondent give size of tubes (dia.) to steam with charcoal or spirit? I think I have seen model boilers working at 100lb., according to pressure-gauge; and should like to know what they are made of, or how they resist that pressure?—AMATEUR MODELLER.

[73198.]—**Dynamo.**—I am wishing to try an electric light in one or two rooms of a house, but, unfortunately, have no motive power available. Would some reader be kind enough to let me know what would be the cheapest mode? A 20c.p. would do. Would there be any gain in using an electro-motor worked by a single-fluid battery to drive the dynamo? What would be the loss in using an accumulator, which I would have to bring half a mile to charge from a dynamo, and what size would do for lamp above named?—LUX.

[73199.]—**Date of Ring.**—Can any reader inform me of the probable date of a ring whose description is as follows:—Precious opal, diamond shaped, diameters of diamond shape each 2-5th of an inch, set open in gold with small rose diamond at each angle of stone, surmounted by a half-circle of five rose diamonds, above which rise five radiating arms each terminated by a small emerald cut "en cabochon"; the whole giving the effect of a diamond-shaped shield, surmounted by a coronet. No marks of any kind on gold, which is plain at back of ring, but richly chased as it nears the stone where the setting is narrowed in considerably. It seems a setting like that of the opal in ring No. 1221 of the Townsend collection in South Kensington Museum, judged from the catalogue. I should be extremely glad of any information as to the probable date of the ring, which is a very beautiful and remarkable one.—T. PRESTON BATTERSBY.

[73200.]—**Cell for Speculum.**—Why is not some commoner wood, such as oak or ash, as good for speculum to rest upon as mahogany?—C. D.

[73201.]—**Magnet.**—I have a small shocking coil, and I want to magnetise some pieces of soft iron. Could I do so by connecting them to the coil, or how could I do so, and I would like to know if, by putting another battery on to the coil, would I get it any stronger, or would another battery be too much for the coil? It is now worked by one small battery?—MAGNET.

[73202.]—**Indian Jugglery.**—Could "Eos" or any of your readers give a short description of a few of the principal clever feats as performed by Indian jugglers, but more particularly the one that I have heard of, which consists of a ball of twine being thrown up into the air which is said to remain suspended without any apparent support, and along which one of the performers climbs? Are the spectators hypnotised and see the trick in imagination only?—C. HOLT.

[73203.]—**Lead Poisoning.**—There having been a large number of cases of poisoning by lead-contaminated water in the district in which I reside, I should be glad to have the advice of some of your readers as to how the difficulty may be obviated. What is the process adopted at the Keighley waterworks, or by any other water department where there is a serious attempt made to cope with the annoyance?—C. HOLT.

[73204.]—**Enamel, White**—same as used for the inside of frying-pans, &c. What are the ingredients, how mixed, and the proportions, how applied, how baked, and for how long a time, and at what temperature?—E. BUDD.

[73205.]—**Trouve Motor.**—What size Trouve motor and what number and what sort of batteries would be best fitted for a rowing boat, 20ft. long? It is required to work for about eight or ten hours at a time. Would above motor work best, or what sort? Please give dimensions. —AMATEUR.

[73206.]—**Astronomical.**—Will some one kindly repeat the method of finding the G.M.T. of the southing of the principal fixed stars referred to in Vol. L., page 354 of the "E. M."? I cannot get a copy of this number. Also would one of your astronomical readers be kind enough to show when the star Altair is due west from Greenwich any day this month?—GEO. E. ELLIOTT.

[73207.]—**Pitting of Boiler Tubes.**—Can any correspondent inform me how I can prevent the boiler tubes of my steam-engine from becoming pitted with deep holes so that leaks occur? The water is very soft and pure.—E. L.

[73208.]—**Casting Black Resin.**—Will any fellow-reader tell me how to cast ordinary black resin in square or round blocks (about 1lb. each), so as to be bright all over? Also of what material to make the moulds?—ELECTRON.

[73209.]—**G.E.R. Locos.**—Will some reader kindly give me a sketch and description of Mr. Worsdell's compounds which run the express service from Liverpool-street to Colchester and Ipswich? Are there any others besides Nos. 700 to 709 and 230? If so, what are their numbers and dates?—REGULATOR.

[73210.]—**Oxy-Hydrogen Microscope.**—What is the arrangement of lenses in the above, and would it be possible to arrange the eyepiece and objective of a good binocular microscope for lantern purposes? Is the light from a good 4-wick lantern sufficiently strong to project a good image on the screen? Also describe the method of construction of the rolling curtain effect used in optical lanterns?—JEJUNE.

[73211.]—**To Mr. Bottone.**—I have a bichromate battery consisting of four cells, each holding about three quarts, with two carbon plates and one zinc, each 9in. by 4½. Will you kindly tell me what proportion of bichromate and sulphuric acid I shall require in each cell? Also what voltage it will give, and what lamps it will light, and for how long? Do you supply electro-motor castings which would be suitable for the above battery, and what power would such a motor be? Can you recommend any book which fully explains the meaning of the terms watts, ohms, volts, and ampères?—A. G.

[73212.]—**British Association Series of Small Screws.**—I should be glad to know the sizes in parts of an inch and other particulars of the British Association series of small screws.—FABER.

[73213.]—**Accumulators, Charging.**—Should like to set up few accumulator cells (L 15), but as engine could only be used for charging for about three hours each day, would it have an injurious effect to charge them at double or more the maximum charging rate for this short period? —DYNAMO.

[73214.]—**Mica Grease Lubricants.**—We have been using a solid grease lubricant for some time past, but are informed that it contains mica, and will eventually have a detrimental effect upon bearings. Shall be glad to have the opinion of a practical engineer as to whether this is so or not.—ENGINEMAN.

[73215.]—**Board of Trade Exams.**—Can any of our readers give any particulars of the examination conducted by the Board of Trade with reference to weights and measures, or where such information may be obtained?—ASMODEUS.

[73216.]—**Microscope.**—How can I find the magnifying power of microscope with the following eyepieces? A, eyelens 1in. focus, field lens 2in.; B, eye lens ½in., field lens 1in. Distance between field lens and objective, 10in. Objective ¼in. and 1in.—J. H. C., Halifax.

[73217.]—**Tuberculosis.**—What is the Kock-Ehrlich process for the examination of sputum for this bacillus? What are the stains used, and what objective is necessary? —J. H. C., Halifax.

[73218.]—**Asphalte.**—Can any reader inform me the best way to test asphalte, the difference in the various kinds—namely, Claridge's, Val de Travers, the Limmer, and the Brunswick Rock—how long they wear, which is the best for roads, and which is the best for pavements? Any information will oblige.—HORNSBY.

[73219.]—**Drilling Watch Jewels.**—Wh
*modus operandi* pursued in drilling the jewels
pivots to work in?—JNO. LORD, jun.

[73220.]—**Proportion of Engine Parts.**
some kind contributor give the following partic
½H.P. engine? I want the design to be nea
whole thing pretty compact and strong. The c
be 2½in. bore, 3½in. stroke, horizontal, 200 re
What should be depth of piston, diameter and
piston rod, connecting rod, eccentric connectin
slide valve, and shaft? What diameter and wei
wheel? I would have steel for piston and conne
and shaft.—CHASSEUR.

[73221.]—**Tentering Gill Holes.**—Can a
tell me how to bore 14 very (1-16) small holes at c
tion, similar to and what is used on flannel
machines? How are the holes drilled for the
think they are all done at once; it would not
them one at a time. The piece of brass is 3-16
2½in. long, ¾in. broad; holes placed alternatel
rows one above the other.—MECHAN.

[73222.]—**Spirit-Lamp for Boiler.**—
reader kindly give me dimensions (size and n
wicks, &c.) of a spirit-lamp, suitable for a vertic
boiler 6½in. diameter, 11in. high, to make steam
Also best kind of spirit to use.—F. J. B.

[73223.]—**Drain Ventilator.**—Will som
kindly inform me the best way to ventilate a 6i
pipe drain, about 60yds. long, with 3 w.c.'s dis
in it at different junctions? What size, and w
of the drain should the highest shaft be o
JESSIE.

[73224.]—**Ventilating Bedrooms.**—Wi
correspondent inform me the best way to ven
bedrooms that are divided by a passage? I do
to go to any great expense, but want it efficientl
JESSIE.

[73225.]—**Furnace.**—Will someone give a ske
dimensions for a furnace or oven for converti
5cwt. at one time of small iron castings into m
iron?—INQUIRER.

[73226.]—**Steel Rust.**—Wanted, a recipe for
or any other preventive of rust, for coating fe
fire-irons. The chimney down-draught in damp
rusts them in a few hours.—W. C.

[73227.]—**Marking-Ink.**—Will any of "o
good enough to tell me how to make the above t
not wash out?—SAUL.

[73228.]—**Examination.**—Would Mr. Botto
say what would be the best books to get to stud
examination in electric lighting and transmis
power? The books I have are:—"Gordon's Tre
Electric Lighting," "S. P. Thompson's Dynamo-
Machinery," "Ferguson's Electricity," 1871, a
books of Mr. Bottone's, "Electric Instrument-M
and "The Dynamo." None of them say anythin
transformers. It would be home study for techn
examination in April or May next.—J. T. B.

[73229.]—**Electric Lighting.**—I have 8 Le
cells. Would Mr. Bottone kindly tell me if th
number would give a small electric light, and what
Also dimensions, how to fit up, where to get th
and the cost of it? The lamp would be used fou
hours each night for two or three weeks.—R. SMIT

[73230.]—**Dynamo.**—Some time ago Mr.
kindly advised through these columns, re co
Chaster's motor to dynamo, to wind armature,
3in. by 1½in., with 5oz. No. 20, and fields with
connected as shunt. I do not think that more th
No. 22 can be got on fields, as there is not room f
The question is, Would this machine pay to c
What lamp would it light? Would it be bett
heavier fields?—IOTA.

[73231.]—**Signalling.**—Can any of our railwa
inform me if I can work a 1in. either gas-pipe o
rod, 800yds. long, similar to the signal rods, and i
get an exact motion at further end, say, of 3in.?
want to load it heavy, it will only have to do ve
work. Only I want some guarantee that it will,
stance, move a bolt 3in. or so. Their opinion w
most highly esteemed by—UNCLE JOE.

[73232.]—**Expansion Valve.**—I wish to co
ordinary steam-engine to one of above. Would
our practical readers kindly assist me with the fo
and other practical hints? Should the ports i
valve coincide exactly to those in cylinder face, and
they close towards each other at back of main
What is the rule for setting the expansion eccentri
lation to the crank, and should the throw of
eccentrics be the same, as I have two the same thro
use? Also best means of adjustment, and finally,
economical change?—J. T.

[73233.]—**Electro.**—If I get a piece of soft i
bend it the shape of a horseshoe magnet, and th
it with copper wire and magnetise it, will it be a
magnet through covering it with copper wire?
the best for magnets, iron or steel? I do not kno
about electricity or magnets, and would be glad
information.—ELECTRO.

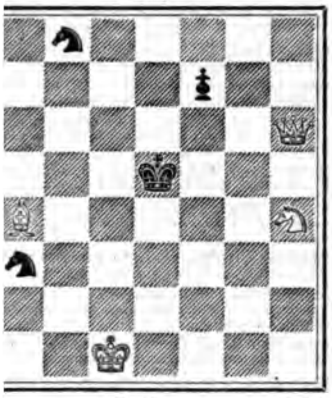
MR. J. W. BLAKEY, in a paper read bef
Scarborough Naturalists' Society, had a sad
tell of the falling-off of the fisheries on our
east coast. In 1880 the port of Bridlingt
1,046 tons of fish inland, in 1884 only 6
while last year the total amount was 294 ton
cause of this dwindling is simply the des
practice of inshore trawling. All evide
tended to establish the important fact that th
banks inshore are the rearing grounds of im
fish. "I have no hesitation," he adds, "i
that one trawler at the present time will,
kill thousands of pounds' worth of immatur
a day. And for the sake of getting the ma
which come in to feed amongst and upon th
this dreadful sacrifice is going on day and n

## CHESS.

nunications for this department must be "J. Pierce, Knollside, Yawl, Lyme Regis,

### PROBLEM MCCXXXII.

*Black.*



*White.* [6 + 4

ite to play and mate in two moves.

Solution to 1230.

| *White.* | *Black.* |
|---|---|
| 4. | 1. Any. |
| or Kt mates. | |

Problem 1231, the Black Bishop at K B sq, white one.

### TICES TO CORRESPONDENTS.

olutions to 1230 by J. Humble, W. Gleave especially as regards the avoidance of cooks Biene, C. P. P., W. A. Clark (Black Q cleverly ut the mates are rather impure), G. W. 'r. Fernando, A. Fellows, junr., Lieut.-Col. . Martin, and T. H. Billington; to 1229 by Ryan (second solution), A. Fellows, junr. '. Middleton (2), J. H. Eastwood (2), and D.

d to state in our notice of the "Two-Move ms," by B. G. Laws, that the publishers are ons, and that the price is one shilling.

-We do not know the exact date, but fancy July or August.

rs.—Thanks for Problem. We should pre- n a diagram; but, anyhow, it is impossible elves of it before this Tourney is concluded.

## RS TO CORRESPONDENTS.

*mmunications should be addressed to the* Editor *h* Mechanic, 332, *Strand, W.C.*

### INTS TO CORRESPONDENTS.

n one side of the paper only, and put drawings ons on separate pieces of paper. 2. Put titles nd when answering queries put the numbers he titles of the queries to which the replies charge is made for inserting letters, queries, . Letters or queries asking for addresses of rs or correspondents, or where tools or other be purchased, or replies giving such informa- be inserted except as advertisements. 5. No ing for educational or scientific information through the post. 6. Letters sent to corre- nder cover to the Editor, are not forwarded. nes of correspondents are not given to in-

ion is especially drawn to Hint No. 4. The d to letters, queries, and replies is meant for ood, and it is not fair to occupy it with ques- are indicated above, which are only of indi- st, and which, if not advertisements in them- to replies which are. The "Sixpenny Sale ers a cheap means of obtaining such informa- trust our readers will avail themselves of it.

g are the initials, &c., of letters to hand up day evening, Dec. 10, and unacknowledged :—

nd Co.—Cuttriss and Co.—R. L. Walker.— reman.—Otto.—R. C. Royle.—E. W. Broad- ekon.—J. A.—Bazaar.—H. E Eales.—W. H. ovice.—Caldemone.—Jack of All Trades.— .—S. P.—J. L.—W. R. Waugh.—E. Thor-

at was the nature of the question about the d? If received, it was, no doubt, acknow- replied to in some way; though, as a matter have no space to spare for such subjects. answer to you on p. 281—"Repols."? If refer to that, or to the number for Nov. 20, short history of the superstition of finding means of the hazel twig. The subject has red to in several back volumes.)—Phono- There is no hard-and-fast size for the convenient size is all that is needed. 2. read that will leave the lines sufficiently far The cylinder can be made of anything firm t so light that it can be easily driven. (See e number for Nov. 7 last.) If you are in so great a hurry, why not purchase or hire one if possible? It is doubtful if one can be made in the time)—T. Griffiths. (What do you mean? It is necessary that the paint should be excited by light before it can be luminous in the dark Objects that are always in darkness can be excited by means of a piece of burning magnesium ribbon or wire if coated with Balmain's luminous paint. So far as we understand your query, it is not likely that the paint you require is in existence.)—W. (See indices for directions to make dulcimers, or the numbers for Sept. 29 and Oct. 20, 1882. Screws are objectionable, and it is as well to have different sizes of wire, though not absolutely necessary.)—One in Trouble. (If one battery-cell is not enough, try two, coupling in series—that is, zinc of one cell to carbon of the next. We thought the articles recently given, and the many replies inserted during the last 10 years or so, had made that matter plain.)—The Boiler. (Better fill the idle boiler quite full, rather than leave it half-full of water. If the water is naturally hard it will do; but if not, add more quicklime than it can dissolve. The best plan would be to clean the inside, and dry thoroughly; then smear every part with a mixture of plumbago (blacklead) and washed fat, or with the whitelead and grease used on bright iron work.)—Paper. (We do not know about the rails; but the discs of railway-wheels are often made of paper, especially in America, and last well; but the whole wheel is not of paper. 2. The name Woodite comes, we believe, from the patentee's name. We understand it is cellulose treated in a special manner.)—Perplexed. (The candle-power of a gas-burner depends on the quality of the gas, and the kind of burner. In London an Argand-burner is the legal test for the gas, which should give 16 candles when burned at the rate of five cubic feet an hour. A No. 5 burner of any make is supposed to be capable of burning five cubic feet of gas an hour; but the rate varies with the pressure, &c. The candle-power may vary from 12 to 20, and more—highest of all with rich gas, such as Cannel.)—Jejune. (Apply to the Secretaries of the Society and of the Institute, who can furnish full particulars. The address of the Chemical Society is Burlington House, W., that of the Institute of Chemistry, 9, Adelphi-terrace, W.C.)—W. J. Payne. (We do not know. 2. Pepper's book, if you cannot refer to back volumes. 3. Do they get out at all? Are they not hidden behind the mirror-screen, until such time as they can escape openly or under cover?)—H. W. Constable. (We are afraid that series must remain incomplete, unless another writer takes up the subject.)—W. S. B. (Albuminous substances are those containing carbon, nitrogen, hydrogen, oxygen, and sulphur. They build up the tissues of the body, and albumen itself (e.g. white of egg) coagulates on boiling. The albuminous substances occur in both animal and vegetable branches of natural history, and to give a mere list of albuminous foods would occupy much space. All kinds of flesh foods, the cereals, all emulsive seeds free from poisonous matters, and in most vegetables such as carrots, turnips, cabbage, peas, &c.)—Jno. Lord, jun. (See Hints above. Query will be inserted.)—A. J. B. (You can get a copy of the specification at the Patent Office, Southampton-buildings, London, W.C. We cannot undertake to search for dates of expiration of patents.)—H. (We know nothing of the invention. Why not write to the paper where you saw the paragraph?)—J. G. (In all such cases the tenant bears the cost of the lease.)—T. Shonfeld, Practical Bookbinder, A. Caplatzi, Mu Nu., S. J. B. (In type.)

**Corpulence.**—New Treatment.—Pamphlet free. All persons suffering from this burdensome and dangerous state of the body, and even those developing tendencies thereto, should call or write at once for a treatise on the subject, just issued (gratis and post free) and published by the Medical Battery Company, Limited, 52, Oxford-street, London, W.

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**Gas Engine**, half-man-power. Exchange, Mechanical, Electrical, Lathe Chucks, or Apparatus suitable for 3½ S.C. lathe, or Planing Machine.—Disley, Blandford, Dorset.

"**Allen's Commercial Organic Analysis**" wanted, second volume; will take both if necessary. "Cameron's Oils and Varnishes" wanted. Offers.—J. W. S., 4, Brunswick-place, Leeds.

½H.P. Beam **Engine**, fitted with governors, throttle and slide-valve, &c., on iron bedplate. Exchange Singer's Sewing Machine or Printing Press.—John Pedley, 8, Stuart-street, Luton, Beds.

"**Household Physician**," by J. McGregor Robertson, four vols. cloth, unsoiled, cost 30s. Exchange Laverne's Detective Lens, or Photo offers.—Below.

Rodger's treadle **Fretsaw Machine**. Exchange Walking-stick Tripod, or Photo Lantern Slides.—Davis, 30, College-road, Cork.

**Lantern Slides.**—Temperance and other sets, Life Models, Comics, Views, &c., for other good sets (temperance preferred.)—W. S. Price, Wellington, Somerset.

Four-wick **Lamp**, 1½in. wicks, and Lantern Slides offered in exchange for similar lamp, with 2in. wicks.—W. S. Price, Wellington, Somerset.

Wanted, fairly good Model Locomotive, if possible with rails, to go by methylated spirits. Good exchange given.—P., Box 5, Post Office, Stirling.

**Fly or Embossing Press**, McGlashan and Field's patent. Will exchange for heavy Universal Chuck, about 6in. in and out jaws.

"**Whishaw's Railways**," good condition, with plates and sections, complete; 2½in. reflecting Telescope, with universal motion, good definition. Mechanical offers.—C. Beal, Worgate-street, Hoxton, N.

"**Amateur Photographer**" posted weekly in exchange for English Mechanic.—W. R. Fairey, Harrold, Bedford.

**1,000 Pocket Knife Blades**, by Barber, Sheffield, various sizes and finish. Would exchange for good Drilling Machine for power, or anything useful to bicycle maker.—H. R. Watson, Cycle Works, Ripley, Derby.

Clockwork **Revolving Stand**, 26in. high, three embossed glass plates, nickel-plated, runs five hours, 25s.; or exchange.—As below.

Great **Window Attraction.**—Family of five watchmakers at work, all life-like and amusing. Exchange Watchmaker's Lathe Heads.—Boyd, Alva, N.B.

**Newtonian Telescope**, 13½in speculum, 14ft. focus, equatorially mounted. Exchange small Lathe or good Microscope. Offers.—Houldershaw, Liversedge.

**Magic Lantern Screen**, 10ft. square, mounted on rollers, with box and elevators complete, cost £5. What offers? Exchange.—Cox, Lancaster-street, Barnsley, Yorks.

Light **Fly Rod and Tackle**, cost 10s. 6d. Exchange for Gent's Silver Albert, or offers.—Address, Ernest C. Sladen, Ewell, Surrey.

**Horizontal Engine**, 3½ by 5, iron bed, steel piston ring, strapped connecting rod. Exchange ½ or ¾-horse Boiler, good condition; or ¼-horse Launch Engine.—Thomson, 11, Walmer-place, Longsight, Manchester.

Solid leather 30in. **Portmanteau**. old machine head Guitar, Concert ebony Flute (Wallis), eight pillar keys, &c. Wanted, Harmonium, &c.—Harris, South Brink, Wisbech.

Harness' six-guinea **Medical Battery**, two coils, &c.; Air-Gun, with pump, wants repairing; Dynamometer, value 5s. 6d. Wanted, English Concertina, &c.—Harris, South Brink, Wisbech.

Three-draw **Telescope**, in good condition; anything value 15s.; also small Gold Pencil-case Pendant. Exchange value 7s.—P. Muckle, 2, Bowles-place, Whetstone, N.

½-plate **Lancaster's Instantograph** wanted; good exchange given.—W., 14, Wills-street, Birmingham.

A small **Turning Lathe**, complete, on wood table, 3in centres, 20in. iron bed. Exchange for Stocks and Dies, or offers.—31, Dover-street, Canterbury.

"**Money Market Review**" (Saturdays, 6d.) high-class paper, about 50pp.; trade, finance, companies' meetings, dividends, traffics, &c., with complete official price-list.—Below.

Will **Post Above** every Monday in exchange for other periodical; also back volumes, complete, unbound. Offers. Newcomb, Southbourne, Christchurch.

Pulvermacher's **Chain Battery**, cost £5 5s. Exchange Electrical Apparatus.—Johnson, 35, Larches-lane, Wolverhampton.

**D Piccolo**, six German-silver keys, screw head, tuning slide; Magneto Machine, wants repair. Exchange Mitre-cutting Machine.—W. Fowler, 22, Cheriton-road, Folkestone.

**A Valentin's Knife**, new. Wanted, Stereoscopic Views, Lantern Photos., or Comics.—A. Wire, Birkbeck road, Leytonstone, E.

Vertical **Slide Valve Engine**, 2in. bore, 3½in stroke, complete, boiler, &c. Exchange for Model Locomotive.—A Hatton, Point Park, Uddingston, Glasgow.

**Bicycle Home Trainer**, nearly new, complete with registering clock and bell, strikes every mile, band-brake, cost £6. Offers.—Reaney, 70, Manningham-lane, Bradford.

"**English Mechanic**," 16 vols. to date, indexes, offered for S.B. Breech-loading Gun or Aneroid Barometer (not pocket).—S., Mrs. Morton, 8, Keir-street, Edinburgh.

"**English Mechanic**," 15 vols. in exchange for Model Engine, partly finished not objected to; or any offer entertained.—Trench, 316, Hawthorne road, Bootle.

Wanted, Nos. of Vol. XXX. "**English Mechanic**," containing papers I. to IV. on use of Blowpipe, by Muller. Offers.—Fahey, Rosemont-road, Acton.

Wanted, a first-class **Electric Motor**, powerful, in exchange for Typewriter, new Silver Lever Watch, Cloth, Revolver, &c.—R. Crowther, Slaithwaite, Huddersfield.

**Bicycle**, capital, nearly new, Rover. Wanted, a good American Organ, or useful offers.—Pearce, Lathe and Tool Maker, Kent House, Crystal Palace-road, Dulwich.

6in. screw-cutting **Lathe**, 5ft. bed. Wanted, good American Organ, or useful offers.—Pearce, Tool Maker, Kent House, Crystal Palace-road, Dulwich.

**Slide-Rest** for 6in. Lathe, good article. Useful offers wanted in exchange.—Pearce, Lathe Maker, Kent House, Crystal Palace-road, Dulwich.

**Planed Castings** of a 4½in. Slide-rest. Also square thread screws and gunmetal nuts. Exchange.—Pearce, as above.

Small **Screws**, Stocks, Dies, Taps, as new, value 4s. 6d. Three brass clock movements, two strikers; one large watch ditto; offers.—Lamont, 43, Thompson-street, Govan.

48-keyed Lachenal's **English Concertina** and Case. One drawing-in note incorrect, another broken out. For 30-keyed (or more) Anglo by same or other good maker.—W. Hand, Chesterfield.

**Lantern Slides**, about 60. Scotch views and various. Want ¼ Camera or offers.—Finlay, 11, Bothwell-street, Glasgow.

Harness' **Electropathic Belt**, cost £4, nearly new. Exchange ½-plate Amateur Photographic Outfit or offers. No post cards.—T. Smith, 50, Roe-street, Macclesfield.

Wanted, Folding Bagatelle Board and glass top Counter Case.—J. R., 84, High-street, Whitechapel, London, E.

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Pair **Lanterns**, with 3½ double condensers, gas bag, blow-through jets, slides, &c. Exchange Dynamo, Camera, or Photo. Appliances.—MacLucas, Llanelly.

Wright and Butler's Petroleum **Heating Stove**, two 4½in. wicks, all recent improvements, ruby and white glass slides, very cheerful appearance, almost new. Exchange Wimshurst Machine.—1, Moorhill-street, Stapleton-road, Bristol.

**Model Engine**, cylinder ¾in. bore, reversing gear, parallel guides, &c.; photo, 2d. Exchange to value 18s. 6d., Printing Type preferred, or offers.—P. Gannon, Chelmsford.

**Equatorial Mounting**, complete, for 6in. to 8in. Telescope, Brass Circles, &c. Wanted, firm Altazimuth Tripod.—Particulars to and from—Jackson, 1, Bonny-street, Blackpool.

5in. **Screwcutting Lathe**, 5ft. gap bed, treadle, 22 change wheels, &c., new; for good second-hand Gas-Engine about one horse.—15, Albion-place, Grantham.

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What offers for several **Sounders and Keys**, S.N. Instruments, 3 Induction Coils, Galvanometer, and 21 Sealed Batteries?—Huddleston, 21, Upham Park-road, Chiswick, W.

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**Dynamo**, shunt wound, 55 volts, 45 amps., quantity of cable, carbons, and incandescent Lamps; also 3-cylinder Willen's Engine. What offers?—Huddleston.—Below.

Two **Steam Gauges**, Mercury Vacuum Gauge, Shock Coil, in case. Wanted, ½-plate Camera or offers.—Huddleston, 21, Upham Park-road, Chiswick, W.

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**Turning Woods.**—Ebony, Box, Lignum Vitæ, Rosewood, parcels 5s. and 10s. each. Good value.—Harger Bros., Settle.

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**On Hard Soldering.**—A sample of easy running hard solder inclosed, with practical instructions.—Rose, Jeweller, Bolton. 1s. 6d.

Write for **King, Mendham, and Co.'s** (Bristol) new Illustrated Catalogue, 4½d. Acknowledged to be invaluable to amateurs.

"**The Wimshurst Machine**," by W. P. Mendham, gives theory of action and many experiments. Post free, 13d.—King, Mendham, and Co.

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Every's Patent **Musical Bars**, softer and purer tone than bells or gongs for long-case clocks.

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**Lathes**, from 35s. to £350. Milling Machines for Electricians and Brassfinishers.

Send six stamps for **New Catalogue**, with list of second-hand Engines, Tools, Machinery.

Keep your fireplace tidy, save coal, by using **Patent** Coal Savers, 1s. each.—Bradbent, Stretford, Lancashire.

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**Dr. Allinson writes**:—"Consult Fournet re Eyesight and Spectacles." Fee 5s.—18, Bentinck-street, Manchester-square.

**Silvered Glass Specula** and Plane Mirrors of perfect figuring. Eyepieces, fittings, mountings, and stands.—Linscott, Ramsgate.

**Standard Ohms**, platinoid wire, in silver-plated covers, post free 7s. 6d.—J. Sunderland and Co., Instrument Dept., Halifax.

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**New Books** less than half-price. Science, history, travel, biography, &c. Clearance list.—John Collier, Leamington.

Twelve new **Fretwork Designs**, post free, 7d. and 1s. 1d. Satisfaction guaranteed or money returned.—Taylor, Blackpool.

**Insulated Wire**, cotton covered, for dynamos, motors, &c. Sample 1d.—F. Holloway, 35, Summerfield-crescent, Birmingham.

**Hard Woods.**—Box, green ebony, mangle, zebra, bullet tree, satinwood, hard mahogany, &c.; in Docks.—Apply, Buchanan, 7, Fenchurch-avenue, London, E.C.

**Optical Lantern**, 4in. compound condensers, achro photographic combination rack front, 3-wick lamp, and case, 30s.—G. H. Carter.

**Lantern Photos.**, plain. 3s. per dozen; 4in. compound condensers, 8s. 6d.; three-wick lamps, 11s. Lanterns on hire.—G. H. Carter.

**Rapid Rectilinear**, 5 by 4, 17s. 6d.; 7 by 3, 22s. 6d.; electric lamps, bells, and accessories.—G. H. Carter, 65, Torriano-avenue, N.W.

**Astronomical Object-Glasses**, in brass cells, of first quality. Optical planes and prisms.—Clarkson.

**Astronomical Telescopes**, Apparatus, Stands, Racks, Finders, made to order.—Clarkson, 28, Bartlett's-buildings, Holborn-circus, London.

**Astronomical Eyepieces**, any power, 15s. each. Barlow lens to increase power of eyepieces, 20s.—Clarkson.

**Revolving Diagonal Eyepiece**, forming either sun or star diagonal, arranged for four rotating eyepieces, £1.—Clarkson.

**Transit Instrument**, on iron stand, complete, and in perfect adjustment. Also Ross Transit Instrument.—Clarkson.

**Astronomical Telescope**, Calver's, 6½in. finder, four eyepieces, slow motion, stand, £15.—Clarkson.

**Astronomical Telescope**, 2¾in. Lancaster's, Wray object-glass, two eyepieces, £5 10s.—Clarkson.

**Astronomical Telescope**, 6in. equatorial and driving clock, Cooke, York, from Buckland Observatory, £110.—Clarkson.

**Astronomical Telescopes.**—8in. Cooke, 3in. and 3¼in. Wray, 4in. Cooke, 3¼in. Negretti and Zambra.—Clarkson.

**Universal Equatorial**, Cooke's best series, with driving clock, to carry 4¼in. telescope, silver circles and pillar.—Clarkson.

**Universal Equatorial**, to carry 3in. telescope, with circles (Grubb, Dublin), £3 10s.; new price, £8.—Clarkson.

**Astronomical Telescopes.**—Sales effected, several on books, also on stock.—Clarkson, 28, Bartlett's-buildings, Holborn-circus, London.

**Theodolites and Levels**, several by Troughton and Simms on stock, perfect adjustment.—Clarkson.

**Microscopes**, binocular and students', several by Beck, Swift, and objectives and apparatus.—Clarkson.

**Microscopic.**—Very superior Stained Botanical Preparations. Interesting list and sample, 2d.—Walter White, Litcham, Swaffham.

**Printing Presses**, complete with type from 10s.; Type from 1s. per fount.—Adams Brothers, Daventry.

"**Heat: the True Solution of the Problem**," by Humphreys, post 2d.—11, Cambria-street, Fulham, S.W.

**Foreign Hardwoods** for fancy turning.—W. Daniel, Hardwood Merchant, 77, Church-street, Shoreditch, London. List free.

Model **Steam Engines**, also separate parts and castings; lists free one stamp.—Phillips, Modeller, 18, Colenso-road, Clapton, London.

**Fur Boa**, very dark brown, real Russian tail, 10ft. long, very full and soft, perfectly new, value, 55s.; sacrifice 18s. 6d. Rare chance. Genuine fur.—Mrs. A. C. Jameson, 73, Victoria-road, Kilburn N.W.

**Umbrellas Re-covered** equal to new, from 2s. each. Splendid value. List free.—Howarth, Umbrella Maker, Burnley.

**Piles!**—Agonising cases cured.—Palmer's "Indian Ointment," 13½d.; three, 2s. 6d. (internal remedies included).—Chapel-terrace, West Auckland, Durham.

**Palmer's "Indian Medicines,"** 2s. 6d., cure debility, wasting of vital forces, &c. Renders life a pleasure.—Above.

Free, for 2s. 6d., 6 of the best **New Novelties** in existence. Satisfaction guaranteed.—Everitt, St. Peter's-street, Coventry.

**Have a Good Light for Christmas.**—Water-white Kerosene Oil, 7¼ gallon. Free, delivered in barrels.

**Five Gallons** delivered by Carter Paterson, 3s. 6d.; deposit on can, 2s. 6d., required. Gives a pure light.

Chemically-prepared **Cottons**. Intense lustrous light. Great economy in oil. Any size, 6d. yard, free.

**Lamp Repairs a Speciality.** Solvent and other Naphthas, Marine Glue.—H. Jones and Co., Viaduct-street, E.

**Electric-Bell Fitters please note.**—Special lines in Indicators. Largest makers outside London. Equalled by few, surpassed by none.

**Large Stock**, ornamental or plain cases. Prompt delivery. Illustrated catalogue, four stamps.—Sunderland and Co., Instrument Department, Halifax.

**Lathes and Benches**, several second-hand. Send for list to Syer and Co. 45, Wilson-street, E.C.

**H. Thorpe**, 59, Theobald's-road, manufacturer of all kinds of small Machines, automatic, electrical, or mechanical. Wheel and Rack-cutting in any metal. Screws, Terminals, and small Brasswork of every description.

All parts of the **Bell Telephone**, bobbins, compound magnet diaphragms, ebonite cases, &c.

**The Watkins Exposure Meter**, for landscapes, portraits, copying, enlarging, micro. work 12s. 6d. from Hamer, Chemist, Hereford.

"The first attempt to solve this important question upon scientifically correct lines."—Dr. Otto Witt, Berlin.

"I think it the most useful invention that has yet been produced, and absurdly cheap."

Model Horizontal **Engine**, with copper boiler, cylinder 2⅝in. by 1½in.—Hickson, 4, Fitzwilliam-street, Sheffield.

**Model Boiler**, vertical steel tubular, nearly new, perfect working order, size 6½in. by 12in., brass fittings and mountings, price 16s. 6d.—Lawn, Nailsworth, Gloucestershire.

**4d. Each.**—The Diamond Edition Copyright Songs and Pieces. Lists free.—Alphonse Cary, Clapham Junction, S.W.

**Organs**, with knee swell, from 5gs., or 4s. monthly.—Alphonse Cary, Clapham Junction, S.W.

**Violin Strings.** Wonderful tone and durability. Three firsts (sample), 1s. 1d.—Alphonse Cary, Clapham Junction, S.W.

**Violins** for artists, own make, Cremona oil varnish, six guineas. Approval.—Alphonse Cary, Clapham Junction, S.W.

**Musical Instruments.**—Illustrated Catalogue, 148pp., 1s. (free to customers).—Alphonse Cary, Clapham Junction, S.W.

**Fiddler's Handbook**, full of useful technical information, price 9d.—Alphonse Cary, Clapham Junction, London, S.W.

**Electric Watch-Stands**, complete, 14s., will give an intermittent light for 18 months at cost of 3d.—Below.

Combined **Primary and Secondary Battery**, 2·40 volts, in vulcanite cells, 5s. Specially recommended for lighting jewellery.

Pocket **Lithanode Accumulators**, 4 volts, in vulcanite cells, 10s. complete; for lighting fairy lamps or dress ornaments.

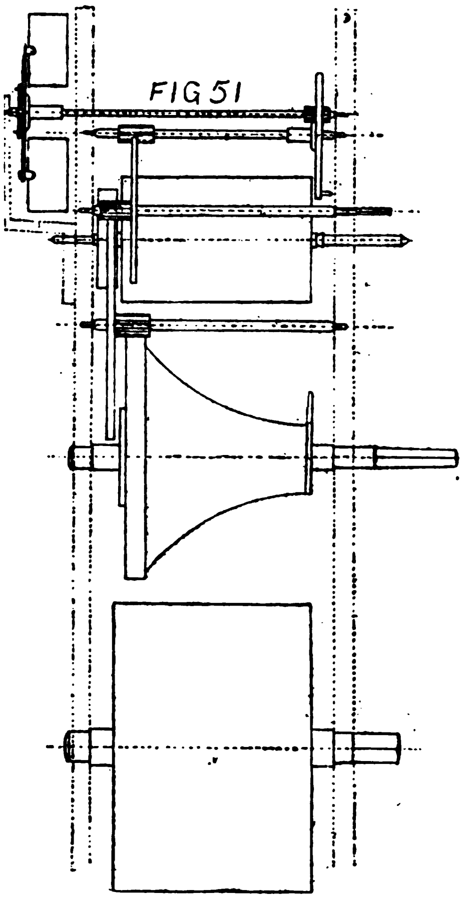
**Lithanode Cells**, small, 2s. 6d. Send for wholesale quotations.—J. Rabey 36, Love-lane South Norwood, Surrey.

e English Mechanic
WORLD OF SCIENCE AND ART.
*FRIDAY, DECEMBER* 19, 1890.

## TO CONSTRUCT A QUARTER CHIMING CLOCK.—VII.

### 26.—Pitching the Chiming Train.

itching the striking train, a line was rawn across the back plate through the e-wheel hole. On this line, 2⅝in. from ntre—that is, at the same distance as triking-fusee holes—drill the chiming- pivot-hole, and upright as before. off the second-wheel depth above the but ⅜in. nearer the centre. Fig. 1 a general idea of the positions. The wheel holes are drilled still nearer to ntre. The warning-wheel comes above ut somewhat to the right. The fly, he solid variety, may be placed to the the warning-wheel, well clear of the pallets. If a regulating fly is used, as shown in Fig. 1, it may be placed to the right of the warning-wheel, as marked. It is secured by a brass cock, and the depth may be scored off and pitched in exactly the same way as the pallet-staff—that is, as far as being carried through the back plate is concerned. The chiming-wheel and barrel are planted near the edge of the plate, to the right of the second wheel. Fig. 1 will show the position.



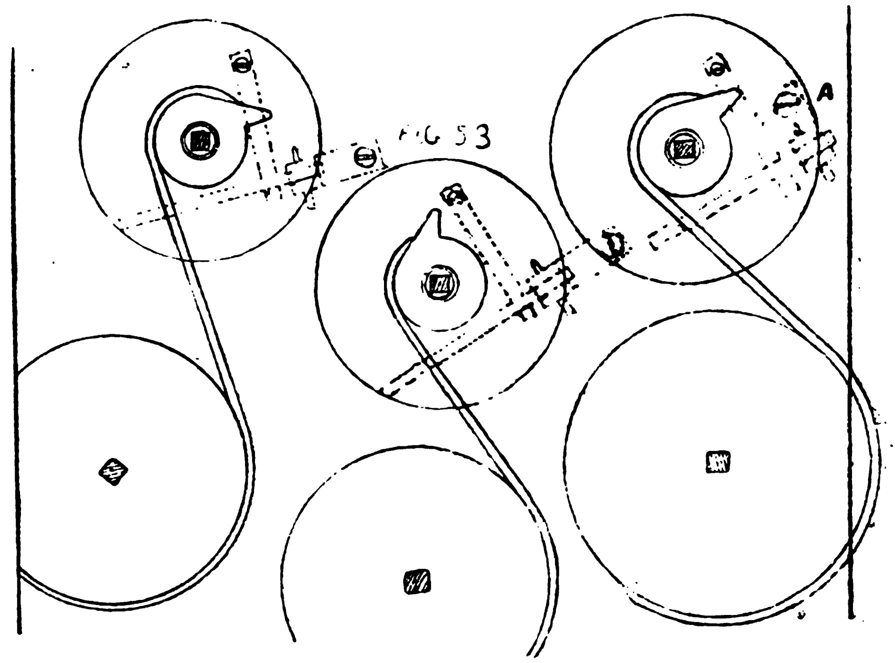


Fig. 52.

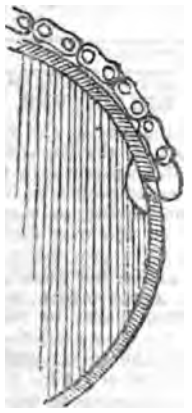
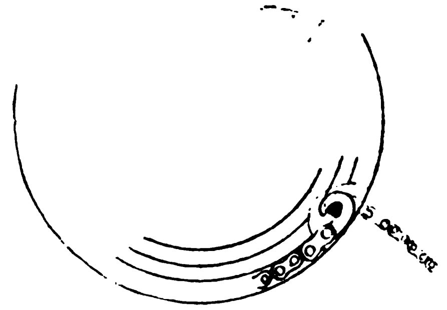


Fig. 51 shows the arrangement of this train. The barrel is planted on a level with the striking-train barrel. Care must be taken that it runs quite free both of the bottom pillar and the "going" barrel. Barrel ratchet and click are exactly the same as in going and striking trains. Having now got all the wheelwork between the plates, the chains or lines will be next considered.

Steel chains are, of course, by far the best; but the expense is rather heavy. As far as timekeeping goes, the clock will perform just as well with lines as with chains; but there will always be the chance of one or other of them breaking, which necessitates the whole clock being taken to pieces to replace it.

FIG 54



If it is decided to use chains, they must be purchased through a dealer in clock materials. I think I can safely say no reader will attempt to make them at home. The chains, it will be seen, are provided with hooks at either end. Oblique holes are drilled in the barrels about 3/16in. from the front edges, into which the chains are hooked. These holes must not be too wide. Fig. 52 will show how this is done. The direction of the chains can be seen from Fig. 53. When the fusee is full, there should be half a turn still upon the barrel. In the last turn of the fusee, where the other end of the chain is fixed, drill two holes the width of the groove, and ⅜in. apart. Clear out the brass between these, and put a pin through, as shown in Fig. 54. The chain is hooked upon this pin. There should be depth enough under this pin to accommodate the hook when the chain is in the position shown by the dotted line, as it is when the clock runs down: otherwise the chain will very likely break.

If, instead of chains, lines are used, they should be of the best gut obtainable, and full size for the groove in fusee; but they must not *overlap* the edges, or they will fray out quickly.

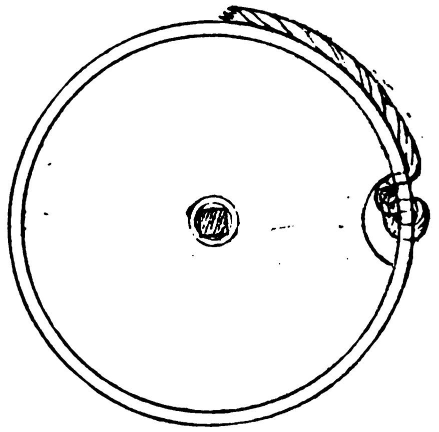


FIG 55

LII.—No. 1343.

The method of fastening into the barrel is shown in Fig. 55. The holes (three) are drilled $\frac{1}{8}$in. from edge of barrel, and must come where the cover is cut away. The end of the gut is cut off flat, and held against a piece of hot (*not* red-hot) metal to spread and harden the end. This prevents it pulling through. The sharp edges must be taken off the holes, or the gut will cut through in time.

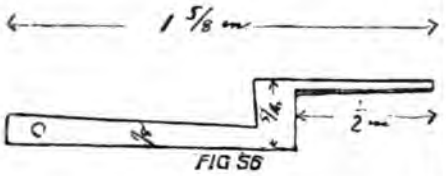


FIG 56

To fasten into the fusee, drill a hole in the last turn about $\frac{1}{4}$in. deep. In the face next to great wheel drill a $\frac{1}{4}$in. hole to meet the first, about $\frac{1}{8}$ to $\frac{3}{16}$ deep. This will accommodate the knot in gut.

To put the chains or lines on, proceed as follows:—First fasten to both barrel and fusee, then carefully wind up on barrel, set spring up by means of ratchet and click outside front plate, then screw the ratchet tight, and wind up on fusee.

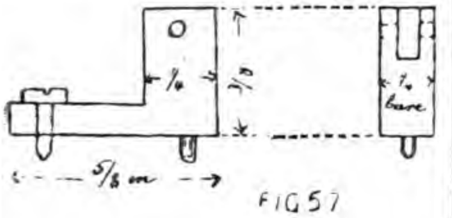


FIG 57

We now come to the stop-work. Make three pieces of steel as in Fig. 56. They are to be $\frac{1}{8}$in. thick, and dimensions as in the figure. These are pivoted to the plate by means of the three brass pieces, one of which is shown in Fig. 57. The joint-pins should not be fixed in, but must be removable. The brass pieces also are only screwed to the plate, and are further held by a steady-pin. Three flat brass springs must also be made and screwed to the plate, as shown in Fig. 58, which is a general view of the stop-work. These springs keep the steel pieces against the gut during the last turn of the fusee, and must not be too strong, or injury to the gut will result. For the same reason the part A (Fig. 58) is nicely rounded and polished. The shoulder B (Fig. 58) is undercut to draw up close to the stop-finger on fusee, and make the action safer. The heel C (Fig. 56) prevents the steel pieces being raised too far from the plate by the springs.

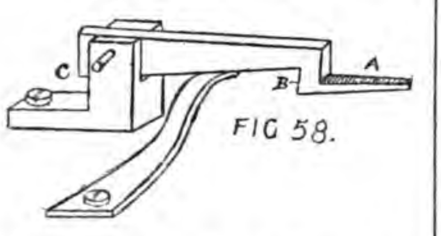


FIG 58.

The action is as follows:—The steel piece, it will be seen, lies across the path of the gut, and when this comes in contact with the part A at the last turn of the fusee, the steel piece is depressed, and the stop-finger on fusee, coming round, is caught by the shoulder B, and the winding is thus arrested.

Fig 53 shows positions of three stops and springs. The piece A (Fig. 53), it will be seen, is slotted in a different direction to the other two.

Care must be taken that the joints work quite easily, as if the action fails from any cause, a broken gut is almost sure to result.

Fig. 59 shows relative positions of fusee and stop. The stop finger on fusee revolves between the stop and the plate, except when it comes to the last turn in winding; then the gut or chain depresses the stop, and the finger on fusee is caught by the shoulder of stop. The stop-spring is omitted for the sake of clearness.

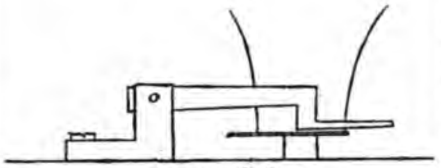
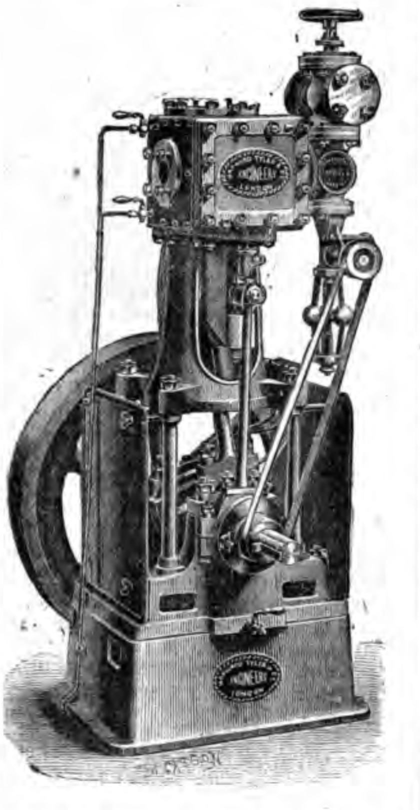


FIG 59

The motion-work in front of the front plate will now be proceeded with.

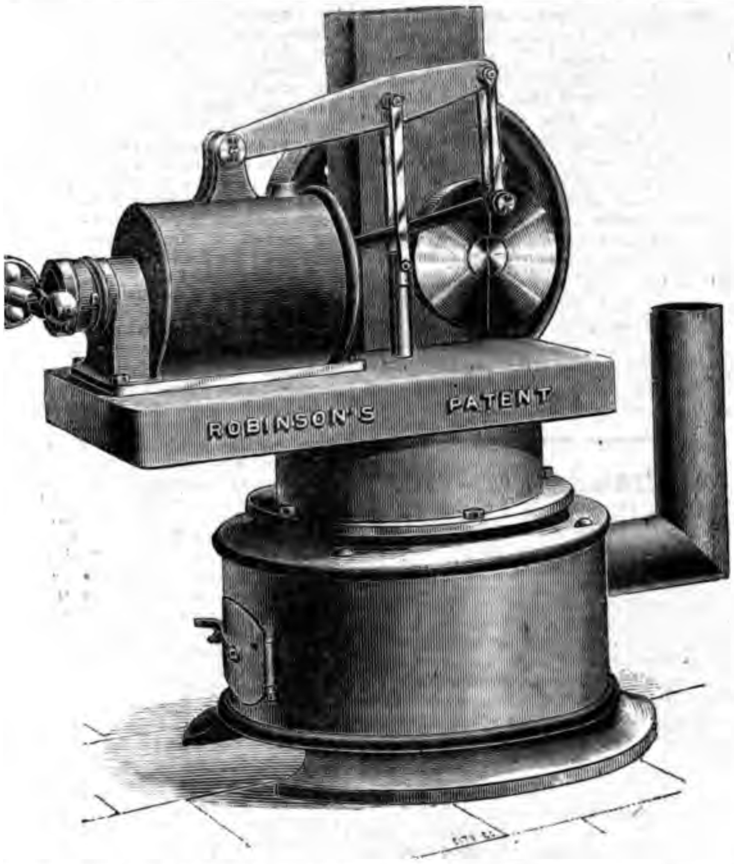


## VERTICAL HIGH-SPEED ENGINE.

THE engine we illustrate has been constructed by Messrs. Hayward Tyler and Co., London and Luton, engineers, for electric light purposes to the following specification:—It is of the single-cylinder double-acting high-pressure non-condensing type. The general design is new, consisting of a strong cast-iron bed-plate having four mild steel vertical columns secured into suitable bosses. These columns carry a cast-iron superstructure forming the guide bars, and a connection for the lower end of the steam cylinder. The bed-plate has the main bearings cast in one piece with it, and is provided at its lower edges with a capacious channel for catching waste oil. The cylinder is $7\frac{1}{2}$in. diameter, and the piston has a stroke of 7in. It is made of the hardest workable cast iron truly bored and faced. The cylinders and steam-chest covers are secured by closely-pitched studs, and are of very strong section. The completed cylinder is tested by hydraulic pressure to 250lb. per square inch. It is well protected by a clothing of slag wool or other non-conducting material, and is neatly cased by blued sheet steel secured by screws. Suitable drain cocks are provided. The piston is of cast iron, very deep, and fitted with Ramsbottom rings. The slides are of cast iron with ample surface. The valve is of a special double-ported type with short travel, and is
to the valve-rod by a circular gunmet
a lock-nut and pin. The piston-rod
head are of the finest mild steel forg
one piece, with an extra large screw a
the piston end fitted with a gunmetal
piston is carefully ground to the rod.
head is fitted with square-bottomed
bearings, and a cap of steel forged soli
guide slippers, which are accurately
scraped to fit the guide bars. Mild
with extra deep nuts and large pins a
securing the crosshead cap. The conn
is of mild steel. The crosshead end i
with a fork in which the steel crossh
firmly shrunk. The lower end is
pattern with gunmetal bearings with
and having very ample surface. The
is of steel of double web type with lar
weights in one piece with the webs.
spindle is of steel of large diameter, f
with the guide, which latter is of
The eccentric-rod is of mild steel, wit
eye at the upper end, and a palm at
end for attachment to the eccentric st
eccentric is of cast iron, very wide, pro
a reversing plate, so that by simply c
bolt the engine may be run either
eccentric strap is of best gunmetal of
shape and section, provided with steel
extra deep nuts. The main bearings
gunmetal fitted into bored seats in the
secured by driven gunmetal stop-pins.
ing cut is taken through the bearings a
fitted into the seats to secure perfect
The valve-rod bracket is of cast iron in
with the valve-spindle stuffing-box, so a
perfect accuracy between the guide and
box, and secured to the turned face o
by flange and studs. The governor
high-speed type acting directly on
beat perfect equilibrium throttle-valv
so constructed as to have no joints. It
able whilst running. A heavy tu
polished flywheel is securely keyed to
end of the crank-shaft close to the main
The diameter is 3ft., width 5in. A str
iron base-plate carries the flywheel wel
the floor line, faced on the upper surface,
vided with hand-holes for bolts and
flange for securing to the foundatio
lubricating boxes are fitted in suitable
so that by means of copper pipes the oil
to every bearing. Special means of car
oil from the lower ends of the pip
bearings are adopted, so that the whol
oiled while in motion, and thus obtain
running if necessary. Large sheet ste
plates are provided for the back and fro
engine, neatly finished, provided with
for easy removal, and arranged so that
of the oil drips into the oil channel. T
pin in the bed-plate drains through a
the general oil-channel, and a gunmet
provided for drawing off the oil from th
as need be. Every part has been ma
enough for a steam pressure of 180lb. p
inch. The bearing surfaces through
been most carefully considered so as
perfect running. A steam stop-valve
usual small fittings are provided. A
350 revolutions per minute is about the
the engine will run without trouble
desired.

## KRUGENER'S PHOTOGRAP OBJECTIVES.

SOME improvements in the constru
arrangement of the lenses of phot
objectives have been patented in this co
Dr. R. Krügener, of Bockheim, Germa
are not without interest, as they dep
certain extent on the new Jena gla
patentee says:—The progress made i
graphy during the last few years has con
increased the requirements with r
optical apparatus, whilst by the m
undertaking of the Glastechnische Labo
at Jena the calculator or the designer o
apparatus has had placed at his disposal
glass enabling conditions to be fulfill
were formerly altogether unknown. I
graphic objectives the aforesaid conditi
more especially upon the evenness a
ness in focal depth of the picture
plate, as regards the arrangement
spherical surfaces. The present inventi
result of a research which has been ca



labour spent in calculations, and in
modifications have been taken into
. In this research it has been found
imstanees are most favourable if the
system is made of a single flint-
positive focal length, whilst the rear
m, which may be composed in any
ler, annuls the faults caused by the
front, and together with the former
tem, produces a picture which is
and chromatically correct. As an
serve an aplanatic device in which
t or system consists of a negative
is cemented to a positive crown-glass

nts of the same for the following
s are :—

crown.
flint.
+ } front lens, flint glass.
− } central thickness, 6·19 millimètres.

istance between the front lens and
·26.

} rear lens, flint glass.
} central thickness, 1·34 millimètres.
+ } crown.
+ } central thickness, 19·38.

n has a free opening of 33 milli-
a focal length of about 200 milli-
the present case + signifies convex,
re.

## ON'S HOT-AIR ENGINE.

dated Sept. 30, 1887, we illustrated
of hot-air engine then recently
Mr. H. Robinson, of A. E. and H
f Albert-square, Manchester, and
on annexed shows a modified and
m in perspective; but the details
ically the same as in the sectional
en on p. 103, Vol. XLVI. These
made in various sizes, and the air
d by either coal or coke, gas or oil.
little attention, and, of course, are
e, as there is nothing to explode.
shown is a No. 6 engine, giving
n-power at a running cost of about
n hour. The approximate dimen-
ylinder, 10in. diameter; height of
3in.; length, 3ft. 11in.; and width
ight being less than half a ton.
nes are made, which are generally
Bunsen burners or oil-lamps; the
is small, and the quantity of lubri-
l is practically a minimum. The air-chamber is placed over the furnace, and contains the "regenerator," by means of which the air is heated and expanded, and so actuates the piston in the working cylinder which is seen on the top. This piston acts at right angles to the motion of the regenerator. A flywheel is fitted to the crank shaft, and a governor is applied, as seen, at the inlet to the working cylinder, so that all parts being practically balanced and controlled, it is only necessary to attend to the fire now and then to keep the engine running as long as may be required.

## HOW BOOKS ARE BOUND.—XIII.

By "Practical Bookbinder."

THE finishing of morocco-bound books presents but little difference to that of calf or other leather-bound books; that is, in so far as the execution or the actual work is concerned. The leather is washed with paste-water, and receives two coats of glair, and when dry the gold is laid on and the design worked off, as has been already explained in calf work.

The sides of a book bound in calf are, generally speaking, finished very plain, the most common style being a two or three-line, mitred round the edge; whilst books bound in morocco are often treated to the most beautiful designs in gold and colours. To say that these designs are the wcrk of artists, and to designate their productions as works of art, is mere twaddle: words of mine could not express the beauty of some of the books I have seen. The time and labour expended upon them could not be calculated. Some of them seem so very intricate, that it is almost impossible to conceive their being wrought out by hand. They must always be a puzzle to the uninitiated. Take, for instance, a scroll design, where scrolls innumerable interlace each other: there seems to be neither beginning nor end: tell someone who has no idea of bookbinders' tools that it is wrought out with a few curves, lines, and flower sprigs, and small wonder if an incredulous smile plays over his honest face.

Such is the case, however, and often very fine designs are but the ingenious combining of some half-dozen tools.

I have already given some idea of finishers' tools. We have lines all sizes—two-lines, three-line; pallets with a broad and narrow line together, called broad-narrow, narrow-broad-narrow, &c. Then we have curves or gouges all sizes and pitch, being in fact parts of different sized circles, so that with these things we are able to do almost anything.

Fig. 41 is a design entirely made up of curves and lines. It is one of those beautiful designs attributed to Grolier, a famous French amateur who flourished in the 15th century. There are a great many of this distinguished book-lover's books to be seen in the British Museum. They are all well bound—some in brown calf, and some in what seems to be morocco. The simplicity of the ornamental work is their great charm. They all bear the inscription "A. J. Grolier, et Amicorum," showing that although he loved his books as his own life, he was by no means a selfish man, as he wanted his friends to have the pleasure of using them.

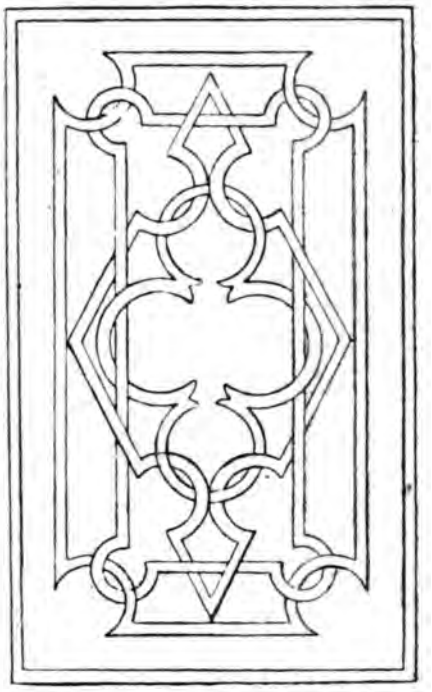


Fig XLI

The design given above is capable of being treated in a variety of forms. For instance, it may be simply wrought as it is, or the corners may be filled in with flower sprigs, or it may be illuminated by filling up the different panellings with a distinct colour of leather.

In working out such a design upon the sides of a morocco-bound book, it has, of course, all to be marked off. This is done differently, according to circumstances. A very handy method is to cut a piece of soft paper the size of the book side, and fold it evenly in four. Tool one corner of the design upon this while folded. When opened out the design will be complete. This is then laid upon the book, and a little tack of paste put at each corner to keep it in place. The whole design is carefully gone over above the paper. When the paper is removed it is, of course, found impressed into the leather.

Some designs, because of not being four-cornered, cannot be treated in this manner, and, indeed, it is often more convenient to mark off with the dividers, straight-edge, and marker. After the marking is complete, the side should be washed with paste-water, and, when dry, glaired twice. When glairing morocco, a rub over with a soft shoe-brush, kept for the purpose, takes away the dirty, shiny appearance sometimes seen on such work. When the glair is thoroughly dry, the gold is laid on, and pressed well into the design. Sometimes it is necessary to lay on double gold. Put a little lard in the cotton, besides the ordinary olive-oil, for laying on, as, if there is much tooling to be done, the side is apt to get dried up before it is finished, and thus cause trouble. After the gold has been laid on, the tools are taken up, and the design is impressed all over. The heat of the tools makes the gold adhere, as already explained; the surplus gold is wiped off, and all cleaned with the rubber.

I have given, in Fig. 42, a neat little design, which will be useful to the amateur or country binder whose stock of tools is not very large. It can be done with a two-line fillet, and from four to eight flowers, sprigs, and corners. I have fille in one corner, to give an idea of the style, and marked with crosses the other spaces to be filled up with tooling. I would fain give a few more designs, but space has to be considered. Besides the elaborate gilded designs already spoken of, there is another style commonly called antique, which is most often applied to morocco work, though why it should be called antique I will not pretend to state. It is sometimes called *blind* tooling, and I think this is the most appropriate term. It simply means that all the ornamentation is black or blind. When this kind of work is well done it is really very beautiful.

The usual method of execution is as follows: —The design is marked off upon the side, which is well damped with clear water; the water is allowed to strike well in, so that the entire side will remain damp during the time occupied in working up the design. The tools must not be used so hot as for gold-work. The lines and all the ornaments are brought up very bright. It is in this effect the merit lies; the brighter the tools the more pleasing will the work appear to the eye. The tools have to be impressed again and again to produce the desired effect. The fillets, instead of being run up, are made fast and slid up and down. These blind designs are often picked out with gold, and when judiciously performed the work is very pleasing. The tools used for blind work are, of course, much heavier and more solid than those used for gilding.

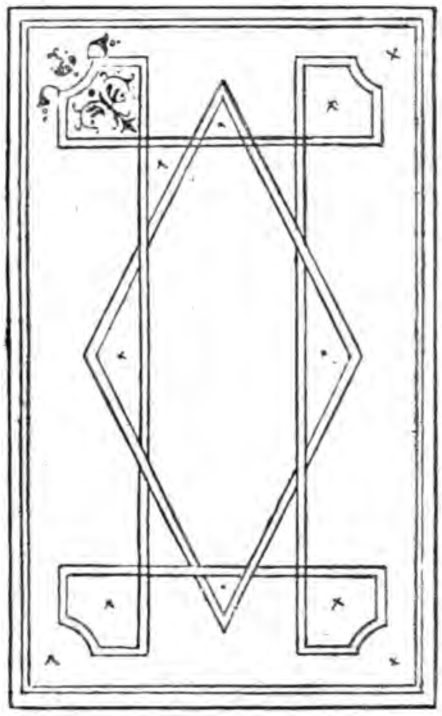


Fig XLII

Brown calf is often treated in this manner, and when the tools are wrought up till almost black, it looks very well indeed.

Before departing from this part of my subject, the following general instructions for gilding upon silk and velvet may be useful:—The proceedings necessary to be adopted for gilding upon these substances are, from their delicate nature, different from those laid down for gilding on leather.

The glair used on the latter would tend to stain, and therefore it is necessary to employ some other means for fixing the gold. This is by drying the whites of eggs and reducing them to powder, which is put in a bottle and tightly tied over by a piece of muslin, by which means it is equally distributed on the space intended to be gilt. Besides the dried eggs, there are at present other substances used—powdered rosin, gum sandarac, &c. The powder being applied, the gold is cut in slips and taken on the roll. The design is then firmly impressed, and the superfluous gold brushed off with a soft brush or clean piece of cotton. In lettering or fixing single tools the same proceedings must be adopted by taking the gold upon the tool and applying it to the work. Where the design is large, or elaborate work is required, it will be better executed in the following manner:—The design must be drawn upon paper and worked through upon the silk or velvet, after which the impression must be carefully glaired with a camel's-hair pencil, and, when dry, rub the parts intended to be gilded with the finger passed through the hair or with a clean rag slightly oiled, and after laying on the gold as directed for leather, reimpress the tools and whip off the superfluous gold with a clean flannel. There are a great many other styles of binding and decoration to which I might refer, but I am afraid to transgress upon the space of this most excellent journal. Before, however, taking a complete farewell of my readers, I may have something to say about hand-colouring calf, sprinkling calf, marbling calf, &c.

## THE ELECTRO-MAGNET.—VIII.*

SO far back as 1840, Ritchie found that it was more difficult to magnetise steel magnets (using for that purpose electro-magnets to stroke them with) if those electro-magnets were short, than if they were long. He was, of course, comparing magnets which had the same tractive power—that is to say, presumably had the same section of iron magnetised up to the same degree of magnetisation. This difference between long and short cores is obviously to be explained on the same principle as the greater projecting power of the long-legged magnets. In order to force magnetism not only through an iron arch but through whatever is beyond, which has a lesser permeability for magnetism, whether it be an air gap or an arch of hard steel destined to retain some of its magnetism, you require magneto-motive force enough to drive the magnetism through that resisting medium; and, therefore, you must have turns of wire; that implies that you must have length of leg on which to wind those turns. Ritchie also found that the amount of magnetism remaining behind in the soft iron arch, after turning off the current, at the first removal of the armature, was a little greater with long than with short magnets; and, indeed, it is what we should expect now, knowing the properties of iron, that long pieces, however soft, retain a little more—have a little more memory, as it were, of having been magnetised—than short pieces.

### Winding of the Copper.

How are we to determine beforehand the amount of wire required, and the proper gauge of wire to employ? The first stage of such a determination is already accomplished; we are already in possession of the formulæ for reckoning out the number of ampère-turns of excitation required in any given case. It remains to show how from this to calculate the amount of bobbin-space, and the quantity of wire to fill it. Bear in mind that a current of 10 ampères—i.e., as strong as that used for a big arc light—flowing once round the iron, produces exactly the same effect magnetically as a current of 1 ampère flowing around ten times, or as a current of only one-hundredth part of an ampère flowing around a thousand times. In telegraphic work the currents ordinarily used in the lines are quite small, usually from five to twenty thousandths of an ampère; hence in such cases the wire that is wound on need only be a thin one, but it must have a great many turns. Because it is thin and has a great many turns, and is consequently a long wire, it will offer a considerable resistance. That is no advantage, but does not necessarily imply any greater waste of energy than if a thicker coil of fewer turns were used with a correspondingly larger current. Consider a very simple case. Suppose a bobbin is already filled with a certain number of turns of wire, say 100, of a size large enough to carry 1 ampère, without overheating. It will offer a certain resistance, it will waste a certain amount of energy of the current, and it will have a certain magnetising power. Now suppose this bobbin to be re-wound with a wire of half the diameter; what will the result be? If the wire is half the diameter it will have one quarter the sectional area, and the bobbin will hold four times as many turns (assuming insulating materials to occupy the same percentage of the available volume). The current which such a wire will carry will be one-fourth as great. The coil will offer sixteen times as much resistance, being four times as long and of one-fourth the cross-section as the other wire. But the waste of energy will be the same, being proportional to the resistance and to the square of the current; for $16 \times \frac{1}{16} = 1$. Consquently the heating effect will be the same. Also the magnetising power will be the same, for though the current is only one-quarter of an ampère, it flows around four hundred turns;
the ampere-turns are one hundred, t
before. The same argument would hol
any other numerical instance that migh
It therefore does not matter in the
magnetic behaviour of the electro-mag
it is wound with thick wire or thin wir
the thickness of the wire corresponds to
it has to carry, so that the same number
power are spent in heating it. For a coi
a bobbin of given volume, the magnet
is the same for the same heat waste. I
waste increases in a greater ratio than th
ing power, if the current in a g
increased; for the heat is proportional t
of the current, and the magnetising pow
proportional to the current. Hence it
ing effect which in reality determines
of the wire. We must—assuming that
will have a certain strength—allow eno
to admit of our getting the requisite
ampère-turns without over-heating.
is to assume a current of one ampère
calculates out the coil. Having do
same volume holds good for any o
of wire appropriate to any oth
The terms "long-coil" magnet an
coil" magnet are appropriate for th
magnets which have, respectively, n
of thin wire and few turns of thick w
terms are preferable to "high-resist
"low-resistance," sometimes used to d
two classes of windings, because, as I
shown, the resistance of a coil has in its
to do with its magnetising power.
volume occupied by the copper, the
current density (say, for example, a curr
of 2,000 ampères per square inch of cros
the copper), the magnetising power of t
be the same for all different gauges of
specific conductivity of the copper itself
portance; for the better the conductivi
the heat-waste per cubic inch of winding
ductivity copper is therefore to be p
every case.

Now the heat which is thus genera
current of electricity raises the temperat
coil (and of the core), and it begins to
from its surface. It may be taken as
approximation that a single square inch
warmed 1° Fahr. above the surroundin
steadily emit heat at the rate of $\frac{1}{215}$ of a
if there is provided only enough surfac
of a steady emission of heat at the rat
per square inch of surface, the temperat
surface will rise to about 225° Fahr.
temperature of the surrounding air. Th
is determined by the average emissivity o
stances as cotton, silk, varnish, and other
of which the surfaces of coils are usually

In the specifications for dynamo mac
usual to lay down a condition that the
not heat more than a certain number
warmer than the air. With electro-mag
safe rule to say that no electro-magnet
to heat up to a temperature more than
above the surrounding air. In many case
safe to exceed this limit.

The resistance of the insulated copper
bobbin may be approximately calculat
following rule. If *d* is the diameter of
wire in mils, and D is the diameter in
wire when covered, then the resistance
inch of the coil will be:

$$\text{Ohms per cubic inch} = \frac{960{,}70}{D^2 \times}$$

We are therefore able to construct a
and amperage table which will enable u
late readily the degree to which a give
warm when traversed by a given curre
versely, what volume of coil will be need
vide the requisite circulation of curren
warming beyond any prescribed exce
table will be found in the *Journal* of the
Arts, p. 932.]

By the light of the knowledge one pos
the relation between emissivity of surfa
heating by current, and limiting tempera
seen how little justification there is for
pirical rules as that which is often given
to make the depth of coil equal to the d
the iron core. Consider this in relation
lowing fact: that in all those cases whe
is negligible, the number of ampère-turns
magnetise up a thin core to any prescri
of magnetisation will magnetise up a co
section whatever, and of the same leng
same degree of magnetisation. A rule
increase the depth of copper proportiona
diameter of the iron core is absurd.

### Miscellaneous Rules about Win

To reach the same limiting tempera
bobbins of equal size wound with wires
gauge, the cross-section of the wire must
the current it is to carry; or, in other
current density (ampères per square inc
the same in each. Table X. shows the
of the various sizes of wires, at four diffe
of current-density.

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* Extracted from the Cantor Lectures delivered by Prof. Silvanus P. Thompson, B.Sc., before the Society of Arts.

To raise to the same temperature two similarly-haped coils, differing in size only, and having the auges of the wires in the same ratio (so that there re the same number of turns on the large coil as n the small one), the currents must be proporional to the square roots of the cubes of the linear imensions.

Sir William Thomson has given a useful rule for alculating windings of electro-magnets of the ame type, but of different sizes. Similar iron cores, imilarly wound with lengths of wire proportional the squares of their linear dimensions, will, when xcited with equal currents, produce equal intensities f magnetic field at points similarly situated with espect to them. Similar electro-magnets of different zes must have ampère-turns proportional to their near dimensions if they are to be magnetised up an equal degree of saturation.

### Specifications of Electro-magnets.

One frequently comes across specifications for nstruction which prescribe that an electro-magnet all be wound so that its coil shall have a certain sistance. This is an absurdity. Resistance does ot help to magnetise the core. A better way of rescribing the winding is to name the ampère-urns and the temperature limit of heating. Another ay is to prescribe the number of watts of energy hich the magnet is to take. Indeed, it would be ell if electricians could agree upon some sort of gure of merit by which to compare electro-agnets, which should take into account the magtic output—i.e., the product of magnetic flux into agneto-motive force—the consumption of energy watts, the temperature rise, and the like.

### mateur Rule about Resistance of Electro-Magnet and Battery.

In dealing with this question of winding copper a a magnet core, I cannot desist from referring to at rule which is so often given, which I often wish ight disappear from our textbooks—the rule which lls you in effect that you are to waste 50 per cent. f the energy you employ. I refer to the rule which tates that you will get the maximum effect out of n electro-magnet if you so wind it that the resistnce is equal to the resistance of the battery you nploy; or that if you have a magnet of a given sistance, you ought to employ a battery of the same sistance. What is the meaning of this rule? It is rule which is absolutely meaningless unless in the st case the volume of the coil is prescribed once r all, and you cannot alter it, or unless once for the number of battery elements that you can ve is prescribed. If you have to deal with a ed number of battery elements, and you have to out of them the biggest effect in your external cuit, and cannot beg, buy, or borrow any more ls, it is perfectly true that, for steady currents, a ought to group them so that their internal retance is equal to the external resistance that they ve to work through; and then, as a matter of t, half the energy of the battery will be wasted, t the output will be a maximum. Now that is a ry nice rule indeed for amateurs, because an ateur generally starts with the notion that he es not want to economise in his rate of working; does not matter whether the battery is working ay furiously, heating itself, and wasting a lot of wer; all he wants is to have the biggest possible fect for a little time out of the fewest cells. It is rely an amateur's rule, therefore, about equating e resistance inside to the resistance outside. But is absolutely fallacious to set up any such rule for rious working; and not only fallacious, but absoely untrue if you are going to deal with curts that are going to be turned off and on ickly. For any apparatus like an electric ll, or rapid telegraph, or induction coil, or y of those things where the current is going vary up and down rapidly, it is a false rule, we shall see presently. What is the real nt of view from which one ought to start? I often asked questions by, shall I say, amateurs well as by those who are not amateurs, about scribing the battery for a given electro-magnet, prescribing an electro-magnet for a given tery. Again, I am often told of cases of failure which a very little common sense rightly directed ht have made a success. What one ought to k about in every case is not the battery, not the tro-magnet, but *the line*. If you have a line, n you must have a battery and electro-magnet orrespond. If the line is short and thick, a few of good copper wire, you should have a short k battery (a few big cells, or one big cell), and ort thick coil on your electro-magnet. If you e a long thin line—miles of it, say—you want a g thin battery (small cells, and a long row of n) and a long thin coil. That is, then, our rule: a short thick line, a short thick battery and a rt thick coil; for a long thin line, a long thin tery; and electro-magnet coils to match.

ut, after all, my rule does not settle the whole stion, because there is something more than the le resistance of the circuit to be taken into unt. Whenever you come to rapidly-acting aratus, you have to think of the fact that the ent, while varying, is governed not so much by the resistance as by the inertia of the circuit—its electro-magnetic inertia.

### Forms of Electro-magnets.

This at once leads us to consider the classification of forms of magnets. I do not pretend to have found a complete classification. There is a very singular book written by Mons. Nicklès, in which he classifies under 37 different heads all conceivable kinds of magnets, bidromic, tidromic, monocnemic, multidromic, and I do not know how many more; but the classification is both unmeaning and unmanageable. For my present purpose I will simply pick out those which come under three or four heads, and deal separately with others that do not quite fit under the four categories.

*Bar Electro-magnets.*—In the first place, there are those which have a straight core, of which there are several specimens on the table here.

*Horse-shoe Electro-magnets.*—Then there are the horse-shoes, of which some are of one piece bent, and others are of the more frequent shape, made of three pieces.

*Iron-clad Electro-magnets.*—Then from the horse-shoes I go to those magnets in which the return circuit of the iron comes back outside the coil either from one end or the other, or from both ends, sometimes in the form of an external tube or jacket, sometimes merely with a parallel return yoke, or two parallel return yokes. All such magnets I propose to call—following the fashion that has been adopted for dynamos—iron-clad electro-magnets. The advantages, as well as the disadvantages, of the jacketed magnet I alluded to when I pointed out that for all action at a distance it is far better not to have an iron-clad return path, whereas for action in contact the iron-clad magnet was distinctly a very good form. In one form of ironclad magnet the end of the straight central core is fixed to the middle of a bar of iron, the ends of which are bent up and brought flush with the top of the bobbin, making thus a tripolar magnet, with one pole between the other two. The armature in this form is a bar which lies right across the three poles. There is an example of this excellent kind of electro-magnet applied in one of the forms of electric-bell indicator made by Messrs. Gent, of Leicester.

Then besides these three main classes — the straight bar, the horseshoe, and the ironclad—there is another form which is so useful, and so commonly employed in certain work, that it deserves to have a name of its own. It is that called by Count du Moncel the *aimant boiteux*, or club-footed magnet (Fig. 24). It is a horseshoe in fact, with a coil upon one pole and no coil upon the other. The advantage of that construction is simply, I suppose, that you will save labour—you will only have to wind the wire on one pole instead of two. Whether that is an improvement in any other sense is a question for experiment to determine, but on which theory perhaps might now be able to say something. Could'nt Du Moncel, who made many experiments on this form of magnet, ascertained that there was for an equal weight of copper a slight falling off in power with the club-footed magnet. Indeed one might almost predict, for a given weight of copper, if you wound all in one coil only, you will not make as many turns as if you wound it in two; the outer turns on the coil being so much larger than the average turn when wound in two coils. Consequently the number of ampère-turns with a given weight of copper would be rather smaller, and you would require more current to bring the magnetising power up to the same value as with the two coils. At the same time the one coil may be produced a little more cheaply than the two; and indeed such electro-magnets are really quite common, being largely used, for the sake of cheapness and compactness, in indicators of electric bells.

Du Moncel tried various experiments about this form to find whether it acted better when the armature was pivoted over one pole or over the other, and found it worked best when the armature was actually hinged on to that pole which comes up through the coil. He made two experiments, trying coils on one or other limb, the armature being in each case set at an equal distance. In one experiment he found the pull was 35 grammes, with an armature hinged on to the idle pole, and 40 grammes when it was hinged on to the pole which carried the coil.

Another form of electro-magnet, having but one coil, is used in the electric bells of church-bell pattern, of which Mr. H. Jensen is the designer. In Jensen,s electro-magnet a straight cylindrical core receives the bobbin for the coil, and, after this has been pushed into its place, two ovate pole-pieces are screwed upon its ends, serving thus to bring the magnetic circuit across the ends of the bobbin, and forming a magnetic gap along the side of the bobbin. The armature is a rectangular strip of soft iron, about the same length as the core, and is attracted at one end by one pole-piece, and at the other end by the other.

### Effect of Size of Coils.

Seeing that the magnetising power which a coil exerts on the magnetic circuit which it surrounds is simply proportional to the ampère-turns, it follows that those turns which lie on the outside layers of the coil, though they are further away from the iron core, possess precisely equal magnetising power. This is strictly true for all closed magnetic circuits; but in those open magnetic circuits where leakage occurs it is only true for those coils which encircle the leakage lines also. For example, in a short bar electro-magnet, of the wide turns on the outer layer, those which encircle the middle part of the bar do inclose all the magnetic lines, and are just as operative as the smaller turns that underlie them; whilst hose wide turns which encircle the end portions of the bar are not so efficient, as some of the magnetic lines leak back past these coils.

### Effect of Position of Coils.

Among the other researches which Du Moncel made with respect to electro-magnets, was one on the best position for placing the coil upon the iron core. This is a matter that other experimenters have examined. In Dub's book, "Electro-magnetismus," you will also find many experiments on the best position of a coil; but it is perhaps sufficient to narrate a single example. Du Moncel had four pairs of bobbins made of exactly the same length, and with 50 mètres of wire on each, one pair was 16 centimètres long, another pair 8 centimètres, or half the length, with not quite so many turns, because of course the diameter of the outer turns was larger, one 4 centimètres in length and another 2 centimètres. These were tried both with bar magnets and horseshoes. It will suffice, perhaps to give the result of the horseshoe. The horseshoe was made long enough—16 centimètres only, a little over 6in. long. to carry the longest coil. Now when the compact coils 2 centimètres long were used, the pull on the armature at a distance away of 2 millimètres (it was always the same of course in the experiments) was 40 grammes. Using the same weight of wire, but distributed on the coils twice as long, the pull was 55 grammes. Using the coils 8 centimètres long, it was 75 grammes; and using the coils 16 centimètres long, covering the length of each limb, the pull was 85, clearly showing that, where you have a given length of iron, the best way of winding a magnet to make it pull with its greatest pull is not to heap the coil up against the poles, but to wind it uniformly; for this mode of winding will give you more turns, therefore more ampère turns, therefore more magnetisation. An exception might, however, occur in some case where there is a large percentage of leakage. With club-footed magnets results of the same kind are obtained. It was found in every case that it was well to distribute the coil as much as possible along the length of the limb. All these experiments were made with a steady current. It does not follow, however, because winding the wire over the whole length of core is best for steady currents, that it is the best winding in the case of a rapidly varying current; indeed, we shall see that it is not.

### Effect of Shape of Section.

So far as the carrying capacity for magnetic lines is concerned, one shape of section of cores is as good as another; square or rectangular is as good as round if containing equal sectional area. But there are two other reasons, both of which tell in favour of round cores. First, the leakage of magnetic lines, from core to core is, for equal mean distances apart, proportional to the surface of the core; and the round core has less surface than square or rectangular of equal section. All edges and corners, moreover, promote leakage. Secondly, the quantity of copper wire that is required for each turn will be less for round cores than for cores any other shape, for of all geometrical figures of equal area the circle is the one of the least periphery.

### Effect of Distance between Poles.

Another matter that Du Moncel experimented upon, and Dub and Nicklès likewise, was the distance between the poles. Dub considered that it made no difference how far the poles were apart. Nicklès had a special arrangement made which permitted him to move the two upright cores or limbs, 9 centimètres high, to and fro on a solid bench or yoke of iron. His armature was 30 centimètres long. Using very weak currents, he found the effect best when the shortest distance between the poles was 3 centimètres; with a stronger current 12 centimètres; and with his strongest current nearly 30 centimètres. I think leakage must have a deal to do with these results. Du Moncel tried various experiments to elucidate this matter, and so did Prof. Hughes, in an important, but too little-known, research, which came out in the "Annales Télégraphiques" in the year 1862.

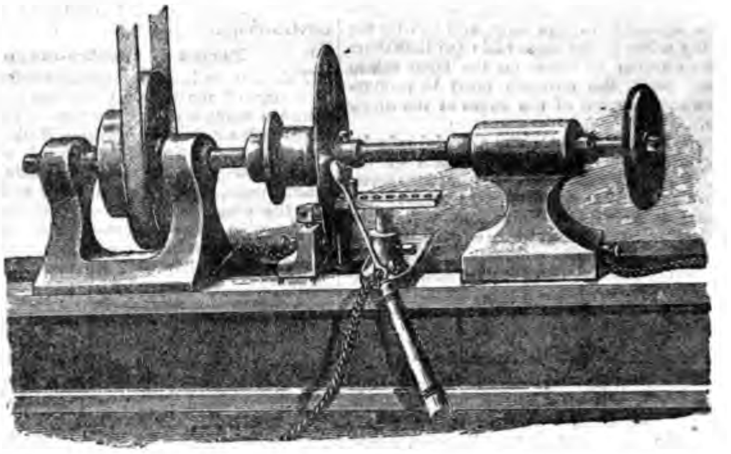
### Researches of Prof. Hughes.

His object was to find out the best form of electro-magnet, the best distance between the poles, and the best form of armature for the rapid work required in Hughes's printing telegraphs. One word about Hughes's magnets. This diagram (Fig. 25) shows the form of the well-known Hughes electro-magnet. I feel almost ashamed to say those words "well-known,", because although on the Continent everybody knows what you mean by a Hughes electro-magnet, in England scarcely any one knows what you mean. Englishmen do not even know that Prof. Hughes has invented a special form of electro-magnet. Hughes's special form is this:—A permanent steel magnet, generally a compound one, having soft iron pole-pieces, and a couple of coils on the pole-pieces only. As I have to speak of Hughe's special contrivance amongst the mechanisms that will occupy our attention, I only now refer to this magnet in one particular. If you wish a magnet to work rapidly, you will secure the most rapid action not when the coils are distributed all along, but when they are heaped up near, not necessarily entirely on, the poles. Hughes made a number of researches to find out what the right length and thickness of these pole-pieces should be. It was found an advantage not to use too thin pole-pieces, otherwise the magnetism from the permanent magnet did not pass through the iron without considerable reluctance, being choked by insufficiency of section; also not to use too thick pieces, otherwise they presented too much surface for leakage across from one to the other. Eventually a particular length was settled upon, in proportion about six times the diameter, or rather longer. In the further researches that Hughes made he used a magnet of shorter form, more like those employed in relays, and with an armature from 2 to 3 millimètres thick, 1 centimètre wide, and 5 centimètres long. The poles were turned over at the top towards one another. Hughes tried whether there was any advantage in making those poles approach one another, and whether there was any advantage in having as long an armature as 5 centimètres. He tried all different kinds, and plotted out the results of observations in curves which could be compared and studied. His object was to ascertain the conditions which would give the strongest pull, not with a steady current, but with such currents as were required for operating his printing telegraph instruments; currents which lasted but one to twenty hundredths of a second. He found it was decidedly an advantage to shorten the length of the armature, so that it did not protrude far over the poles. In fact he got a sufficient magnetic circuit to secure all the attractive power that he needed, without allowing as much chance of leakage as there would have been had the armature extended a longer distance over the poles. He also tried various forms of armature having very various cross-sections.

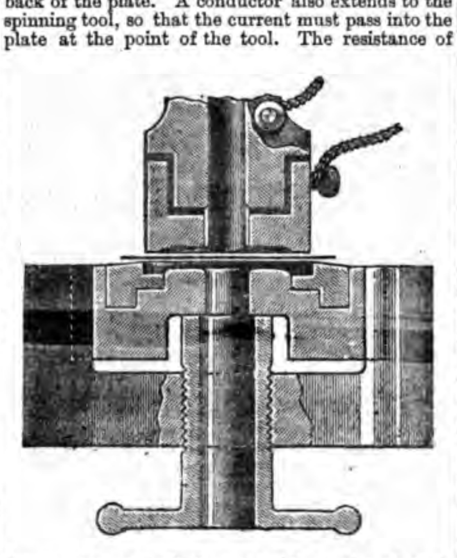
### Position and Form of Armature.

In one of Du Moncel's papers on electro-magnets you will also find a discussion on armatures, and the best forms for working in different positions. Amongst other things in Du Moncel you will find this paradox: that whereas using a horseshoe magnet with flat poles, and a flat piece of soft iron for armature, it sticks on far tighter when put on edgeways; on the other hand, if you are going to work at a distance, across air, the attraction is far greater when it is set flatways. I explained the advantage of narrowing the surfaces of contact by the law of traction, $B^2$ coming in. Why should we have for an action at a greater distance the greater advantage from placing the armature flatway to the poles? It is simply that you thereby reduce the reluctance offered by the air gap, to the flow of the magnetic lines. Du Moncel also tried the difference between round armatures and flat ones, and found that a cylindrical armature was only attracted about half as strongly as a prismatic armature, having the same surface when at the same distance. Let us examine this fact in the light of the magnetic circuit. The poles are flat. You have at a certain distance away a round armature; there is a certain distance between its nearest side and the polar surfaces. If you have at the same distance away a flat armature having the same surface, and, therefore, about the same tendency to leak, why do you get a greater pull in this case than in that? I think it is clear that if they are at the same distance away, giving the same range of motion, there is a greater magnetic reluctance in the case of the round armature, although there is the same periphery, because though the nearest part of the surface is at the prescribed distance, the rest of the under surface is farther away; so that the gain found in substituting an armature with a flat surface is a gain resulting from the diminution in the resistance offered by the air gap.

## ELECTRICITY IN SPINNING METAL.



IN the operation known as "spinning" metal—mostly sheet-copper, brass, or silver—it is necessary from time to time to anneal the sheet, the rubbing of the spinning tools tending to harden the metal. To obviate this, Mr. M. W. Dewey, of Syracuse, N.Y., has devised a method by which heat can be applied locally, and he uses electricity for the purpose. His invention is designed to be adapted to metal-spinning lathes, to drawing dies, and to other sheet-metal working machines. The source of heat is a current of electricity, which must of necessity have a large volume and low electro-motive force. In the case of a spinning lathe (above) the current is applied to the work through the mandrel, in case it is of conductive material, or if it is of wood or other non-conductor, it is applied through a brush which touches the back of the plate. A conductor also extends to the spinning tool, so that the current must pass into the plate at the point of the tool. The resistance of the contact and of the material of the plate is sufficient to produce the heat necessary to anneal the metal, so that the process of spinning can be carried forward without interruption until the work is completed. In the case of drawing dies, the lower portion of the upper die is insulated from the other part, and connected with an electrical generator, so that when the die touches the metal sheet, it forms an electrical connection. The punch by means of which the drawing is done passes through the upper portion of the die, which is connected electrically with the other conductor of the generator, so that the current flows through the lower part of the die, through the plate, through the punch, and back to the generator, thus producing at the point of contact between the punch and the plate the heat necessary for annealing. This invention is particularly adapted to the manufacture of cartridge shells and the drawing of tubes, and is shown in the illustration.

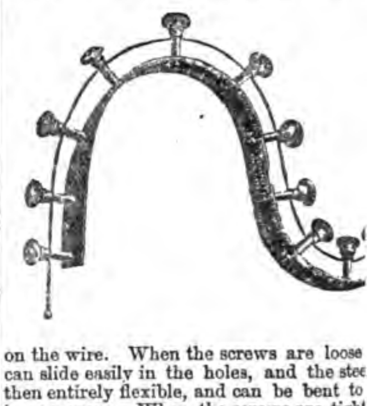


## STRIPPING FILMS FROM GELATINE PLATES.

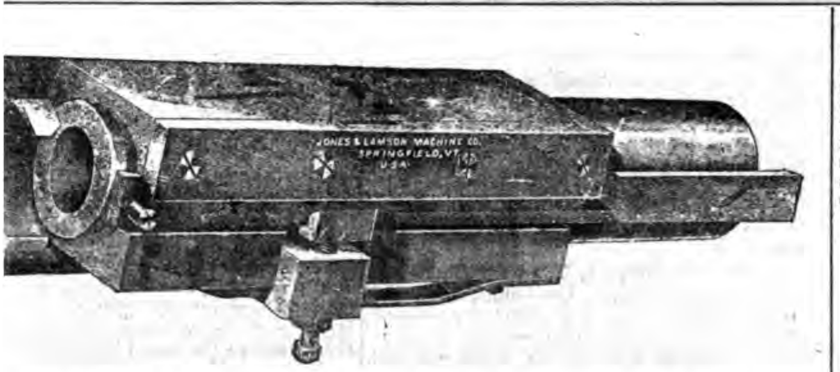
ONE of the German photographic papers gives the following as a good method of stripping the film from the glass plate, but it is necessary to be cautious with the hydrofluoric acid—which should preferably be kept in a very weak solution. In commencing, the negative must be freed from the varnish, which is done best with methylated alcohol. The negative is then placed on a levelling stand, and coated over its whole surface with a rather thick film of 2 per cent. plain collodion; after setting, the plate is thoroughly rinsed with water, until all greasiness of the film disappears. The plate is then placed in a solution of ten drops of hydrofluoric acid in 100 c.c. of water; the solution should not be used stronger, as otherwise the film would probably frill. In order to avoid this failure entirely, it is well to add to two parts of the above weak hydrofluoric acid solution one part of alcohol. As soon as the film begins to
the edges, the plate is removed from the
rinsed carefully, but thoroughly. After
the plate with the film side up is placed
support (a few sheets of moistened blottin
covered with a moistened smooth piece of g
paper, and the latter slightly pressed by
the ball of the thumb or by a rubber
The paper is next very carefully stri
together with the film; if this is done ski
film will adhere well to the paper; the latt
have been cut a little larger than the film.
to remove the paper from the film, and at
time to give to the latter a suitable suppo
polished glass plate, a little larger than th
picture, is rubbed with talc powder, th
evenly with collodion, rinsed with water, a
aside for about five minutes to drain.
moist plate is then coated with a 20
gelatine solution, and completely dried o
ling stand. Such plates keep well, so that
be placed in stock. After drying, one of th
is placed in a dish with cold clean water, a
same time the paper, together with th
placed in the water; the whole is then b
contact under water without producing air
the plate is next removed, and is o
squeegeed and the paper stripped off w
moist. After drying, a sharp knife
through the edges, and the film, which h
strong and flexible, will easily leave the
may then at once be used for printing.

## BRADLEY'S CURVE-RUL

THE curve-rule shown in the illustratio
is the invention of Mr. E. T. Bradley
and Bradley, Swanton, Vermont, U.S.A.
sists of a thin flexible steel band, divid
scale of inches, to which studs are att
riveting them to the band. Each of the s
hole near its upper end, through which a w
loosely. It also has a set-screw on its
with a knurled head, and the end of the sc



on the wire. When the screws are loose
can slide easily in the holes, and the stee
then entirely flexible, and can be bent to
to any curve. When the screws are tigh
wire braces or stiffens the band so that it
rigid and holds it in any desired position,
then be used as a ruler. Its uses will be o
any experienced draughtsman who has be
pelled to whittle out templates for drawin
which could not be drawn with any of these
"hard rubber curves" which are sold by in
makers. The flexible curve makes it a
instrument for architects, designers, drau
and pattern makers, especially those en
marine work, or in drawing or measurin
irregular curves of any kind. One of its
suggested in some experiments made some
to determine the proper shape for a car-


JONES & LAMSON MACHINE CO.
SPRINGFIELD, VT.
U.S.A.

a box similar to a large armchair was l, and several different persons' forms led in it in sand. A pasteboard template ut to fit the form thus left in the sand. ment herein described could have been o the impression left in the sand, and been quickly and easily transferred or on paper. For carriage makers or car- r, in fact, designers generally, it will be l.

## IFICIAL MEERSCHAUM.

llowing is given in the *Zeitschrift für wandte Chemie* as a new process for pre- ificial meerschaum. The following pre- re prepared by means of a solution of ass: (1) of silicate of magnesia, by ag it through a solution of sulphate of (2) of silicate of alumina, by precipi- ugh a solution of alum; (3) of silicate of ecipitating through a solution of chloride All these solutions are diluted, 1 part g used for 10 parts of water. In order ate the solutions, the operation is per- 20°, except in the case of the silicate of or which the solutions have a tempera- ut 50°. (4) A solution of fused chloride (1 part to 15 parts of water) is precipi- between 15° and 20° by a solution of f soda (1 to 15). The precipitate of lime is first dried and then freed of the of the water that it may contain by g it and exposing it upon hurdles in a ally, it is totally dehydrated by heating clean iron kettle. The sulphate of lime red is in the form of a very fine and very ler. It is carefully preserved in boxes pt in a perfectly dry place.

. of water at 40° are put 19lb. of preci- n 20 successive and nearly equal portions. g should be done with much care and stirring. There are afterwards added to e the following substances, weighed in 7¾lb. of precipitate (1); 3 3/16lb. of preci- ; 5½lb. of precipitate (3). All these s should be mixed with water, and then which is in the form of a thin *bouillie*, is y introduced into a vessel through a ss sieve, and thence into wooden boxes on large slabs of plaster covered with d about 4in. in thickness. In about 25 minutes the mass may be detached des of the frame by means of a blunt rass, and the frame may be removed. s left upon the slabs of plaster until it is dry to be sawed into small blocks of mensions, according to requirements. cks are more thoroughly dried upon a stove. Then they are worked with a a lathe, and are waxed and polished as of objects made of genuine meerschaum. e remarked that, on introducing the hot to the frame, care should be taken not e air bubbles at the same time. Vary- tions of precipitates (1), (2), and (3) may The larger the proportion, the harder r will be the final mass.

## TOOL FOR TURNING TAPER D IRREGULAR FORMS.

ustration shows a taper and irregular ng box tool recently brought out by the Lamson Machine Co., of Springfield, This tool is designed for a turret screw r turret lathe, and occupies but one hole et, like any other turret tool. It is for e turning of taper pins and bolts of all l irregular shapes, like handles, &c. lesigned for turning the taper bolts used ive shops, where it has met with great s fitted for taper and irregular turning , and is made in all sizes, adapted to the hines and turret lathes made by the The sliding template shown in front is a f steel, with its under side of the exact taper required. The point of the screw beneath bears on a shoe, which in turn bears on the template. This screw passes through an arm of the rocking tool carrier. The pin at the head end of the sliding template is to be held by a projection on the carriage. The carriage is readily set in the proper position, so that, when the power-feed of the turret is thrown in, for either direction, the tool advances or recedes, while the template remains stationary. The point of the cutting tool is thus swung out or in, and the exact taper or form of the template given to the piece turned. A taper can be cut in either direction up to the full milling length of the machine, and it will cut from or up to a shoulder. This is wholly unlike the ordinary taper attachment of an engine lathe. On a lathe the taper which is cut is double that to which the taper-bar is set, so any error made in setting is doubled in turning. The taper of the piece turned will be the exact taper of the template, and the template, being a detachable part, can be made as accurate as the class of work to be done may require. The accuracy of the taper work done by it compares very favourably with that done on the lathe, while, of course, the rate at which work can be turned out by it is much faster. Any number of templates of different tapers or forms can be readily made, and all that is needed to change the taper is to replace the template with another, which can be done in an instant. After a template is once made no further meaurements or adjustments are necessary for that taper, so that the advantages of the system will be at once apparent to anyone who has had experience in producing taper work in large quantities.

## BLEACHING WITH SODIUM HYDROSULPHITE.

THE bleaching process with sodium hydrosulphite, which has been industrially employed since 1883, yields excellent results; but, as is also the case with bleaching by sulphurous acid, the fibres thus bleached are unfit for dyeing. For the production of hydrosulphite about 300 lit. sodium bisulphite 35—40° Be. are put into a pine-wood tub of 500 lit. capacity, to which scraps of pure zinc are added until they reach the surface of the liquid (the volume of metal must not be more than a quarter of the total volume), when the tub is covered up. In order to prevent a too high temperature, earthenware tubes are inserted into the tub, in which cold water circulates. After 1 hour the liquid is drawn off into a tub, which is always to be kept full, covered, and allowed to stand for 12 hours, when an abundant amount of zinc sodium sulphite has crystallised out. The remaining liquid portion is the bleaching agent. As the latter by the contact with the air is apt to be converted into sodium bisulphite with rising temperature, the tubs for the production of hydrosulphite, as well as for bleaching with it, must always be kept as full as possible and carefully covered.

For bleaching, the material is first well cleaned—i.e., treated with sodium carbonate and then with soap, and entered into a 1,000 lit. tub containing a mixture of the bleaching liquid with an equal volume of water, taking care that the tub is nearly filled. After standing covered for six hours the yarn is well wrung and piece goods passed through pine wood squeezers above the tub. Then the material is at once washed in filtered water; if this washing is delayed the fibres are, by the contact with the air, rapidly heated up to 70—80°, and largely altered. Sometimes goods thus bleached after finishing, show stains which are attributable to remnants of zinc sodium sulphite. They are removed by passing the pieces through a cold, very weak bath of hydrochloric acid, and washing in abundant water.

With one single bleaching tub 3,000 pieces of woollen goods at 100m. each—i.e., about 36,000 kil. wool, can be bleached per year. About 100 kil. zinc serves for several years, because the undissolved metal can be rendered serviceable for further use by washing it with abundant water which is feebly acidulated with hydrochloric acid. The price of bisulphite is about 25fr. (5 dol.) per 100 kil. When the bath falls below its original level, it is filled up with dilute hydrosulphite, whereby the strength of the bleaching bath is preserved for almost an unlimited period. In a tub of 1,000 litres capacity, about 130 kil. wool can be entered at a time, the cost amounting to about 1·36fr. per 10 kil. fibre. The simple and cheap process, which is in some factories worked since several years, is probably destined in no distant time to supersede the ordinary bleaching methods.—G. DOMMERGUE, *Chem. Ztg.*

# SCIENTIFIC SOCIETIES.

## THE LANTERN SOCIETY.

AT a special general meeting held at 20, Hanover-square, on December 8th, it was resolved that the entrance fee should be abolished, and members joining now are therefore only liable for the subscription.

At the ordinary meeting held the same night, a paper was read by Mr. J. G. Grenfell, F.R.M.S., on "Means of Protection amongst Animals." The paper, which was illustrated by some 50 slides, was of very considerable interest, the lecturer describing the different means adopted by animals for their protection in the great struggle for the survival of the fittest, some of the methods employed being of a most remarkable description, more especially in cases of mimicry, where the animals reproduce the appearance of natural objects with such marvellous exactitude as to defy detection.

The following are the arrangements for the meetings of the Society up to the end of February:—December 22, Mr. C. E. Gladstone, on "Some Architectural features of Normandy and Brittany." January 12, Mr. E. M. Nelson, F.R.M.S., on "The Lantern and its Relation to Photography and the Microscope." January 26, Mr. C. Harrison, on "The Civilisation of Egypt and Assyria, as illustrated by its Physical Remains and Records." February 9, Mr. J. Traill Taylor, on "Lenses and Condensers for Lantern Work." February 23, Exhibition of Lantern Slides for members and their friends.

# USEFUL AND SCIENTIFIC NOTES.

THERE has just been founded in Paris an association with the double object of freeing the raw materials of industry from import duties and encouraging exports.

**Poisoning by Stale Oysters.**—A remarkable case of poisoning by stale oysters occurred recently in Chicago, Dr. William M. Hibbard being the victim. The doctor was taken ill shortly after eating the oysters, and, according to the Chicago *Journal*, Drs. Frank Billings, McArthur, and Frothingham were called in to attend the case. The patient rapidly grew worse, and it was decided to perform an operation, with the hope of saving his life. An incision was made in the stomach, and it was discovered that the poison had progressed too far; that the intestines had been so completely eaten up that the patient had only a few hours in which to live, and the operation was abandoned. The attending physicians stated that death resulted from ptomaines. Dr. Liston H. Montgomery said that ptomaines was an alkaloid that was generated during the progress of the decay of animal matter, and possessed very dangerous properties. In other words, it was a putrefaction of albuminous nature, a ferment very poisonous. It forms in human bodies, and the exclusion of air favours its formation It produces death like morphine.

**The Deepest Mine in Lancashire.**—One thousand and forty yards is the depth which miners in the lower workings of the Ashton Moss Colliery descend to their work every day. This is about eight times the distance from the gilt cross and ball of St. Paul's down to the pavement below. It is the deepest mine in Lancashire, and Mr. Garforth tells us that the temperature in the workings is 87°. Yet the men, up to the present, work the same hours as in shallower pits, and we are told "without experiencing any serious inconvenience," though they do not work with the same energy. Some of the practical difficulties which the witnesses before the Royal Commission anticipated in working at so low a level have fortunately not been realised. The air is described as dry in the roadway and at the coal face. More important is the announcement that there are reasons for believing that the increase of temperature in descending further will be found to be in diminishing ratio. Meanwhile, it is satisfactory to learn that no water is met with in working in such deep mines, except occasionally a few drops with a saline taste; that the quantity of gas given off is not greater than in workings nearer to the surface; and that the quality of coal cut, at from 2,000 to 3,000ft. below the surface, is equal to and even superior to that from shallower mines. Mr. Garforth's final opinion is that coal will eventually be worked at as great a depth as it can be proved to exist.

# SCIENTIFIC NEWS.

THROUGH the Royal Astronomical Society, elements and ephemeris of Zona's comet have been published as calculated by Mr. J. R. Hind, F.R.S. He gives the perihelion passage as 1890, Aug. 8·43592, G. M. T., the longitude of perihelion 113° 16′ 52·1″; longitude of ascending node 85° 25′ 2·7″; inclination 25° 38′ 57·4″. The position Dec. 20, Greenwich midnight, will be R.A. 2h. 35m. 4s., N. Dec. 31° 53·6′. The brightness is rapidly decreasing, and by Christmas day will be only half what it was at time of discovery.

MM. Terby and Van Lint contribute to the *Bulletin* of the Belgian Royal Academy of Sciences observations on the relative frequency of meteors on August 9th and 10th last. An observer, whose "field" covered one-fifth of the horizon, saw from three to five meteors in fifteen minutes, a number which increased after midnight. The maximum was reached on Aug. 10, when, between 12.30 p.m. and 1.11 a.m., the average was a meteor every two minutes. Two only of the total number of meteors observed had a brilliancy comparable with that of Jupiter.

The *Journal* of the Liverpool Astronomical Society contains some useful papers and notes—one by Mr. J. E. Gore being a popular account of the Giant Suns, in which he concludes that Sirius cannot be considered as one of the giant suns.

Mr. G. J. Symons, F.R.S., mentions a recent case of what is known as a "silver thaw," reported to him by Mr. H. Sowerby Wallis. The phenomenon is somewhat rare. Mr. Wallis writes:—A very curious instance of silver thaw occurred this morning, Dec. 15. On leaving Highgate at 8.30 a.m., when the temperature was 22°, I was astonished to feel small drops of rain strike my face; soon after it fell sufficiently to case my overcoat with a layer of ice; in about a quarter of an hour the fall changed to one of snow, and the exceptional phenomenon ceased. But to have rain with a temperature of 22° (10° below freezing), shows a strange anomaly in the variation of temperature with altitude.

The death is announced at Lima of Dr. Antonio Raimondi, the distinguished Italian explorer, who was born at Milan in 1825. Raimondi landed at Callao in 1850, and was the first to explore every part of Peru thoroughly and systematically, devoting a lifetime to the task. In 1853-54 he traversed the whole extent of the province of Tarapaca; from 1855 to 1857 he was in the provinces of Huanuco and Huamalies; and in 1858 he paid his first visit to Cuzco, the ancient capital of the Incas, penetrating also into the forests of Santa Anna to the eastward. He next visited the scenes of Humboldt's researches, and navigated the Peruvian tributaries of the Amazon. After other explorations, he penetrated into the wild forests of Caravaya, discovering the true courses of the rivers Ayapata and St. Gavan. Many other geographical discoveries followed, and in 1867 he made a careful study of the mineralogy and geology of the department of Ancachs. The final exploring journey of Raimondi led him through the Amazonian provinces to the frontier of Brazil. There is scarely another example of so thorough an examination of a vast region such as Peru by a single individual; and its completion gave the deceased traveller a high position, not only as a geographer, but as a naturalist and geologist. His undertaking occupied 20 years of incessant and arduous work. It was resolved that Raimondi's great work on Peru should be published at the expense of the nation, and by a decree of June, 1873, complete effect was given to this resolution. His death will be much lamented in the country of his adoption.

The death of a distinguished engineer is recorded in the person of Mougel Bey, who died a few days ago in Paris at the age of 82. Mougel received his education at the Polytechnic, and after the French Revolution of 1830 migrated to Alexandria, where he superintended, if he did not originate, many of the harbour improvements. To him is due the idea of constructing the dam across the Nile, to facilitate navigation, but the work was stopped through the advent of a new Khedive; and thirty years afterwards, when English rule was instituted in Egypt, Mougel was sent for to complete his work. He also superintended the construction of the Suez Canal.

Herr Anton Waga, an eminent Polish naturalist, died recently at the ripe age of 91.

We have also to record the death of Mr. George Hutchinson, a well-known man in his circumscribed world, for he was foreman draughtsman at Elswick, and had much to do in early years with those devices which made the name of Armstrong familiar all over the world. Mr. Hutchinson was in his 78th year, and had been connected with Elswick Works since their commencement.

Mr. W. F. R. Weldon, M.A., F.R.S., Fellow of St. John's College, Cambridge, has been appointed by the Council of University College, London, to the Jodrell Professorship of Comparative Anatomy and Zoology, which was held for sixteen years by Prof. Ray Lankester. Mr. Weldon at present is a Lecturer on Invertebrate Morphology to the University of Cambridge.

Mr. Karl Pearson, M.A., of King's College, Cambridge, has been elected Gresham Lecturer on Geometry. He is at present Professor of Mechanics and Applied Mathematics in University College, London. There were twenty candidates.

The Rev. H. R. Haweis gives an interesting account of a phonographic experiment with a cylinder engraved by the vibrations of the voice of Robert Browning. Dr. Furnivall and Col. Gouraud happened to meet at Mr. Haweis's house, when it was mentioned that the day was the anniversary of Browning's death, and would be a fitting opportunity to try the cylinder bearing the marks of his voice. Accordingly a few "wires" were sent off, and later on a party met in Edison House, when, Miss Fergusson working the instrument in the presence of Mr. and Mrs. Haweis, Col. Gouraud, Mr. R. Lehmann, Mr. T. Seligman, and the Rev. John Penfold, there were first heard the words of Col. Gouraud addressed to Mr. Edison, telling him that Browning's voice would follow, afterwards the cheery voice of the poet with, "Ready," and then, "I sprang to the saddle, and Joris, and he." When delivered to the cylinder Browning broke down, and some one prompted him after he had delivered a few of the lines, which was faithfully reproduced, including Browning's apology for not remembering his own lines. When the original was taken at Mr. Lehmann's house in 1889, Browning was asked to authenticate his words, which he did by shouting into the phonograph Robert Browning. Those words came out distinctly and loudly at the recent *séance* followed by the applauding voices and loud clapping of hands which had been faithfully recorded by the cylinder. It remains to say that those who understand the principles and construction of the phonograph have no doubt of its abilities; but here we have them vouched for by several witnesses who were present when Browning spoke into the instrument, and who are well acquainted with the tones of his voice.

The Koch discovery still occupies the attention of the daily papers, and all sorts of statements are made. It is now said that Dr. Brown-Sequard's liquid produces the same effect in cases of tuberculosis as Dr. Koch's lymph; and at least one well-known medical man hints that the lymph is really a preparation from the diseased tissues or secretions of tuberculous patients. A French paper publishes, on the authority of an anonymous *savant*, a recipe for the preparation of Koch's mysterious liquid. The liquid is a solution in glycerine of a ptomaine secreted by the bacillus of tuberculosis in bouillon culture. The bouillon is first sterilised, and then precipitated by cyanide of gold, the result being the formation of a double salt of gold and the insoluble alkaloid. This double salt, collected on a filter, is decomposed by baryta or some other alkali. The alkaloid (ptomaine) is then dissolved in glycerine, the resulting solution constituting the famous liquid of Dr. Koch.

In Italy the Minister of the Interior has forbidden the use of Koch's lymph, except in hospitals.

The council of the Royal Geographical Society have agreed to contribute £200 to Mr. Theodore Bent for the purpose of exploring the remarkable ruins in Mashonaland, about which so much has recently been heard in connection with the British South African Pioneer Expedition. These ruins have been known since the 16th century, and been described by Karl Manch and others, but no systematic examination and excavations have ever been carried out.

From an official report of the U.S. su
we learn that since 1742 the total
recession of Niagara Falls (Horse-sh
been 104ft. 6in., but at one point it am
as much as 270ft. The mean recession
American part is only 30ft. 6in. Full d
the report will reach this country in d
and will attract much attention in certain
for many important arguments have bee
on data derived, or supposed to have been
from Niagara.

The telephone patents, so far as re
Bell's receiver, have expired, and th
master-General, replying to a question,
hoped soon to announce the decision
Government with regard to licenses for te
exchanges. He reminded the House, h
that the more important patents do not
until July next, and it is probable no
move will be made until that time.

It is stated that Mr. Edison has take
patent for a fire-proof insulating cover
wires. The basis is said to be balata o
percha dissolved in chloroform and sub
the action of a stream of chlorine, which
the compound fire-proof, and pliable als
chlorination is stopped at the proper stage

The Rogers Typograph is one of the ne
founding composing machines in which t
positor touches keys and so releases a nu
matrices which are assembled in lines,
out, and then the type-metal is injected
form a line of the proper height, which is
up to thickness and passed on to a galley
line in a column. Great speed is claim
naturally much economy. The compa
lend the machines, but will not sell.

**New Style of Flywheel.**—A novel fl
of large dimensions, differing materially
struction from those ordinarily in use, ha
designed by Messrs. Mannesmann, to guard
the terrible danger of bursting, to which a
cast-iron flywheels are subject when work
high speed. This wheel, which is in opera
the Mannesmann Tube Company's works, i
nection with their process for making seamless
consists of a cast-iron hub, to which are s
bolted two discs of steel plates, about 20ft. i
meter. Round the periphery of the wheel
formed, about 70 tons of No. 5 gauge wi
wound, under a tension of about 50lb., thus b
the whole securely together. There can be no
parison between the resistance of a wheel s
structed to the centrifugal force and that off
this force by a cast-iron one. This flywhe
20ft. diameter and weighing 70 tons, revolv
times per minute; therefore the periphery
wheel has a speed of 2·85 miles per min
nearly three times the speed of the Flying D
man. It works on the main shaft, from wh
tube mill is driven by means of helical t
steel wheels.

**Treatment of Ingrowing Toe-nail.**—
*Asclepiad*, Dr. B. W. Richardson gives the
ing method of treating ingrowing toe-nail,
he says "answers perfectly." Half an hour
the operation is to be performed the pat
directed to immerse the foot in a bath of
water, and gradually add hot water until the
of the water is heated up to what can just be
fortably borne. Then into the water one
of common washing soda is added to each
the water in the bath, and the foot remains
alkaline fluid for the half hour. At the end
time, the nail will be found quite soft and f
The foot is now to be well dried with a tow
with a strong short-bladed scalpel th
is to be neatly scraped, over the cro
it, until it is as thin as thin paper. Next,
the handle of the scalpel, or with a flat d
the part of the nail to be removed is gently
as far as possible from its holdings; the na
the matrix is painted with carbolic colloid;
breaths of ether spray are played over the
blade of a fine but strong pair of scissors is
under the nail in the usual way; the division
to the matrix is effected, and the offending
ture is gently evolved and eased out of its
Every stage of the operation is entirely pa
there is no suffering from reaction, and a p
of cotton-wool treated with styptic colloid is
application of dressing that is needed. If c
colloid be not at hand, a drop of solution o
bolic acid will answer; and if styptic coll
wanting, Friar's Balsam—compound tinct
benzoin—containing 10 grains of tannin to th
ounce, will serve the purpose for dress
wound. In the course of the past twenty
have performed the operation for removal
growing nail, in the manner here described, si
and in each case with perfect immunity fro
and with complete success.

# TERS TO THE EDITOR.

*not hold ourselves responsible for the opinions of ondents. The Editor respectfully requests that all tions should be drawn up as briefly as possible.]*

*nunications should be addressed to the* Editor *of* h Mechanic, 332, *Strand, W.C.*

*ues and Post-office Orders to be made payable to* re Edwards.

*rder to facilitate reference, Correspondents, when f any letter previously inserted, will oblige by the number of the Letter, as well as the page on pears.*

d have everyone write what he knows, and as he knows, but no more; and that not in this in all other subjects: For such a person may particular knowledge and experience of the such a person or such a fountain, that as to s, knows no more than what everybody does, keep a clutter with this little pittance of his, ake to write the whole body of physicks, a vice ce great inconveniences derive their original." *e's Essays.*

## HE SO-CALLED "COMET."

]—In the "E.M." for Dec. 5th and the number, attention is directed to the f a "comet" said to have been seen at own on the 27th of October last, and of further accounts have appeared. Permit fore, to reproduce the subjoined details of ation of this object as they appeared in , with a view to the discussion of the your scientific readers.

opinion, the reported facts do not harth those resulting from the movement of r any cosmical body in space, but rather relating to *atmospheric* phenomena.

we suppose the object in question to be strip of translucent vapour (that condiloud which at night resembles auroral some 30 miles long, originating in the hes of the cirrus, and carried by a N.W. ross the country from a point west of the a point south-east; the variation in the le in its progress, its inclination to the vith the assistance of the full moon to eception, and if this theory be worked ing to the given data, I think it will be t in with the recorded phenomena here —

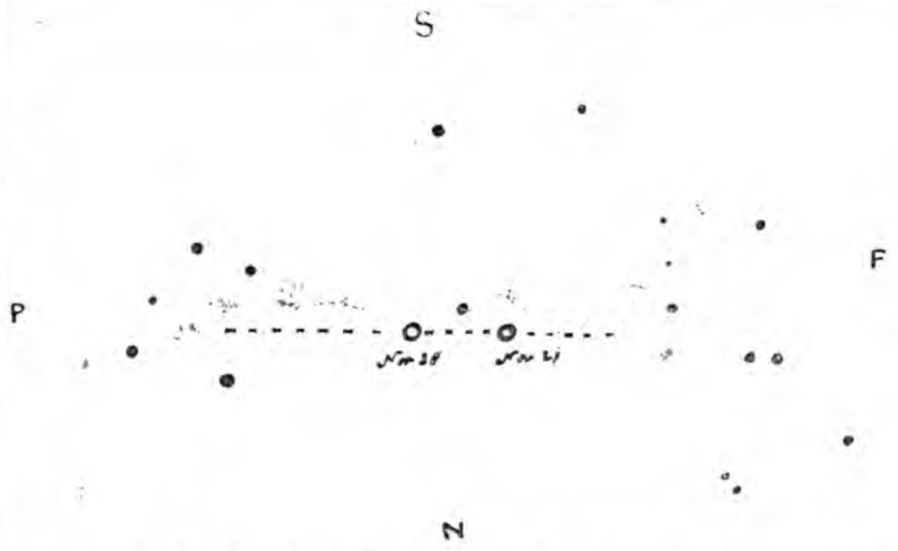
*ature*, Nov. 27:—"Mr. Eddie reports amstown that a comet was seen from 32 on the night of Oct. 27. When last ded in the south-eastern heavens. It rom nearly due west around the western rn horizon at an altitude of about 20° to earing in the south-east, performing t very brief period a journey of at least vas, at its longest, 90° in length, and did half a degree in width, except where it ry faint, and slightly spread out at its xtremity. There were also faint indicateral division. The preceding portion ed in cometary form; but no nucleus discerned. When first seen it was an angle of 45° towards the south, and 30° long; but as it moved southward it most parallel to the horizon, with an about 20°, till it stretched along the orizon, an enormously long, narrow, allel, weird-looking riband of grey light ibly across the sky. It passed over ght staars, notably α Centauri and vis; but it did not appear to dim their e moon was full." **W. H. Wood.**

ys, Birmingham, Dec. 9.

## A SPLENDID METEOR.

–It was my good fortune on the evening ast, the 14th inst, at about twenty-five ten, while passing through a suburb limits of the London fog, to witness the nificent meteor I have ever beheld many years of star-gazing. Like the ribed in your issue of the 21st ult., it the northern portion of the heavens, rse was diagonal rather than perpen- emitted a dazzling radiance that recalled ming of a Bengal light, while it rather blue lightning in the tone of colour. utterly impossible to give any adequate of the surpassing splendour of this om outer space, during its brief gh our terrestrial atmosphere. As on so striking and unusual cannot e attracted the attention of many trust other readers of the "E.M." h additional details. It would be interesting to learn over how wide as visible, as affording data for determeight above the earth, and I should be r whether the rushing sound, by which was accompanied, had any existence in .

**A. E. Spencer.**



## PATH OF NEPTUNE.

[31879.]—I had hoped "H. S." would have furnished your readers with a chart of the stars near Neptune. However, many will look forward to his promised charts for the easy finding of Uranus and Vesta. Possibly he will also add charts for Juno, Ceres, and Pallas when near opposition, for he is *facile princeps* at that kind of work. Meanwhile, to assist "Idris" and his co-observers, as they may not have access to back numbers of "ours," I inclose a chart of the leading stars near Neptune as prepared by Mr. Grover, of Rousdon Observatory, which I trust will assist in finding and following this interesting planet.

The annexed sketch shows the position of the planet on Nov. 21 and Nov. 28. Owing to cloudy weather, it has not been seen since in the writer's locality; but it will be easy to distinguish it as nearing the preceding group of stars. Its steady light, and slow, though very apparent motion, will aid in identification. **W. R. Waugh.**

## STUDENTS' MICROSCOPES—SUBSTAGES.

[31880.]—The engraver having reduced my drawing, on p. 336, to one half of the original size, it has become a quarter scale instead of a half, as stated in the description of it. I omitted to mention that the "tail-bar" is not the usual tube, but a solid ⅝in. rod, whose weight partly counterbalances the body, &c. Though I show it as a binocular, I think, for such an instrument, the monocular form is in some respects better, and far less top-heavy—a very common fault with students' microscopes, and with some which do not come under that designation.

As regards substage-fittings and James More's letter, on p. 314, it appears to me a question of the use to be made of the microscope—whether it is for simple investigations that do not need very high powers (or excessively delicate adjustments of the illuminating apparatus), or whether the utmost resources of the optician's skill are to be made use of.

For the ordinary work of a student, I should say a carefully fitted tube beneath the stage to receive a simple achromatic condenser, a paraboloid, and the polariser of the polariscope, &c., fulfils all needful requirements, while the removal of the tube, of course, allows of extremely oblique illumination of the mirror. On the other hand, if the work to be done is of a special character, then it seems to me that a "Student's" microscope is scarcely the kind of instrument to be employed, nor do I think that it is well to complicate the one (by "centring-substages," and so forth), in order to make it an imperfect and unsatisfactory substitute for the other.

The mode of attaching the tube-fitting beneath the stage of course admits of great variety. The form used by Watson is that first employed (I think) by Nachet, and fully described and illustrated by Carpenter, but it is somewhat curious that notwithstanding Doctor C.'s strong recommendation of it, Nachet soon discontinued the pattern. If, instead of a simple screw, the bar turned on a stout pin, with a spiral spring to keep it pressed firmly up to the stage, it might be better. The top edge of the tube could then be made conical, and fit into a conical recess in the under-side of the stage itself. Thus, when in place, the spiral spring would keep it up into place, but by slightly depressing the bar the whole could be turned altogether aside.

James More's remark as to "centring-substages" is certainly not applicable to *all* continental types, as I have a German instrument with centring screws to the substage-fitting, the substage itself being carried by a dove-tailed plate. It has also the arrangement for rotating the whole upper part in the optical axis—as in Zeiss' pattern, though it is not one of his make.

Some years ago Browning carried the body in an outer tube in which it could be rotated so as to give a means of centring, but I do not know if the pattern is now made. It is, I fear, doubtful whether "Microscopist's" suggestion to prepare a kind of joint specification of the requirements in a student's microscope would have any practical result nowadays, though a somewhat similar procedure resulted in the production of the so-called "Society of Arts" microscope some 30 or 40 years ago. That, however, was when "student's" microscopes were still almost novelties, and decidedly expensive articles. **A. S. Lukin.**

## JAPANESE PAPER FROG.

[31881.]—I beg to inform J. G. Bartel (letter 31861) that I made the above according to directions given, but because he and his mother have failed, do not think he is justified in saying they are "stupendous duffers." I am in the habit of teaching paper-folding to a remarkably backward set of children, and for their benefit simplify all forms as much as possible, and yet it took me three hours of one evening and a considerable portion of the next before I could make the Japanese paper frog correctly. I shall be glad to send your correspondent, J. G. Bartel, specimens of every stage if he wishes to make this aggravating reptile.

**Rebecca Gandertoy.**

23, John-street, Hull, Yorks.

[31882.] —Having succeeded one evening in making these from the English Mechanic description solely, the latter must be correct. I do not know where Mr. Bartel (letter 31861), breaks down, so that I can offer no other suggestion than that he should adhere strictly to the explanation given (Dec. 13, 1889). To repeat in full the whole process would take up space, and I might not be more explicit than the "E. M." **G. E. S.**

## DRY BATTERIES.

[31883.]—Let me tell Mr. Ball (letter 31875) that the "Smee" cell, as used for plating, *is* constant in so far as, on closing the circuit, the E.M.F. and current drop to a definite value, which is sustained for a very considerable time. The "Daniell" has not the exceedingly low resistance of the "Smee"; but its current and E.M.F. are practically absolutely constant. The "dry" cell has the bad qualities of these two types in addition to its own, and none of their advantages. This is the only comparison that can be made. Mr. Ball will never succeed in convincing a sane person that of two absolutely identical cells, the one with absorbing or setting material, in addition to the exciting fluid, will have the lower resistance. O absorbed in or collected on the negative element prevents polarisation to a very great extent.

I have neither the time nor the inclination to argue on side issues, or to discuss Mr. Ball's speculations; indeed, I confess to being prejudiced against the latter, since the incidental remark that storage cells depended on layers of gas for their active condition, and against the former since I observe how carefully Mr. Ball evades the main question, and how skilfully he attempts to interpret his statement of "3½ volts for a week or so." Facts are of more value than speculations, and I would therefore suggest, for the third time, that Mr. Ball should state the facts about his cell of 3½ volts. He will win undying fame, as no element with zinc for the positive element has ever been found (*really* found) to have an E.M.F. of $3\frac{1}{2}$ volts for even so short a time as "a week or so." I have no wish to wrest from Mr. Ball the secret of his absorbent or setting material; but the composition—not necessarily in minute detail—of the fluid and poles should be stated. I hope that, though Mr. Ball has not thought of repeating his experiment during the three or four weeks that have elapsed since it was first called in question, he will do so now, and in future acquire the laudable habit of performing experiments *before*, and not *after*, describing them.

H. G. L.

## LATHE MATTERS.

[31884.]—I AM delighted to see matters connected with ornamental turning cropping up again, after a long rest, and I hope such experienced writers as Rev. C. C. Ellison, "F. A. M.," and others will continue to write a little on the subject now and then.

I wonder if any of our readers have tried cotton cord as a substitute for gut, for overhead work? I fell in with a kind which once was used for ladies' dresses, but it is now out of date, and this I find far away better than gut. I secured two sizes—viz., $\frac{3}{16}$in. and $\frac{1}{8}$in. diameter. I keep three or four bands, spliced with thread, loose on the drum of overhead, these of various lengths to suit the different cutting frames, &c., and those not in use I throw back over the frame which supports overhead, out of the way.

The advantages of the cotton are two—viz., smoothness of motion, there being no hook-and-eye, and, second, a fine easy grip, which is caused by the elasticity of the material. I have also used a thicker cording for driving the lathe; this I get in the ironmongers, and it is used for the rather unsavoury purpose of lowering coffins into the grave. With this a nice silent drive is obtained without any click.

I wonder if someone would take the trouble to give any hints on the sharpening and setting of drills, &c., for ornamental work. This I, and I am sure others do too, find to be most difficult, even with a goniostat. How many holes may be drilled without sharpening the drill, given that the holes be rather less than $\frac{1}{8}$in. deep, and the drill in perfect order to begin with; material, say ivory, or blackwood? Others will appreciate a reply besides

Phedrick.

## SPEECH OF LOWER ANIMALS.

[31885.]—MANY people, I believe, cannot hear the shrill sound made by the bat, and I have known people deaf to the noise of the cicada; so there may be some slight foundation for the remarks in letter 31868, page 335; but what then? Supposing the *rate* of vibration were reduced, the sound would not be the same, any more than the sound of a flute is that of a fife. Moreover, I question whether the means suggested would have the effect supposed.

If the phonograph cylinder is run at a different speed in "reading off" to that in "recording," we merely get the tune played faster or slower, as the case may be. We do not get the *octaves* above or below the original notes, as S. B. Kincaid appears to think. It was, however, noticed many years ago by Mr. Masters, of Rye, that if the recording (and reading off) stylus was double-pointed, the result was to get the octave above the actual note. There would be no need of microphone or telephone, as the phonograph itself is sensitive to the most delicate sound-waves, even that of breathing.

I wonder who told "G. F." that phonograph cylinders were made of the ingredients he names. Edison, I have always understood, kept the matter a secret. The one I have certainly looks like wax tinted with some brown substance.

A. S. L.

## ACOUSTICS.

[31886.]—A QUESTION was asked the other week concerning the cause of the sound produced by the cracking of a whip. "Dubito" and S. Bottone replied, the one saying that it was due to the sudden return and consequent vibration of two divided columns of air; the other that it was due to compression and rarefaction. These gentlemen must pardon me if I say that these replies are not answers, and that I totally disagree with their conclusions. The first alleged cause—viz., the separation and consequent collision of the molecules of air can be produced only by an explosion, in which a quantity of highly-expanded gas is suddenly formed, and as suddenly condensed, such as occurs during the explosion of gunpowder, or coal-gas. The second explanation is not adequate: it is only another way of saying that a solid body moved through the air experiences resistance due to friction. Now, however rapidly you may move a whip through the air, it will not produce the explosive noise referred to, unless a peculiar motion be imparted, any more than will a stick or a sword, or any other body, and the resulting sound will be a species of whistle caused by *impact* on the molecules of air, in a precisely similar manner to the impact of a stick on a lamp-post. In cracking a whip the thong is caused to double upon itself, and is then suddenly straightened with great violence, which must cause considerable vibration in the thong itself, and also, of course, in the circumambient air. It is this sudden vibration which causes the sound. It is again a case of impact.

Sm.

## THE AURORA BOREALIS: ITS PHENOMENA EXPLAINED.

[31887.]—*Of Auroral Arches and Auroral Clouds.*—The phenomena known as Aurora Borealis has been a theme of admiration and mystery in all ages and to all nations; the strangeness of its appearance and the magnificence of its splendour, surpassing all other sublunar phenomena, not only have excited the wonder of the multitude, but aroused the most gigantic intellectual powers to the investigation of its cause. We meet with the names of Descartes, Halley, Dalton, Arago, Bravais, and De la Rue among its ardent investigators; but the cause and manner of its appearances are still mysterious to philosophers. Prof. A. Young, of Darmouth, says of it: "It is true we know but little as to the manner in which the auroral beams are formed and made luminous, only that in their origin they are what we call magnetic and electric to a great extent."

Prof. S. P. Thompson honestly admits: "The phenomena of the aurora are among the mysteries of science of which no explanation has yet been given." So we must understand that all the theories about the aurora are nothing but conjectures.

The regions at which the Aurora Borealis are most commonly seen are those about the latitude of the north magnetic pole—Finland, Lapland, Iceland, Greenland, &c.

Our atmosphere, in its lower regions, is a great insulator of electricity; but the rarefied spaces of the upper regions are found to be conductors of it, and these regions are said to be the home of the aurora.

In trying to account for the auroral lights and their behaviour in rarefied air, philosophers generally have reference to the action of an electric current in the vacuum tube of a Ruhmkorff's machine, which, indeed, is the right place to get it, if it were understood. What is called the vacuum tube is a tube of clear glass; each end of it is closed by a brass cap, through each of which a silver rod is introduced into the tube, the inside end of each is terminated by a ball, and fixed not far apart. The tube now is placed in connection with an air-pump, so that the air in it can be rarefied at pleasure. Now the two balls must be placed in communication with the poles of the induction coil of the machine. The tube at first is full of common air, and nothing uncommon can be seen; but let the pump be worked, and as the air in it is well exhausted, we see reddish-coloured light playing about the positive ball. As the tube is emptied, the light expands, and extends gradually down the axis of the tube, looking as a cone of reddish purple light whose vertex being at the pole of the tube, we see that the air, when rarefied, becomes a conductor of electricity.

The air is known to contain chiefly two gases, oxygen and nitrogen, not chemically combined; the nitrogen is much lighter than oxygen, and far more abundant at this exhaustion: most all of the oxygen is pumped out, but a good quantity of the nitrogen yet remains, the characteristic light of which is the purplish-red light seen in the tube.

Prof. Tyndall says that, under certain circumstances, the cone of light is composed of distinct luminous strata, separated from each other by dark intervals transverse to the direction of the discharge. What these special circumstances are, Prof. Tyndall doesn't tell us; but we have a clue from Prof. Guillemin in his "Forces of Nature," page 640. "If the air in the electric egg is rarified to a pressure of two or three millimètres, and if the interior balls are placed in communication with the poles of the Ruhmkorff coil, a magnificent luminous sheaf is seen of a beautiful red, starting from the positive ball, whilst the negative ball and rod are enveloped in a sheet of light of a bluish purple. If before rarefying the air, vapours of different substances are introduced—for example, that of alcohol, phosphorus, or essence of turpentine—the luminous sheaf is interrupted transversely by very narrow dark bands, so that it is alternately formed of dark and bright striæ."

What then is the use of the vapour? The vapour is so to thicken and insulate the space as to give resistance to the electric current. The air is itself an insulator of electricity, but the air in the tube must be greatly rarefied before any light can appear; so to get light in the tube and the proper impediment to the current, we blow dry vapour into it. Now, when the positive current begins to excite light in the tube, this dormant vapour tends to prevent it from spreading out, so the light dams up at the pole; but as the current which produces the light comes pressing on the dam, the dam must finally give way, the pressure from behind will raise the barrier, and the ring of light will be seen ascending in the tube. The comparative low pressure now found at the pole allows another barrier to be formed, so another effort is required to sweep it off, and another ring is seen ascending in rear of the former with a dark space between them, whose width is proportional to the thickness of the vapour and the strength of the current, so the same operation will be continually repeated, till at length the tube is striated with rings from the pole to the equator.

As to vaporous clouds in the auroral region there are abundant evidences. Prof. Nordenskiöld says they are most always seen about the magnetic pole. He calls them the *auroral glory*. The first thing Prof. Tromholt mentions in describing the aurora is "a luminous cloud reaching across the sky in the region of the magnetic pole. Soon after tiny spots of intense light begin to appear in the luminous cloud; still the light is increasing in force, and in a few minutes a broad arc of light stretches over the north-western sky (across the direction of the magnetic pole), resting both its bases on the horizon, and whose highest point lies a few degrees above the horizon: upwards the light is gradually lost in the sky, downwards the intensity is greatest, and the lower edge stands sharply out. Thus the light is made on the same principle as that in the vacuum tube, by the accumulation of electricity about the pole in rarefied air, for electricity always accumulates in the clouds about the magnetic poles, as it does about the poles of the tube when the light breaks out. Prof. Lemstrom proved this experimentally in his expedition to Sodankyle. He says: "The north magnetic pole is surrounded by a belt, in which the terrestrial current and the magnetic variation are far more considerable than farther north and south."

Prof. Crookes tells us that when an electric current is brought to a magnetic pole, it will rotate about the pole; the direction of rotation depends on the pole of the magnet, whether positive or negative. In the northern hemisphere it revolves from west to east—the way the tornadoes go—as the northern magnetic pole of the earth is the negative, and when an electric current revolves in any direction the stream of light excited by it will revolve in the same way.

Prof. Tyndall says: "A luminous discharge is, to all intents and purposes, an electric current, and is acted on by a magnet as a wire carrying a current." When a luminous discharge rotates about a magnetic pole, it will contract a centrifugal force, and ascend from the pole towards the equator, and encountering the vaporous clouds referred to, the discharge will divide into luminous and dark bands alternately, as the striæ appear in the vacuum tube. Prof. Tremholt, in his article "Under the Rays of the Aurora," says: "Following the arc attentively, it will be seen to rise gradually, its point of culmination travels upwards, and the distance between the two bases becomes greater and greater." This shows that the auroral arches continually expand, and must be formed around the magnetic pole and rise, while others follow either visible or invisible.

In describing the breaking up of the aurora, Prof. Tromholt again says: "The forces are now exhausted, the lovely picture grows more and more obscure, and the forms are dissolved into a large, soft cloud of light, covering nearly the entire northern half of the heavens." So we see that the auroral space at the formation of the arcs is in about the same condition as the vacuum tube is when vapours of different substances are blown into it.

*Of the Auroral Streamers and Crowns.*—I shall here make reference chiefly to the light seen at the negative pole of the vacuum tube. Scientists have long ago perceived a difference in the light and action of the current at the two poles of the induction coil; for though the two balls are in the same rarefied air, yet the lights at them are not of the same shape and colour. The bluish purple light about the negative pole and rod is the phosphorescent light of the air at that rarefaction; there are no luminous bands seen about the negative pole of the tube. Prof. Guillemin shows that the tension of the inverse current is not sufficiently strong to allow it to traverse the air. The negative pole of the tube is the one that represents the terrestrial magnetic pole in our northern hemisphere, but the auroral clouds about our pole are often sufficiently thick and the electricity condenses to show us the auroral arcs. This bluish purple light about the negative rod is not the colour of the *arches* of the negative hemisphere: its position is at right angles to the axis of the tube and rod.

Electric currents flow about the pole in the isoclinal magnetic lines: another electric current cannot flow from the direction of the pole at right angles to these; the latter is consequently in the capacity of a *magnetic* fluid, which is always found flowing at right angles to the electric current. Plucker found that when the light about the negative pole is brought near a magnet, it will range itself along the lines of force of the magnet; but the red light about the positive pole of the tube cannot do this, so they are not both of the same nature. If Plucker were to understand the true nature of the light about the negative pole, he

more wonder about it than that iron
e themselves in the direction of the

decided that the light of the auroral
st be magnetic light, as the streamers
s of force of the great magnet, the
dipping needle is in the compass. Dr.
ght, but could not explain it. Prof.
not then born, so Halley could not
at magnetism can excite no light but
nt light, and that in phosphorescent
d in very much rarefied air.
of the current about the negative pole
n tube, Dr. Crookes performed many
riments. He excited many phos-
bstances to glow, such as the residual
tube, and by a farther exhaustion
he drew the current across it, and
ass of the outside wall to phosphoresce
uranium and other glasses. Prof.
d this fluid radiant matter.
s of the phosphorescent lights of gases
d on the colours of their characteristic
out on the density or degree of the rare-
e gas, Dr. Crookes found that under
egree of rarefaction, the phosphores-
the air is the green. Under the next
ity it is blue, then indigo; lastly comes
blue or violet, and this has been
ore than a century. (See *Philos.*
) Dr. Crookes says of the green,
ight, that there is no difference in its
hether the residual gas be nitrogen,
carbonic acid, this green line is the
is the same as the famous green line
m of the solar corona, called 1474. It
d in the spectrum of the auroral
Now that all the colours of the rain-
layed in the auroral streamers becomes
s, as the air above is not of one degree
, as the case is in the tube, but of all

*nation of the Auroral Bands.*—Prof.
served the auroral bands forming in
, which stretch across the earth in the
the magnetic east and west. The
netic lines—which zones are generally
nglomeration of thin sheets of lumin-
nged one behind the other, their direc-
rallel with the inclination needle—the
ter in them is either even, diffuse, or
hort streamers. If the electric current
he band is even, with no streamers,
rent colours; if agitated by a storm,
wells, expands, and divides into

were even, quiet, and of one or two
ould have no objection to call it a
ric band; but as soon as it agitates,
d rolls out rays and streamers, having
f the spectral colours, I say it is a
d, and its light a phosphorescent light.
rrent, by being sent through rarefied
ring out light of no colour but the
colours of the gases, and there are
at region of such variety as to evolve
the spectral colours, so the colours in
are those of phosphorescent lights.

*nation of Auroral Streamers.*—If the
m is violent, the band is thoroughly
e short streamers will flare up and
long ones. They attract each other
and as the band expands, its con-
en broken up—it all dissolves into
t its place can still be traced, as the
ays have their bases in a row along
e former band. Sometimes the storm
en and furious that a band has no
n: then the streamers are more mag-
heir colours more vivid, but follow
nes.

*ral Crown.*—Dalton showed that the
n aurora are all parallel to each other,
ntly perpendicular to the arches or
eeming meeting at high altitude is the
ective; it is due to the vast distance
the eye. This is the forming of the
, which is nothing but bunches of
ng from all parts of the arc, and
eting in the zenith, looking like a large
ad, in which the colours are seen the
. "Here," says Bravais, "all the
lours of the rainbow contribute to
vault. Here is the tender green of
he grand purple of the ruby, and the
of the sapphire, all blended together in
ades." I now ask, Can all these be
electric current traversing the highly-
en gas of that region? No; there can
but phosphorescent lights. So Prof.
—"they are electric *and magnetic* to a

h, U.S.A. **Thomas Job.**

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## SED GAS AS A MOTIVE POWER.

R friends the electricians do not
very great progress in the evolution
of self-contained motors, and the happy day when ordinary road traffic, as well as that on railways and tramways, shall be conducted by other than animal power seems as far distant as ever. I should like to know, as a matter of curiosity, whether *compressed gas* has ever been tried in this connection? We have a variety of excellent and compact gas-engines; but then these are all tied by the leg, so to speak, to the gas-pipe, and are not available for locomotion. The question is, Could we accommodate a sufficient supply of compressed gas on board our car to carry us a reasonable distance without refilling? **Ox. Hyd.**

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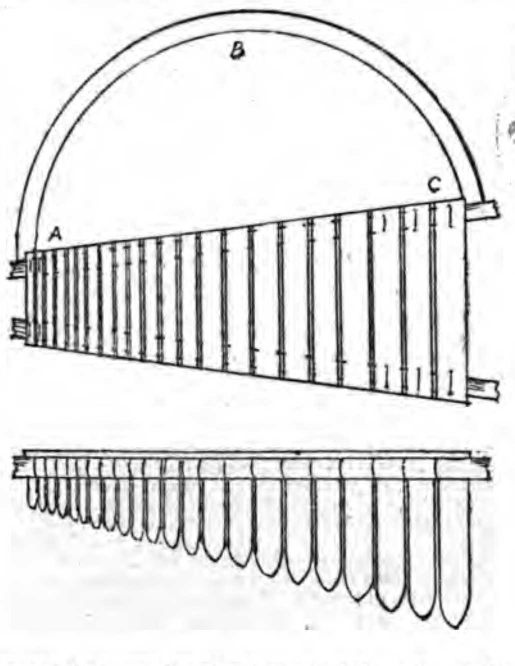
## THE MERIMBA.



[31889.]—There has been lent to the Keith Field Club, for temporary exhibition in their museum in the Keith Institute, an interesting specimen of the musical instrument called the Merimba, which is made by the Caribs of Honduras, and chiefly used for dance music. In its main features it resembles the German straw fiddle, being composed of 23 flat bars, or rods, of wood, which are laid on two hollow wooden tubes surrounded by long straws, or fibres, to a thickness of ½in., and are tied at their nodal lines to these cylinders. The bar yielding the highest note is 9¼in. long, and 1¼in. broad, and that yielding the lowest is 1ft. 5¼in. long, 1⅝in. broad. They are tuned by means of pieces of wax stuck to them underneath at each end. In this respect the merimba resembles the harmonicons which were exhibited by the King of Siam's Court band at the London Inventions Exhibition of 1885. The Siamese minister allowed the late Mr. A. J. Ellis and Mr. Hipkins to determine the musical scale, and told them that the intention was to divide the octave into seven equal intervals. The Merimba also is tuned by octaves, but the European scale has been adopted. The centre note is nearly C, but the wax has fallen from many of the bars, so that the instrument at present is entirely out of tune. The accompanying sketches will give an idea of the form of the Merimba.

The bent bough A, B, C is laid on the seat to be occupied by the performer, who steps inside the semicircle and sits down on this bough, thus keeping the instrument firmly in its place. He plays with two small mallets ending in balls, formed of concentric layers of hard indiarubber, one of the mallets being held in each hand.

The wooden rods yield overtones that are inharmonic to their fundamental notes, and would consequently produce a jarring discord. The most characteristic feature of the merimba is the manner in which this is overcome. Under each tube is a hollow cylinder of the length suited to reinforce the fundamental note of that rod, while the strength of its overtones is not thereby increased. The result is that the fundamental tone becomes so much louder than the overtones that it quenches the sounds produced by them just as the strong light of the sun quenches that of the stars. Their disturbing effect is therefore no longer apparent, and the resulting sound is smooth and harmonious, instead of being harsh and discordant. Those not familiar with the principle of resonance, by which the strengthening of the fundamental note is produced, may obtain an idea of it by referring to the article quoted in our issue of 31st October last, p. 202, and headed, "An Experiment in Resonance."

Near the lower end of each of the resonators is a circular hole of ¼in. in diameter covered with a membrane of pig's bladder. Several of these membranes have been torn on the voyage home, and in consequence the resonators where this has happened are not suited to reinforce the fundamental note. In these cases the notes produced by striking the corresponding rods are rough and inharmonious, and well illustrate the influence of the resonators when complete.

Can any of our readers explain the advantage of piercing these holes and covering them by a membrane? Is there any reason why this should yield a better result than if unpierced hollow cylinders were used. **E. Thorburn.**

Town and County Bank Buildings, Keith, N.B.

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## VACUUM TUBE WITH MULTIPLYING PLANE.

[31890.]—I would suggest that those who possess a coil capable of lighting up several tubes simultaneously should try the effect of three in the arrangement described by Mr. Brocklehurst (letter 31869).

On making a similar apparatus some time ago with a larger box, I fixed the reflecting glasses in position by small pieces of wood at top and bottom, instead of cutting grooves, the whole interior having been well painted with Brunswick black, mixed with a little charcoal to take off the gloss. The three 8in. tubes were attached to hooks screwed into small circular pieces of hard wood, which were fixed to the box with the insulating compound known as Chatterton's. One tube was placed in the apex of the triangle, the other two opposite, the glasses all being equidistant. The current entered at the top of the left-hand one, flowed down that, thence across by a wire to the bottom of the apex one, up that, out through the box, entering it again over the remaining tube, and down this tube to the wire connected to the other terminal of the coil. The effect in a dark room was splendid, as the tubes were of different colours. The connecting wires must all be carefully insulated, or leakage will spoil the effect. Putting the whole arrangement in a large blackened box having an end hole to look through, is still more effective to a single spectator.

**B. Harcourt.**

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## ETHER.

[31891.]—I propose in this letter to deal with two of the objections raised by "Sigma" against the ether theory of electricity.

The first objection is that the directive action of a closed conducting circuit is necessary to enable the ether to transmit energy in the form of an electric current. "If electricity and light are the same thing, why," it is asked, "must the ether have a sink or waste-pipe to enable it to transmit electric energy?" The obvious answer is, that in both cases, if there is no dissipation of energy, there can be no transmission. If we examine the facts a little more closely, we shall find that the conditions for the transmission of radiant energy and of electric energy are not, after all, so very different. Let us suppose that a red-hot ball is suspended in the interior of a hollow sphere composed of some absolutely opaque (and, consequently, perfectly reflecting substance). Under such circumstances the hollow spherical envelope will absorb no heat, and consequently the red-hot ball in the interior will lose none. The action here is analogous to that of a battery on open circuit. In neither case is there any outlet for the pent-up energy, and in neither case is any lost. Now, suppose we make a small hole in our opaque envelope; there will then be a way of escape for the heat of hot ball inside, and it will therefore begin to cool. In the same way, if we join the poles of a battery by a fine wire, a way of escape for the chemical energy of the battery is provided, and this energy begins to be transformed into heat in the wire and other parts of the circuit. It is the phenomena accompanying this transformation that constitute collectively a current of electricity. Again, a large hole in a hypothetical opaque envelope will allow more heat to be dissipated than a small hole. In the same manner, a thick wire joining the poles of a battery allows of a more rapid dissipation of its energy than a fine wire. We may pursue the analogy a step further. The energy of a red-hot ball surrounded by an opaque envelope consists of two distinct parts—one is the heat contained by the ball itself; the other is the radiant energy contained by the ether in the space between the red-hot ball and the opaque envelope. The energy in a battery on open circuit likewise consists of two parts: one is the energy of chemical affinity in the battery itself, the other is the energy of the electrostatic charge on the wires attached to the poles. The latter portion of the charge is, on the ether theory, contained by the ether in the neighbourhood of the battery.

The second objection is that insulators ought always to be transparent; for the ether in an insulator must be elastic, and consequently capable of transmitting light. If, however, we examine the causes of the opacity of a body, we find no difficulty in reconciling the facts with the hypothesis in question. The light, or rather the radiant energy, that falls on any body is disposed of in three ways: A certain portion never enters the body, but is reflected at the first surface; an opaque body generally reflects more than a transparent one; and a body absolutely opaque would reflect the whole of the light that falls on it, none being either absorbed or transmitted. We should expect such a body to be a perfect conductor, and a body which exhibits this kind of opacity to a high degree to be a good conductor. Another portion of the light penetrates a short distance into the body, and is then scattered by reflection. Neither the reflected nor the scattered light has undergone any change by contact with the body. The remainder of the light that falls on it is absorbed, provided there is a sufficient thickness of the substance to do so. If a very thin lamina of the substance is sufficient to absorb all the light that passes the first surface, opacity is the result. But it is obvious that opacity produced by absorption in the interior of a body is a phenomenon quite distinct from opacity produced by reflection from its front surface. Bodies are opaque, translucent, or transparent, according to the rate at which absorption takes place. It is important to notice that absorption is selective—i.e., it varies in amount for rays of different wave-lengths. This is almost invariably the case in transparent media, and it is only reasonable to suppose that the same thing is true in the case of opaque substances. This fact points to the conclusion that the absorption of light is not due to any want of elasticity of the ether, but to the natural periods of vibration of the molecules of the medium synchronising with the etherial waves falling on them, which consequently absorb the energy of the former. It must be remembered that our knowledge of absorption of radiant energy is confined to a certain small range of wavelength, and that we are not justified in assuming that, because a substance rapidly absorbs luminous rays, it must also absorb rays of all possible wavelengths. These considerations go to show how an opaque body may, nevertheless, be a very good insulator.

I must postpone my remarks on "Sigma's" criticism of my last letter on this subject till another occasion. G. J. B.

## DARWIN'S "MISSING LINK": WHERE SHALL WE FIND IT?

[31892.]—IN studying Dr. Aveling's "Darwin Made Easy," I venture to say that an ordinary reader can only come to the same conclusion as I have myself; that is, that no link is wanting that would connect us with our allies—the Anthropoid apes.

In most every point of anatomy and physiology Dr. Aveling has shown a greater difference between man and man, ape and ape, than between man and ape. And yet we are to look for an immediate "tailed ancestor"—which, obviously enough, from its having a tail, would be less anthropomorphous than any of the now existing anthropoid apes—which threw off (to use the phrase) the lowest man on the one hand and the highest ape—the gorilla—on the other; a point in the chain of the "primates" where our relationship is most clearly shown.

If this be the case, we are to understand that the (so-called) missing tailed ancestor threw off an animal which has resulted in ten species, which now come under the heading "Homo," the history of which proves gradual evolution at every turn till we reach the "highest," of the group, and which Darwinians tell us will still go on progressing upwards and onwards; that this same tailed ancestor also threw off an animal which resulted in (to use the phrase for convenience sake) four species, which now come under the heading "Anthropomorpha," the history of which proves gradual "devolution" at every turn till we reach the "lowest" of that group, and which I see no reason to hesitate in saying will still go on deteriorating lower and downwards. Where will these two extreme laws lead us?

For there to be *wanting a common origin* for both man and gorilla, a greater dissimilarity should exist between these two genera, in my opinion, than really does. Two instances at least have some bearing on this theory. First, the wombat and kangaroo of Australia are greatly dissimilar; yet the pouched lion, which has been proved as being the common origin of both genera, has the characteristics of both. Secondly, the great external, if not internal, dissimilarity of our modern dogs and bears is obvious to every observer; yet the common origin of these has been found in the (so-called) Amphyicon of Miocene times, which has now been proved as being quite as much a dog as a bear. But when, however, Prof. Huxley traced the genealogy of the horse, he found every requisite gradation in hoofs, teeth, and size of animals until he reached a clawed ancestor. Here the professor stayed for further researches. As with this last case, so it appears with the case at issue. Dr. Aveling has shown very interesting gradations from civilised man down to the lowest of the man-formed apes—the gibbon, and even to the dog-formed apes—the baboon. The erect posture of civilised man—a so-called special prerogative, his hair covering, height, teeth, blood-vessels, periodical menstruation in the female primates, &c., as shown by Dr. Aveling, shows such remarkable and interesting gradations right through the four genera of anthropoid apes—the gorilla, chimpanzee, orang, and gibbon to the dog-like ape—the baboon, as to infer the gradual evolution of man from that direction. And when Dr. Aveling compares the modes of dwelling, and shows that the gorilla builds huts, which is exactly the same mode as some of the lower human races—in fact, which is a step in advance of some of the human races who have not even that temporary shelter; and when he points to the absence of dress, of tools, of fires among some of the lower human races, the evolution of man up the path that leads from the dog-like apes and runs right through the anthropoid race seems the more confirmed. Nor must we forget the dog-like appearance of the human embryo in its earliest stage of development.

What strikes us most here is that man and the man-like apes have no tails; and it is here for the first time that we meet with the tailed apes in a group immediately below the Anthropomorphous group, known as the Cynomorphous or dog-like ape—the baboon. Yet the more amazing fact is that even in this latter group there is a species of baboon (Innus) without a tail.

It is, then, in my opinion, in that direction that we should look for a connecting link—that is to say, a species of ape with half a tail, or to speak more accurately, a very short tail that would connect the tailed and the non-tailed; for, in my opinion, the sudden dropping of tails by man and the gorilla, which must have taken place if the immediate ancestor of us and the gorilla had a tail, is a greater leap in evolution than the imaginary leap from gorilla to man.

A consideration of the foregoing remarks may account for the non-discovery of the long-sought-for missing link of Darwin.

**Thomas Shonfeld.**

316, East-street, Walworth, Nov. 18th.

THAT most grievous of our minor ills, according to a newspaper, is the toothache, which, it says, may be sometimes cured, and usually alleviated, by a weak galvanic current generated by placing a silver coin on one side of the mouth and a piece of zinc on the other. To increase the effect, rinsing the mouth with acidulated water will be found efficacious. Some people prefer the toothache.

**Cremation and Mummifying.**—A new process of cremation and mummifying has been proposed by Doctors Variot and Cartaz. It is well known that the most delicate tissues, grasses, leaves, and skins can be plated with copper or other metals by electrolysis. At the Paris Electrical Exhibition of 1881, a beautiful variety of objects thus metallised were shown; and at that date an English writer suggested, half-humorously, that the process might in the future be employed for preserving the lineaments of the dead while inclosing their remains, by way of a modern improvement on the ancient Egyptian mummy. The Frenchmen seem to have taken this idea *au sérieux*, and as an experiment have actually plated a dead child. The result is a perfectly faithful statue of the subject, truer to the life than any statuary could hope to achieve. The metallic shell is strong enough to withstand shocks.

# REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[72678.]—**Pellets.** — When in remote parts of India, I have made a large supply of shot in all sizes by uniting the forces of compression and friction in the following simple manner. Having obtained sheet-lead of the requisite thickness, I made a cutter of several blades set parallel in a metal holder, with which I produced a large quantity of cubes. Putting a handful of these into a big frying-pan, I took any heavy, flat-bottomed, smooth utensil of brass (frequently my washerman's box-iron, which is used with red-hot charcoal), and filling this with bullets to give additional weight, I revolved it rapidly, with pressure, on the bits of lead, which soon assumed a spherical form. When this operation was completed, I shook up a lot of the shot, with a rotary motion, in a cylindrical tin canister. Then I cleansed the ammunition by immersing it in hot soap and water, scrubbed it with wet sand, and dried my shot in the sun. I killed great numbers of wild fowl, geese, cranes, and pelicans from my manufactory. To shorten my operations, I got a skilful native artisan to construct two or three brass moulds, each in two sizes of shot, back to back, turning out 10 to 15 pellets at each cast. The necks of the balls were rapidly cut off in line with an old pair of sharp scissors, and the balls rendered quite smooth in the above primitive fashion. Thus I obtained an unlimited supply of projectiles in all sizes, from about BB upwards. Eos.

[72685.] —**Yew.** —What does "Jack of All Trades" mean when he says "he never saw any sound yew"? Yew is one of the hardest and most durable of woods, and, as "Nun. Dor." quotes, is capable of taking a fine polish. I inclose a small piece of a board which has been cut for 40 years or more. J. A.

[That sent is sound enough!—ED.]

[72685.]—**Yew.**—Some 50 odd years ago I was engaged upon an estate that a gentleman had just come into possession of, and there was a quantity of yews upon it; but they had been sapped and so disfigured that they were an eyesore. It was determined to remove them, and as a portion of it was an old farm, it was in a very dilapidated state; it was to be a thorough clear-out. There were several large gates about, and the posts of these were yew; these gates were removed, and the posts were taken up and replaced by oak. My master having to clear off, these were conveyed with the fresh fallen trees to his yard, and he thought them a prize. The posts had evidently been in for years, but they were as sound as those that had just been felled. This plant of yews got wind somehow, and we had a quantity of Jew dealers down upon them; but he would not part with them, as his son had a fancy for cabinet-work, and had made up his mind to have them cut into veneers, thinking, as they were such a beautiful colour, that they were a great acquisition; so after a time they were forwarded to be cut up (in the mean time the Jews would not let the matter rest). The affair was found to be a failure, for there was no such a thing as getting a veneer out of them fit for working, as they were so defective. At last one of the Jews bought them, but for what purpose I don't know; but I believe that they were purchased for small inlaying work—something after the ornamental Tunbridge ware, which is built up to patterns in the block of various woods and cut off to patterns for inlaying. I have not seen it used anywhere else. My father, in his youthful days, travelled with Tunbridge ware, and we used to have some good specimens. The only specimen of Tunbridge ware I am possessed of now is a white oak walking-stick of my father's, the which he prized, turned to imitate bamboo. I have seen yew in Kent, Sussex, and Wiltshire, and recently close home, but it was all alike. My master had two vases turned out of a piece of the soundest, but they fell all to pieces. If it had been burr, it could have been worked. Those I saw felled lately the roots were the best parts, and bole; but they were not even considered worth the carriage for fuel, so was thrown into an excavation that was made to get gravel, and there they lay buried. I have heard others older than I say the same thing as their experience. There are some good old yews at Liddiard-Tragoz, Wiltshire, on the Bolingbrook estate, if I remember right; but you have only to examine them to know what they are, if you have any knowledge of timber. In my youthful days I had read and heard much about the English archers and their good yew bows, and the height of my ambition was to have one, as I was no mean hand at bow or sling, and several times I was likely to have got into serious trouble through getting into plantations and selecting my own timber for the purpose of making one. But no matter how I selected or treated it, it was a failure: I baked it, charred it, put it up the chimney, oiled it, hat I would, I might as well have tried to de one out of lead; and it has always ystery how they treated yew to make a .

JACK OF ALL TRADES.

]—**Bleaching Fish-oil.**—I think this nay obtain some information from Alex. ook on "Soap-making." The chloride of dded in the proportion of 1 per cent. with nt. of oil of vitriol diluted with 20 times its of water. The oil is heated gently, the "cream" added first, and then the cid, stirring well until the desired effect is . Steam is then blown in, and the oil o rest and settle for some hours. Some-nic acid is used previously to the above t. Bichromate of potash is also employed, by sulphuric acid, and, after washing with nitric acid; but the preliminary treatment in the use of a caustic soda ley first, fol- a sulphuric acid solution. In every case ssary to allow time for the settlement of ire. Some information might be found in s's "Chemical Technology" (Baillière), eland's "Soap-maker's Private Manual" it costs £10.

NUN. DOR.

]—**Pampas Grass.**—If "G. C. C." ynerium argenteum, merely dry the plumes ng up. Pampas grass does not grow well ls nor in all situations. Perhaps the flowers on were those of the male plant.

NUN. DOR.

.]—**L. and N.W. Co.'s Foot-rs.**—The foot-warmers referred to are not to the L. and N.W. Railway. They con-ate of soda, which becomes liquid when and gives out the heat previously absorbed lt returns to the solid state. I am quite by "shaking" for a few minutes they ecome "hot again," but they will if the f soda is rendered liquid by the "warmers" erted in a bath of hot water. The simple e salt absorbs the heat from the hot water it out as it cools or solidifies. Full ex- in back volumes.

NUN. DOR.

]—**Gong.**—Whether it is a steel tube or a it will make an effective gong, especially ed on a resonant box. Don't see what use angle" can have to do with it. The of the bar cannot matter much, provided ner is of sufficient weight; and as to the nts, why not try a few bars of different The gongs in some American clocks are ugh for their size, and they are not struck vy blows. Steel, if spring temper, would, give most sound, other things being equal.

NUN. DOR.

]—**Seaside Plants.**—Cannot "Old ake notes of the plants he sees doing well? e true that some plants thrive better in exposed to sea-spray than others, but st be very few that are really injured by Any plant which has "maritima" as its ame will flourish, and such evergreens as nd Euonymus, elm-trees, and many others, e generally found in a Pinetum, do very l as for a border-edging or a grass-like thing can surpass the common thrift. The d kale will flourish. Much more depends il than on the absence of salt in the air.

NUN. DOR.

]—**Waterproofing Vellum.**—I should t soaking in melted paraffin wax would desired effect; but if the vellum is a tympan, it might be varnished with, say, al. In some of the "English Mechanic" s the vellum diaphragm is specially pre- think by means of a solution of hydro-cid. It is a question for experiment by know what they want to do.

NUN. DOR.

]—**Canal Boat.**—"F. M." and "Calde-re both so perfectly correct that one can first sight understand how the bargee e counselled otherwise; but as he belongs of men not, as a rule, addicted to joking ed for an opinion, and accustomed more-t, not upon theory, but upon experimental e, it would, I think, have been worth amining into the reason for his advice, ting it aside too easily. Of course the wrong if, as "F. M." supposes, it is run along the deck of the canal boat; osing that it is not possible, and that any ice from one boat to another must be at a jump, what then? Evidently the bargee, knowledge either of the build or manner a canal boat, had this in his mind—at licitly,—and so his case stands thus: A three miles an hour, and B ditto, but in ite direction, is precisely the same as A, t six miles an hour, and B stationary. alighting from a train in motion, in which do we ordinarily turn our face? Surely ection of the motion, but with an incli-the body backwards, so as to counteract the retarding action of the platform on the feet. This, in practice, everyone knows and acts upon; we should so act if our train were going at three miles an hour, and so likewise if it were going at six miles an hour; or, to return to our former supposition, we should so act if our train or our canal boat were going at three miles an hour in one direction, and our platform, or another canal boat, were going at three miles an hour in the opposite direction. I hope from this it will be clear that the bargee knew what he was talking about, remembering, too, that by following his advice, if there is to be any fall, we have the advantage of a forward one, instead of a backward one, to which "F. M." and "Caldemone" expose themselves.

S. J.

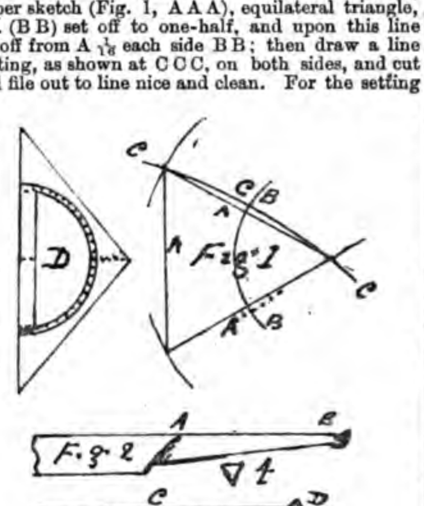
[72953.]—**Boring Taper Holes.**—If your headstock will shift round, set it round to the taper required, and work by the slide; if not, you will have to set your slide-rest round to the angle, and work out by hand, unless you put a large wood wheel upon your rest screw, and work off your counter-shaft—i.e., if your job is driven by steam power. Do not attempt the job with a taper D bit, unless you want one of the three following things to occur: your teeth knocked down your throat, a broken jaw, or your eyes knocked out of your head.

JACK OF ABL TRADES.

[72955.]—**Telephones and Microphones.**—When a battery is used in conjunction with a telephone, it is better, for the sake of the magnet, that the current be sent in such a direction that the flow of the current should strengthen rather than weaken the magnet. Unless the screw pillars of the telephones are marked, it will be necessary to examine the direction in which the bobbins are wound, and to verify which pole is nearer the diaphragm. This is generally north-seeking. Unless, however, very heavy currents are used, and this is not usual where coils are inserted, the effect of reverse current is not very injurious, and the magnet recovers any little loss of power by hanging downwards from its hook.

S. BOTTONE.

[72956.]—**Turning True Cylinders in Steel.**—Now the question is, whether your lathe is true; for there is not one in a hundred that is, or I might be nearer the mark if I say one in five hundred. Spindles of all running machinery should be finished upon dead centres; some milling machines, lathes, &c., are enough to give anybody the hump to see running. For a barrel centre get a piece of thin saw-plate and make a centre gauge, as per sketch (Fig. 1, A A A), equilateral triangle, 1in. (B B) set off to one-half, and upon this line set off from A $\frac{1}{16}$ each side B B; then draw a line cutting, as shown at C C C, on both sides, and cut and file out to line nice and clean. For the setting your rest round for the cone, you should have an angle-gauge, as shown at Fig. 1. The best tools for boring are shown at Figs. 2 and 3, Fig. 4 showing the section; they are made of square steel to suit the rest, and drawn out, as shown, triangular (A, Fig. 2), top face level at B; a fuller is put in to form the cutting edge D, Fig. 3, and the front edge of tool is straight with stock; the other is taper, as shown. This is the strongest section for a tool for the purpose, and should be worked right off and hardened right out. I have made and used these tools for boring taper holes from ¼ to ⅛, 3in. deep; no trouble. Drive by two studs, with leather packing between.



JACK OF ALL TRADES.

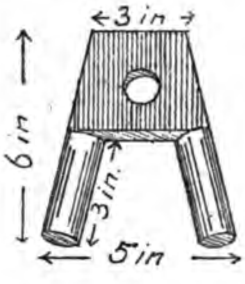
[72960.]—**Equation.**—Your querist "Q." will never get any satisfactory result from the data upon which he is working, because if A be the right weight of the mixed chlorides, B must be greater than the figure he gives. The value given is impossible; this has, perhaps, caused the remarkable answers of those who have endeavoured to work out the equation. Upon sound data, I shall be happy to furnish him with a correct solution of the problem.

Analytical Chemist. CHARLES E. SOHN.

[72960.]—**Equation.**—The mistake is not mine, but "Q.'s." If he will follow me, I will endeavour to convince him that he has made a mistake in his weighings. Assume, for the moment, that the "mixture" consists wholly of KCl. Then 2·177 of KCl will yield $\frac{2·177 \times 173·9}{2 \times 74·41}$ of $K_2SO_4$ = 2·544. Now assume that our "mixture" is all NaCl; 2·177 of NaCl will yield $\frac{2·177 \times 141·8}{2 \times 58·36}$ of $Na_2SO_4$ = 2·644. If now KCl and NaCl are mixed, the quantity of $K_2SO_4$ and $Na_2SO_4$ yielded must come between the numbers 2·544 and 2·644. "Q.'s" number is 2·43. He has lost during the experiment.

Assoc. N.S.S.

[72970.]—**Magic-Lantern Screen.**—Get ten hair-broom handles 4ft. long. Make nine tubes 6in. long of stout tin, of such a size as to fit tightly over the ends of the rods. Now cut out two pieces of wood of size and shape shown in figure.



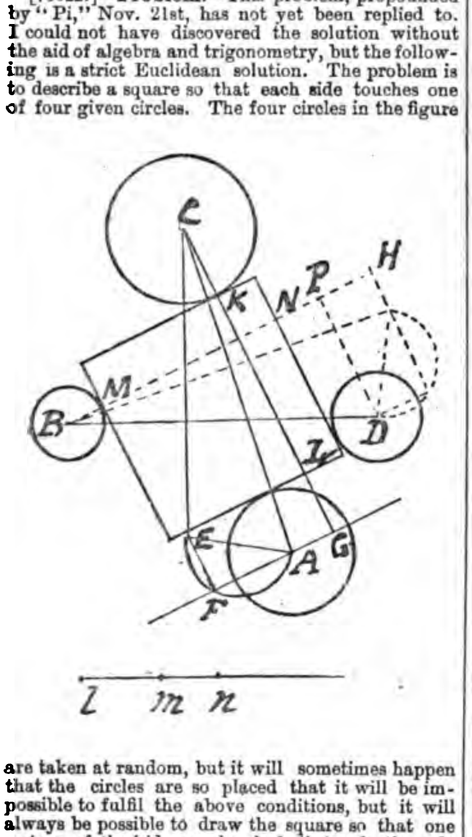
The two round projections are each 3in. long, and of the same diameter as the rods. The holes are bored large enough to take the ends of the rods tightly. Take nine of the rods, and push a tube half-way on to each, driving in a couple of tacks to keep them firm. Now take one of these rods, also that one which has no tube, join them like a fishing-rod, and push the ends into the holes in the two blocks. You will now have eight rods left, which are to be joined in sets of two, making four rods 8ft. long, with a tube on one end. Push the projections in the two wooden blocks into these tubes, the whole forming a four-legged stand with a cross-bar, on which the screen is slipped like a lath in a blind. Get two pieces of ¼in. iron rod, slightly longer than the distance between the ends of each pair of legs when the screen is set up, and bore a ¼in. hole in each leg about 3in. from the ground, and running parallel to the cross-bar. Bend up 1½in. of the ends of each piece of rod to a right angle, and insert the ends in the holes of each pair of legs. The screen will then be complete. Firm, simple, cheap.

CALDEMONE.

[72977.]—**Pulvermacher Chain Band or Batteries.**—These chains are made in three forms. The first, in point of date, is constructed thus:—Cut a few pencils of soft wood into inch lengths; bore longitudinally a pair of holes into each to receive two copper wires, about No. 20. Let these wires project ⅜in. at each end; bend these projections into little loops. Round these wood pencils you now wind, side by side, a No. 28 zinc and a very thinly-covered copper wire; they will make about ten turns. The zinc ends are hooked into and soldered to the loops of one of core wires, and the copper ends to the loops of the other wire. This finishes one link of the chain. Make likewise as many more links as required, and connect them altogether by soldering the zinc ends of one link into the copper loops of the next. The core-wire loops, to which the copper spiral is soldered, I call, for brevity's sake, the copper loops. To the zinc loop at one end of the chain is now hung a little stirrup of zinc or silver, to the copper loop at the other end a gilt-brass stirrup, and this will be the positive pole, whilst the silver stirrup is the negative. To these stirrups the handles or electrodes are attached. The larger chains contain each about 60 links, and give each a current of 60 volts. An apparatus consists generally of two chains, an interrupter, a voltmeter, a pair of electrodes, or ordinary sponge-holders. The voltmeter consists of a bit of glass tube 1½in. by ⅜in., and with brass caps at each end. These caps end *outside* in little eyelets to receive the stirrups of the chain, and *inside* in bits of platinum wire dipping in acidulated water. From the rapidity and number of oxygen and hydrogen bubbles that rise from these platinum points when connected with the wetted chain, you roughly estimate the amount of current flowing. The interrupter is likewise formed of a bit of glass tube, with caps at each end. To one cap is soldered a tiny brass spiral spring, with a little button. The slightest shaking of the chains will cause this button to strike against the sides of the other cap. Each knock makes and breaks the circuit, and when the chains have been dipped in a weak solution of water and vinegar, and joined by this interrupter, the sparks are very smart indeed, as was to be expected from 120 volts tension. The latest improved chain batteries are constructed in a much simpler way, thus—Cut up a strip of gilt, hard-rolled, $\frac{1}{32}$ thick copper into pieces about 1in. square. For about ⅝ these pieces are wider, or have projecting ears. The narrow portion has eight or more cuts made in them, as wide as the copper is thick; then it is rolled into quarter in its cylinders. The wide portion has a slot, ⅛in. wide, cut in it, after the pattern of a buckle, and remains straight. A zinc tube, with ⅛ bore, is cut up into inch pieces; each end has a couple of turns of cotton or silk thread wound round it, to isolate it from the copper cylinder, into which it is inserted to complete the link. These copper and zinc pieces, with their cuts and slots, are all stamped out and rolled up by a machine; the cylinder of the second link hangs in the slot of the first link, and the ends of them are fitted with buckles like the first form of chain. The third form, or wire belts, are equally ingenious and simple, and are made in various sizes, like the other forms. Imagine two thin strings stretched parallel, ½in. apart, with a wooden slide between them to keep them at that distance until wire is wound round them, to be removed. Round this string frame are wound flat, a No. 20 zinc, a sparely cotton-covered and gilt 24 copper wire side by side. After every 10 or 12 turns these wires are cut and alternated, the zinc end being soldered to the copper wire of the next element, and the copper to the next zinc, and so on until a sufficient number of copper-zinc elements are obtained; then the ends of the belt are covered with thin silver and gilt copper-plated rings with eyelets; the zinc wire soldered to the silver, and the finishing copper to the gilt copper ring to form poles of the belt, and the same appliances as in the other forms added. A. Caplatzi.

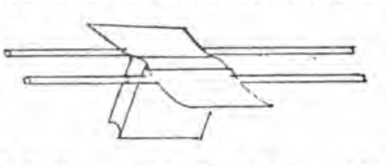
[73012.]—**Errata.**—Please read in answer to this query, p. 318, Dec. 5, "damp sharps—and an ordinary large comb," &c. "Sharps" is in some parts of England the name that "middlings" go by. You will see that the information has got mixed. Jack of All Trades

[73022.]—**Problem.**—This problem, propounded by "Pi," Nov. 21st, has not yet been replied to. I could not have discovered the solution without the aid of algebra and trigonometry, but the following is a strict Euclidean solution. The problem is to describe a square so that each side touches one of four given circles. The four circles in the figure are taken at random, but it will sometimes happen that the circles are so placed that it will be impossible to fulfil the above conditions, but it will always be possible to draw the square so that one or two of the sides *produced* shall touch the adjoining circles, the other sides touching the adjoining circles without being produced. In the figure, join the centres A C and B D. Draw C E at right angles to B D and make C E = B D, join A E, and on A E describe a semicircle; now call the radius of the circle whose centre is A, $a$; and the other radii, $b$, $c$ and $d$ respectively, now (see straight line below the figure) make the distance $l\,n = a + c$, and the distance $l\,m = b + d$, then $m\,n = a + c - (b + d)$ or the difference of the sums of the radii of each couple of circles. Make E F $= m\,n$, join F A and produce in both directions from C, draw C G perpendicular to F A produced, then if lines be drawn touching the circles parallel to F G and C G, the resulting figure is the required square. To prove this repeat the construction, but commence at B instead of C; the resulting figure, as shown by dotted lines, will be exactly the same as the first figure. We have now to prove that K L = M N. We have C G = B H, but C G is made up C + K L + $a$, and B H is made up of $b$ + M N + N P + P H; but N P = radius $d$, and P H = E F $= a + c - (b + d)$. We therefore have C + K L $+ a = b +$ M N $+ d + a + c - (b + d)$ or K L = M N.



Bath. M. I. C. E.

[73035.]—**Tree Calf**—To "Practical Bookbinder."—The operation upon which you desire information is the most difficult of all operations pertaining to the bibliopegistic art. It may, however, be described in comparatively few words. It can only be learned by experience, the experience begot of many years of patient labour. Tree marblers are rare, and employers are prone to allow them to indulge in their little whims, one of which consists of shutting themselves up in a room while engaged in this interesting piece of work. But now to the book. The book which is to be marbled is covered in fair calf and has had the ordinary preparation of being washed with paste-water (I presume I am writing to a binder). While this is drying the sprinkles to be used can be prepared. For the black dissolve half a pound of green copperas in two quarts of water, and for brown half a pound of salts of tartar in one quart of water. These are the more modern preparations, and are just as effectual, if not more so, than the old-fashioned ones, which are more costly. I need not say that they should be put in bottles and well corked. The boards of the book are now bent a little, so as to form a little trough in the centre of each, and laid across rods, as shown in the figure. You should have ready on the bench beside you three bowls, two containing, besides the colours, a large brush, the other containing water and a bunch of fine birch rods, and a press-pin, or a piece of iron gas-pipe. The book should be elevated a little at the head so as to allow the colours to flow to the tail. Take up the birch rod and throw on the water in large drops until they unite and run down the centre in a stream. Then with the brush charged with black and beaten against the press-pin a shower of very fine spots is thrown over the cover, which will produce with the running water fine streaks, which will look like branches. The brown is next thrown on in a similar manner. You will observe that this must be done while the water is quite fresh upon the cover; it must not be allowed to strike in, or the effect will be spoiled. When the veins of colour begin to strike in, a sponge must be taken and the water soaked up from the bottom. The book is now left to dry, when it is afterwards finished in the usual manner. I trust this will be helpful to the querist, and that he will be able to succeed. I would advise much practice with waste pieces of leather and old boards if possible, as a book once marbled cannot be changed without putting on a new cover. I may treat of the subject of sprinkling, marbling, and hand-colouring of leather before I conclude the articles if the Editor permits.



Practical Bookbinder.

[73059.]—**Accumulators.**—To Mr. Bottone.—What appears to me to be a mistake is the answer which has already been given to this query in the issue of December 5. The capacity of lithanode is 1 ampère-hour per ounce avoirdupois. A plate 4in. by 1½in., if $\frac{3}{16}$in. thick, would weigh 3oz., and ought to be equivalent to 3 ampère-hours, or, in other words, should give 12 ampères for ¼ hour. Perhaps the plate from which the result given was calculated was rather thin; but the thinnest made are, when new, ⅛in. thick, and, of the dimensions given, would weigh 2oz. It ought, therefore, to have been equal to 2 ampère-hours—i.e., have given 8 ampères for ¼ hour. Any result, however, would depend upon the amount of surface actually covered by the acid. A. E. Gosset-Farmer.

[73084.]—**Bennett's Cell.**—The Bennett iron cell is next to useless for electric lighting. It forms a cheap and fairly useful battery for electric bells; but even for this purpose it does not equal the Leclanché. To charge it you should put a solution of caustic potash in both porous pot and outer vessel with iron turnings; a solution of 30 to 40 per cent. of caustic potash is, I believe, generally used. I have been informed that a strong solution of carbonate of soda will work well; but I have never tried it, so cannot say. I am making some experiments with batteries made from tins, and will let you know the result (by the Editor's permission) through these columns as soon as they are completed. F. Askew.

[73090.]—**Glow Lamp.**—If your lamp has a resistance of 30 ohms, and only requires ·5 ampère to light it, it certainly is not a 40-volt lamp; 15 volts will give the ·5 ampère which you say it requires. Both the arrangements shown are bad, and use up a lot of power in overcoming useless resistance. The first will send a current of [illegible] ampere through lamp instead of ½ (·5), and the ·1 (ohm) which you propose to insert in one of the mains will have no practical effect, 200 times that amount being required—viz., 20 ohms—since $\frac{E}{R}$

$$\frac{40}{60 + 20} = \tfrac{1}{2}\ (\cdot5).$$

Twelve cells in series will give the exact current, as

$$\frac{E}{R} = \frac{2 \times 12}{1{\cdot}5 \times 12 + 30} = \frac{24}{48} = \tfrac{1}{2}\ (\cdot5).$$

If you have 20 cells, you will get light for a longer time by using them in two parallel 10 series, in which case you will have to insert an additional resistance of 2½ ohms, since $\frac{E}{R}$

$$\frac{2 \times 10}{\left(\frac{1{\cdot}5 \times 10}{2}\right) + 30 + 2\tfrac{1}{2}} = \frac{20}{40} = \tfrac{1}{2}\ (\cdot5).$$

18 cells, 2 parallel 9 series, will give very nearly the required current; the figures work out to $\frac{18}{36\frac{1}{2}}$. In the second case, you will get the best result by using the 24 cells, 2 parallel 12 series, or what is exactly the same, use 12 cells in series to each lamp. To your last query, yes. In conclusion, I may remark that, assuming your lamp has an efficiency of 3·75 watts per candle, which is pretty fair for this class of lamp, it will only give a light of 4-candle power—a good illustration of electric-lighting by batteries. R. C. Royle.

[73092.]—**Wimshurst Machine.**—I think our esteemed correspondent, Mr. Bottone, has made a mistake—most unusual with him—in his reply to this query. It is obviously much better that the two outside plates of a Wimshurst machine should revolve in one direction, and the two inner ones in the other. I have made a very satisfactory 4-plate machine on this principle. The two inner plates are fastened to opposite sides of one pulley driven by a direct band, and the two outer ones are fastened each to a boss keyed to the spindle which drives both, deriving its motion from a crossed band passing round a groove in one of the bosses. The spindle thus, instead of being a fixture, revolves in bearings, consisting of short pieces of brass tube driven tight into the uprights. The arms carrying the neutralising brushes fit on these short pieces of tube which project beyond the face of the uprights for this purpose. This arrangement is better than the one described by Mr. Bottone, because it enables one to alter the angle at which the brush-arms stand. It is useful to be able to do this, as the machine excites itself more easily when the brushes approach the horizontal, but for long sparks they should be more nearly vertical. This change can be effected while the machine is running. It will be seen that, according to this method, the labour of constructing a 4-plate machine is not much greater than that of constructing a 2-plate one, as there are no more pulleys or bands, and only one more boss. Can Mr. Wimshurst suggest a material for the brushes which possesses a little more elasticity than the ordinary theatrical tinsel? If the plates do not run absolutely truly (and mine do not) they bend back the brushes in one part of their revolution, and the brushes are out of control in another part. This is the only drawback I have found; and I think this is the cause of the machine's sometimes failing to excite itself.

Calculus.

[73100.]—**Jibbing Horse.**—Take the horse out of the shafts, and make him go round in a circle till he is giddy. He will not have to do it more than twice. J. F.

[73100.]—**Jibbing Horse.**—If you carry out W. Morton's prescription, there is no doubt that the horse will never jib again. *Two or three weeks without food* ought to cure any horse, and it would be manifestly unjust to whip him and starve him at the same times; besides the S.P.C.A. might interfere.

Sx.

[73106.]—**Paddle Steamer.**—We take for granted that the original makes 44 revolutions per minute in water. Do you mean your model makes 120 revolutions in the water, or out of it? If the latter, perhaps you tried the steamer in a smooth pond where there is little or no resistance to her progress in proportion to what the big one meets. Launch your steamer into the sea where there are big waves to obstruct the speed, and then compare the two together, and note the performances. J. A.

[73102.]—**Microscopical: "A" Eyepiece, A Correction, and General Rules.**—Mr. Bottone's reply to this query was correct; my answer was wrong, the error having arisen evidently from considering that a 1in. eye-lens would require a 3in. field-lens in a perfect achro. combination. So many queries on optical matters crop up that it may be convenient, for the sake of new subscribers, to state the rules relative to lenses and their arrangement in the Huyghenian (Campani) eyepiece. Rule: The focal length of the field-lens should be three t of the eye-lens, and the distance between tres must be half the sum of the focal The diaphragm is placed at a distance eye-lens equal to its focal length, and the es of the lenses are towards the eye. To value of the combination considered as a s, divide twice the product of their focal y their sum. Let us take the combination "F.R.A.S." in letter 31856, for example, ind—

$$\text{ue} = \frac{0{\cdot}36\text{in.} \times 0{\cdot}12\text{in.} \times 2\text{in.}}{0{\cdot}48\text{in.}} = 0{\cdot}18\text{in.}$$

ve divide the focal length of the o.g. given 73030 by this, we get 88·8 (or 90 nearly) as "F.R.A.S." J. D. M.

]—**Chemical.**—In my reply last week I ve put "Fowne's Organic Chemistry." Sm.

]—**Contents of Cylinder.**—"Distiller" the following formula to give results that iently accurate for all practical purposes, gh not rigidly correct, they are very nearly

= diameter of cylinder.
= length of cylinder.
= depth of liquor.
A = area of end of cylinder = $d^2 \times {\cdot}7854$.
= cubical contents.

en the cylinder is less than half-full, or of the liquor is less than the radius of the we have:

$$\frac{hl}{} \sqrt{h\left(d - \frac{3h}{5}\right)} \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

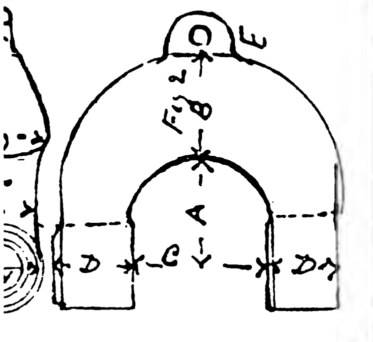
the cylinder is more than half-full; or the the liquor exceeds the radius of the cylinder

$$\left\{A - \frac{4(d-h)}{3}\sqrt{\frac{d(2d+h) - 3h^2}{5}}\right\}$$

nensions are in feet, then C will, in each ound in cubic feet, which, multiplied by ay 6¼, will give the contents in gallons. r" could easily compile a table from the n for each size of cylinder, and say for of depth of the liquor, and thus have hand the means of knowing the approxi- ntity in his vessels.

-le-Hole. LYONS.

]—**Punching.**—Perhaps the following ll suit you:—Fig. 1, A, 2⅜in.; B, 2in: C, g. 2, A, 3¼in.; B, 3in.; C, 3⅝in.; D, 2⅝in.



, 1½in. diam.; pitch, three threads per tress thread E; eye-bitting for shackle , or to bolt porter-bar to for handling.

JACK OF ALL TRADES.

—**Blackening Zinc Surface.**—"C. L." is by immersing the vessels in a weak f sulphate of copper, thoroughly dry by at, and rub over with dry cloths, and nel with a few drops of olive oil. The above good for writing names of plants on zinc ardeners, please note. W. J. W.

—**Blackening Zinc Surface.**—To Thanks to "Jack of All Trades." It has o me that perhaps "Eos" may be able to he process by which the Indian artificers e zinc. The ware is called "Beedur," thing is applied which blackens the zinc aves the silver unaffected. C. L.

—**Banjo.**—If you want to play the ply to accompany songs, I should advise a seven-stringed instrument. You can in the scale on a seven-string than you ive; therefore you can play a better bass ment, and have also the additional ad- hat it can be tuned and played as a hough I should recommend anyone wish- e and play the banjo as a guitar to have s, it being almost an impossibility to play accompaniments on a smooth finger- you want to play solos, thimble, tremolo, uld recommend a five-string as being the have a narrower bridge and handle, and h more comfortable to hold and play. lacing the fingers on the frets at various positions, you can play full chords, sounding all the strings together. I have never found a banjoist who changed from a seven to a five-string have any desire to change back again. I should not recommend a six-string to anyone who is not an experienced player, the fourth string sometimes having to be tuned up or down a tone, from C to D, or *vice versâ*. Do not use a machine head—they are simply a nuisance on a banjo strung with gut strings; for metal strings they are indispensable. Pegs, to work comfortably, ought to be carefully fitted, and then it requires some practice to use them properly; but once you get into the way, they will be no trouble. The metal-rim banjo is certainly the best, giving a much sharper and more powerful tone than a wood rim. Use German silver for making hoop, and line the inside with oak or maple; the edges of metal hoop must be turned over two steel wires to get the best results. I will give you further information if required.

J. G. WINDER.

[73141.]—**Induction Coil.**—Secondary, 2lb. of 36 B.W.G. s.c.; primary, 2 layers of 20 B.W.G. s.c. R. C. ROYLE.

[73141.]—**Induction Coil.**—Put on two layers of No. 16 for primary, and 2lb. of No. 36 s.c. wire for secondary. The usual calculation for secondary wire is 1lb. for an inch spark of above wire. Insulate layers with paraffined paper.

G. C. NEWLAND-SMITH.

[73143.]—**Traction Engine.**—For dimensions of this model I refer you to description given by me on page 218 of No. 1285, Vol. L., of "Ours." A firebox of size mentioned by you might possibly burn charcoal, or even wood; but, I doubt, is a little too small for ordinary coal. J. A.

[73149.]—**Organ Query.**—"Genseric" may probably desire some further information in answer to his question. He has already been told that the "Sesqui-altera" and the "Mixture" are not mechanical appliances, and that they are speaking stops, similar in so far that they are compound stops—that is, they are formed of two or more ranks of pipes which sound together. But he has not been informed exactly what the Sesqui-altera is, and whence it derives its name. Although a Sesqui-altera is in all cases a Mixture, it by no means follows that a Mixture is a Sesqui-altera. I give here the compositions of both Sesqui-alteras and Mixture:—

SESQUI-ALTERA, II. RANKS.

| | | |
|---|---|---|
| CC to $a^3$ ........ | 12th ........ | 17th |

SESQUI-ALTERA, VI. RANKS.

| | | | | | | |
|---|---|---|---|---|---|---|
| CC to C ........ | 15 | 19 | 22 | 24 | 26 | 29 |
| C sharp to $c^2$.... | 12 | 15 | 19 | 22 | 24 | 26 |
| $c^2$ sharp to $c^3$ .. | 8 | 12 | 15 | 17 | 19 | 22 |
| $c^3$ sharp to top .. | 1 | 8 | 12 | 15 | 17 | 19 |

MIXTURE, IV. RANKS.

| | | | | |
|---|---|---|---|---|
| CC to B................ | 19 | 22 | 26 | 29 |
| C to $f^1$ ................ | 12 | 15 | 19 | 22 |
| $f^1$ sharp to $b^2$ .......... | 8 | 12 | 15 | 19 |
| $c^2$ to top................ | 1 | 8 | 12 | 15 |

"Genseric" will observe that in both the Sesqui-alteras there are two ranks of pipes, which stand at the interval of a major sixth. In the first example the 17th or third-sounding rank stand at the interval of a major sixth from the 12th or fifth sounding rank. In the second example he will find this interval between the 19th and the 24th in the first and second breaks, and between the 12th and the 17th in the third break. In the Mixture he will neither find the 17th nor the 24th, and accordingly the interval of the major sixth is altogether absent. It is from this interval, or from "sexta," a sixth, that the Sesqui-altera derives its name. I hope I have made the matter quite clear to "Genseric."

G. A. AUDSLEY.

[73150.]—**Discount.**—Your formula is merely equivalent to the following:—

$$\frac{£1\ 4s.\ 6d. \times \left(\frac{100 - 62{\cdot}5}{5}\right)}{20} = \frac{£1\ 4s.\ 6d. \times 37{\cdot}5}{100}$$

That is to say, the 62½ per cent. is deducted from the 100, and the result is a net amount. It is a very unnecessarily roundabout way of doing a very simple calculation. To take 62½ per cent. off £1 4s. 6d., take 50 per cent. = 12s. 3d. + 12½ per cent. (one fourth of 50 per cent.) = 3s. 0·75d. = 15s. 3·75d. This is the discount required. Deduct it from £1 4s. 6d., and the net amount is 9s. 2·25d.

H. BROCKLEHURST.

[73151.]—**Bunsen Battery.**—You must give size of cell and elements, and strength of current, before anyone can answer this question. Roughly, a "quart" cell will give 1 ampere for 12 hours, but varies with strength of solutions used.

R. C. ROYLE.

[73157.]—**Koumiss.**—I presume your querist wishes to know how to make the article sold in this country, and made from cow's milk. All that is necessary is to bottle, and well cork in soda-water or champagne bottles (ordinary bottles will not stand the pressure), or if a little butter-milk is mixed with the milk, it will be ready for use sooner; about 15 to 20 days will be sufficient to complete the process; but it may be used much sooner, as the milk will be curdled in three or four days. When it is fully ripe it is almost impossible to open the bottle without a portion of the contents being lost; as treble-aërated soda-water is nothing to it for effervescence. The best way is to use a champagne tap, and so draw it off as required. SIGHEE.

[73157.]—**Koumiss.**—To a quart of new milk add a sixth part of water, and to this mixture add, as a ferment, an eighth part of the sourest butter-milk that can be got. In future preparations, a similar quantity of old koumiss will better answer the purpose of a ferment. Cover the vessel with a cloth, and allow to stand in a place of moderate warmth for twenty-four hours, when a thick substance will be found collected at the top. Stir well until this substance is thoroughly mixed with the liquid portion beneath, and allow to stand for twenty-four hours more, when, having filled a bottle two-thirds full, and again thoroughly mixed by shaking, the preparation, now called koumiss, may be used at once, or the bottle tightly corked and kept in a cool place for future use. Always shake the bottle well before using. N.B.—We did not use water, and of course the koumiss was stronger. J. L. DONCASTER.

[73157.]—**Koumiss.**—I have made very good koumiss from cow's milk as follows:—Dilute the milk with one-sixth part of hot water, and, while still tepid, add one-eighth of very sour (but otherwise good) buttermilk. Put it into a wide jug, cover with a clean cloth, and let stand in a warmish place (about 75° F.) for 24 hours; stir up well, and leave for another 24 hours. Then beat thoroughly together, and pour from jug to jug till perfectly smooth and creamy. It is now "still" koumiss, and may be drunk at once. To make it "sparkling," which is generally preferred, put it into champagne or soda-water bottles; do not quite fill them, well secure the corks, and lay down in a cool cellar. It will then keep for six or eight weeks, though it becomes increasingly acid. To mature some for drinking quickly, it is as well—especially this time of year—to keep a bottle or two to start with in some warmer place—say the usual living-room (not close to the fire, though)—and from time to time shake vigorously. With this treatment it should, in about three days, become sufficiently effervescent to spirt freely through a champagne tap, which must be used for drawing it off as required. Later on, when very frothy and acid, it is more pleasant to drink if a little sweetened water (or milk-and-water) is first put into the glass. Shake the bottle, and hold it inverted well into the tumbler before turning the tap. Having made one lot of koumiss as above, you can use some of that instead of buttermilk as a ferment for a second lot, and so on five or six times in succession; after which it will be found advisable to begin again as at first. Mare's milk is the best for koumiss; then ass's milk. Cow's milk may be made more like them by adding a little sugar of milk (or even loaf-sugar) with the hot water before fermenting. But perhaps the chief drawback to cow's milk is that the cream separates permanently, whereas that of mare's milk will remix. Hence I generally use partially skimmed milk, for if there is much cream it only forms little lumps of butter, which are apt to clog the tap, or are left behind in the bottle. MU NU.

[73162.]—**Lamp for Telescope.**—Why not use a small incandescent electric lamp? I find one worked with six agglomerate Leclanché cells does all I want for a 9¼in. F. R. S. E.

[73162.]—**Lamp for Telescope.**—Colza oil does very well for these lamps; but you cannot avoid the formation of soot. A benzoline sponge lamp is a good substitute; but there is nothing better than gas, if available. Sm.

[73163.]—**Waterproof.**—Either get a little ox-gall and put into some warm water, and brush it out, and put into some soft water; or get an ounce of carbonate of ammonia, and dissolve in a pint of warm water, and do the same as above, then hang out straight to dry. JACK OF ALL TRADES.

[73165.]—**Clinkers.**—These you are sure to get, more or less, according to what you use, and quality of coal, as the sulphate of iron and ash will combine at a very low heat.

JACK OF ALL TRADES.

[73166.]—**Equatoreal.**—A movable circle with a fixed vernier for R.A., and a fixed circle with movable vernier for Dec. circles can be cut from sheet brass. No one can give directions for fixing without seeing the stand. Sm.

[73166.]—**Equatoreal.**—"A portable equatoreal." These words, seeing that there are various kinds of such in daily use, afford scarcely enough information to enable one to assist you. Is your stand made after an English, a German, or a French pattern? If of English design, is it Grubb's, Cooke's, or Tully's? Room not having originally been provided for circles, where can it be found? Are the axes long enough? Can they be lengthened, or turned down? Of what diameter where the circles are to be fixed? These questions can best be answered by yourself. For convenience of reading, the circles should be fairly near together, and the vernier conveniently situated. As to the circles themselves, they must, of course, be graduated by exact machinery after they have been provisionally fitted into their respective positions, either by yourself or by an instrument maker. The cost for a set of 6in. circles and verniers will probably not be far short of £3. More when further data are given.

A. Caplatzi.

[73170.]—**Blackening Oxide of Lead.**—You cannot get it black, but you can very near it by exposing it to sulphuretted hydrogen gas.

Jack of All Trades.

[73171.]—**Lithanode Plates.** — You cannot make a connection to lithanode with copper wire; the only way is with "platinum." The two holes you mention are for small ebonite bolts and nuts. The connection is made as follows:—Put the ebonite bolt through the hole, then place a small disc of platinum (like a washer) next to the lithanode, afterwards a celluloid washer, and screw on the ebonite nut. Before tightening up, make a connection to the platinum disc with a piece of platinum wire, which should be long enough to project over the sides of the cell, so that a copper wire, soldered on to it, will be beyond the reach of the acid. You can, however, solder a copper wire on to a short length of platinum wire, only it will have to be well insulated, especially at the joint, or your connection will very soon be eaten through.

A. E. Gosset-Farmer.

[73172.]—**Soldering Brass.**—If "A. W. C." will fit a wooden plug into end of pipe which he wishes to close, and let it be in just $\frac{1}{16}$ past the edge; then cut a circular piece of brass $\frac{1}{16}$ thick, exactly the size of pipe bore, then fit it in, and let it rest on the wood plug; it will then be exactly flush with edge of pipe. He should then "sweat" round edge with a soldering-iron, and when cooled clean off with file and emery-cloth, which will make it both neat and durable. Eddie Geen.

[73172.]—**Soldering Brass.**—If the tube is not to be subjected to any great heat, you can solder with ordinary tinner's solder (fuse at about 340 F.), using as a flux a mixture of salammoniac and resin. If you require it to stand heat you must use brazing composition, which can only be fused with a blowpipe; use borax and water as a flux. Should you find any difficulty in fusing above, the following compo. will suit better: silver 5, brass 2, zinc 5. In either case the end of the tube will have to be fitted in tightly before beginning to solder, and better support it on a block of wood. J. N. C.

[73175.]—**Glass, to Stain.**—Get a short length of 3in. stack-pipe, cast iron, lay it upon its side, and fill it about a third full of fine, dry, slaked lime, and make it nice and level; now lay that across your kitchen grate, and make up a good fire. The lime lay at the bottom, a nice level bed, to put your glass on. Now take some borax and put it in a fire pan and dry off the water, the same as burnt alum is made. Take equal parts of this, red lead, and red ochre, and in a mortar or on a stone, grind as smooth as you can with turps. Now paint letters or any device upon a narrow slip of glass, and put it in upon the hot bed of lime. When you see it run, it is done. You may take out if it is not black enough, put about a third of black oxide of manganese, and grind up fine and mix with it, and proceed as before; and you have the whole process, only in miniature. Jack of All Trades.

[73177.]—**Iceland Spar.**—The simplest polarising prism you can make yourself of your spar is a natural, or Fresnel's rhomb, obtained by slicing away the evennesses on the faces of the crystal, and then polishing it on all sides on paper. As clear spar is now of considerable value, the less you have to cut away, and the larger your finished prism becomes, the better. If required, it can then at any time be converted into a Nicol, double image, or other form of prism. A. Caplatzi.

[73179.]—**Cracked Hands.**—Try the following ointment: — Camphor, 60 grains; boric acid, 30 grains; lanoline, white vaseline, of each $\frac{1}{4}$oz. to make an ointment. F. R. S. E.

[73179.]—**Cracked Hands.**—Anoint your hands with glycerine after washing and while they are still damp. If used without some water it has a drying tendency. Vaseline is no good. Sm.

[73179.]—**Cracked Hands.**—"J. C. S." should get his chemist to mix a powdered ball of salprunel with 2oz. of vaseline, and rub well in. I have found this mixture most healing for all kinds of cracks, chaps, and sores. J. B. S.

[73179.]—**Cracked Hands.**—Wash your hands in luke-warm water—not hot—until they are nice and soft, wipe dry, and while soft and moist apply the ointment. It is no use putting ointment upon a dry hard crack, or wound; but when softened, rub the ointment in for a few minutes as though you owed the crack a grudge, and not upon the crack only, but some distance around it. I have many times so doctored a fresh crack, and next morning it was quite healed, but it may not suit all alike.

W. P. W.

[73179.]—**Cracked Hands.**—Take a little condensed milk, and mix it with water, and get a pennyworth of tincture of myrrh, and put three or four drops into it. After well washing your hands with Pears' soap, or good yellow soap, dry well with a soft towel, then wash your hands with that, and let them dry; or, if you use milk from the cow, mix a table-spoonful with a teaspoonful of honey in a bottle, with 20 drops of myrrh, and well shake. You can put a little into some water, and use it every time you wash. Do not use any of the common soap. Jack of All Trades.

[73179.]—**Cracked Hands (?) Skin Disease through Frost.**—I take this opportunity of giving the following recipe for cracked or chapped hands, which I have found to be a never-failing cure among my many acquaintances whom I have told, having got it given to me, some 12 years since, as an English Mechanic recipe, which cured me thoroughly in one month, and have never been bothered since. Get sixpennyworth of Price's pure glycerine from a chemist, with carbolic acid added the strength of carbolic oil; then just before going to bed wash the hands as clean as possible with hot water, and lightly dry them with towel, and apply the glycerine and carbolic, holding the hands before the fire and rub well in, then put the hands in a pair of old gloves and go to bed; the heat through the night will allow the mixture to penetrate through and through the hands, and make them soft; wash them in the morning as usual, and apply every night for some time, and I am sure inquirer will have reason to thank our practical and amateur paper for its existence. Will look for further reply in the course of a week or two.

Amateur Mechanic.

[73180.]—**Electrical Work.**—Required a crucible, cover, pair of tongs, good coke fire, &c. You can melt brass in an ordinary grate. Sm.

[73182.]—**Small Electro-Motor.** — To Mr. Bottone.—A small drum armature, about 1in. diam., 3in. long, wound as a Siemens-Alteneck, in eight sections, with 3oz. No. 20 wire, will give good results. I have made a Gramme armature 1in. diam., 1in. deep, wound with 1oz. of No. 24, which gave good results; but it took a lot of time to wind, and the power was, of course, very small indeed.

S. Bottone.

[73182.]—**Small Electro-Motor.**—For driving what machinery? A dancing nigger or a Blondin? A wheel of life or a guillotine? A railway train or a boat? An engineer's tools or a conjurer's secret tricks? Where built, weight, and cost are most important. Design must be suited *specially* for each purpose. A motor weighing altogether 4oz. is capable of a good deal of mechanical work. I have such before me, driving a 4in. vacuum tube. It would not be difficult to make one half that size, the wound armature weighing $\frac{1}{2}$oz.

A. Caplatzi.

[73184.] — **Pocket Accumulator.** — I have described the construction of these quite recently in the English Mechanic. If you cannot refer, you had better get my book, "Electrical-Instrument Making for Amateurs," where you will find a full and detailed account of the mode of making them.

S. Bottone.

[73186.] — **Benzole and Benzoline.**—You are quite wrong. Benzol and benzoline are not the same. The first is obtained from coal tar, the second from petroleum. They differ both chemically and physically. For glove-cleaning by all means use benzoline. Sm.

[73186.]—**Benzole and Benzoline.**—Without going very deeply into the chemistry of these bodies, I may say that the former is a pure hydrocarbon of the formula $C_6H_6$. Benzoline is a mixture of several hydrocarbons, along with benzole, and is obtained among the lighter products of the distillation of petroleum. If the benzoline is clean (that is, not placed in greasy or varnish cans), it is almost, if not quite, as effective as benzole, for the removal of grease and similar stains.

S. Bottone.

[73186.] — **Benzole and Benzoline.** — The former fluid is a coal-tar naphtha, the most important constituent of which is benzene ($C_6H_6$). Benzoline is petroleum naphtha, consisting largely of heptane and other paraffins. Benzine is used to denote the more volatile portion of petroleum naphtha. Benzoline is a very good solvent for grease, and is largely used for this purpose by cloth-cleaners; it, however, does not evaporate so readily as benzine, and the odour is more lasting. Benzoline has hardly any action on coal-tar pitch, whilst benzole dissolves it readily. This forms a good ready test for distinguishing between the two liquids. Benzine Collas derives its name, I believe, from the originator, M. Collas.

E. Wightman Bell, F.C.S.

[73186.]—**Benzole and Benzoline.**
confusion exists in the use of the words
benzole), benzene, benzine, and benzo
last two mentioned are one and the
benzine and benzoline); they are light
sometimes also called petroleum spirit;
benzene is derived from coal-tar, and
different substance from benzoline. It
mentioned that retailers are apt to substit
line for benzol, either from ignorance
sake of profit. Benzol is the higher pri
two. Benzine is described in some books
mous with benzol; but this is not correct
to modern use of the words. Benzin
benzol (or should be).

Charles E. Sohn, F.C.S.

[73187.] — **"Fresh" Photograph**
**tions.**—You can keep most photographi
ready, but after 20 years' experience, I
a solution twice. This is the meaning of

F.

[73187.] — **"Fresh" Photograph**
**tions.**—With reference to hypo., the term
means unused, since the stock solut
fairly well in corked or stoppered bottle
unless made-up saturated solution i
according to Major Russell's plan, rapidly
ates. Ferrous sulphate solution, with
paraffin oil over it, keeps several months.
of potash keeps well, so also do alum, ca
soda, and potash. Bromide of potassiu
keeps fairly well in the dark. The citric
tion goes mouldy, but a trace of oil of
remedy that. Soda sulphite and hy
solutions, if exposed to the air, gradually

S. B

[73187.]—**"Fresh" Photographic S**
—In applying this term to pyro., I should
long as the solution retained its origin
have used pyro. solution that had been
two years, and it was nearly black. I a
call that "fresh." You may safely kee
tion the bromides, alum, potassium ox
carbonate, if made with pure water;
alum develops a fungus. Sulphite and
phite of soda cannot long be kept in soluti
out decomposition, and for the matter of
cannot by any means preserve sulphite fro
position; even in the solid form, it begins t
pose as soon as it is made. Citric-acid solu
turn mouldy.

[73188.]—**Oil-stoves or Lamps.**—If
sumption of oil is the same in any given
lamp, the amount of heat produced b
practically identical. With lamps, as "
puts it, he can utilise the light as well as
The metal of the stove, though, retains
longer than a lamp does, and so is to a cer
only slight, extent more useful than a lamp
do not require chimneys—that's an advant

Nu

[73189.]—**Battery Power for Coil.**—
with about 1lb. No. 16 as primary, and $\frac{3}{4}$ll
as secondary, will bear safely four pint cell
mate battery coupled in series. Leclanch
good for working coils; too much intern
ance. S. Bo

[73191.]—**Enamel.**—You will find a go
on enamels in the "Encyclopædia Brit.
Muspratt's "Chemistry." The tempera
muffle is required.

[73191.]—**Enamel.**—This was a paten
expect that it has run out now. The iron
and cleaned, and covered with a wash
and fine silica, and well flushed all over
foundation. Red-lead and red ochre, or
iron and manganese oxide for a black;
colours are mineral colours, mixed with
borax. I don't know of any book. They
in a muffle. Jack of All T

[73192.]—**Accumulators.**—Three smal
lators, about 6$\frac{1}{2}$in. by 4in. by 1in. will do
require. S. Bo

[73193.]—**Electric Light.**—Charge y
with chromic acid, 3oz.; water, 1 pint; sulph
3oz., in the carbon compartment, and w
sulphuric acid, 1 of acid to 12 of water, i
compartment. But you will want more
cells to give 5c.p. See what volts are m
your lamp, and allow one cell for every t
Use No. 18 d.c.c. wire to connect up with.

S. Bo

[73193.]—**Electric Light.**—Take my a
don't go to the trouble and waste of time
light your lamp with a battery as you de
any other primary battery. It will only
complete failure and disappointment, to sa
of the expense and dirty work. I have tri
spent a lot of money upon it, and was at l
gusted that I gave it up. Use your spare
talents in some other way that will afford
amusement.

[73193.]—**Electric Light.**—As you d
what voltage your lamp is, I cannot say

ill require; but, at any rate, two will not
. A 5cp. lamp may be any voltage
out is, as a rule, about 10, which num-
suppose yours to be. Now, a Bunsen
d with nitric acid in the porous pot
.M.F. of 1·86 volt, and as the lamp takes
light it, you see we shall require at least
n series; that is, the cells connected by
strip of copper or stout copper wires
.) will do—the carbon of one cell to be
o the zinc of the next, and so on; and
, we get the combined E.M.F., so that
you see we get 9·30 volts, which will
lamp, but not to its full power. Should
better light, you can add another cell;
g so, you will only help to break down
t more quickly, as, you see, the E.M.F.
16 volts. Your lamp should be marked
oltage it requires; but, if not, make up
nd try it, and if it lights the lamp pretty
must be contented, as the light from a
will be a mere glimmer to a shilling
np. Should the four cells not light it,
dd cells till it does, not going above six.
the cells, fill the porous pots to within
op with nitric acid and the outer jar
lated water (1 of vitriol to 12 water).
s should be level. The current will
stant for about eight hours, when the
ave to be renewed. To connect battery
se number 16 wire double c.c. I have
ke myself explicit; but, should you have
ty, write again, and I will try to help

F. Askew.

-**Plated Teapot.**—If the Britannia
misbehaved itself by "absorbing"
would not have the result you state, as
of sulphur on silver is to blacken it. Who
eapot?

Sm.

-**Volt and Ammeter.**—To ascertain
and the total E.M.F. of a battery or a
ese instruments must be placed in the
t. The voltmeter must be constructed
re than the expected voltage; then,
e quantity of the wire, the resistance is
at not sufficient current passes to do any
r ordinary dynamo working the volt-
ced in shunt across the terminals.

S. Bottone.

– **Model Boiler.**—Methylated spirit
with tubes $\frac{3}{4}$in. to 1in. diameter, carried
iler; funnel $1\frac{1}{4}$in. diameter; nothing
es satisfaction. Dry wood burns with
, and charcoal with a 2in. tube. It is
ke a model boiler appear to work at
ure; but I would be inclined to question
cy of the pressure-gauge. No model
acquainted with can stand this pressure.

J. A.

-**Dynamo and Lighting.**—A 20c.p.
a current of one ampère, and has a
about 48 to 50 volts. Hence 26 cells of
r are required. The smallest available
gives 15 ampère hours, weighs 4lb. per
lb. for the set. Price per cell 8s. =
here would be but little loss in bringing
r from dynamo after charging. To run
motor from battery to work dynamo
ttle short of madness, since about half
of battery cells that would be required
notor and dynamo would work the lamp

S. Bottone.

-**Magnet.**—No, but you can magnetise
inclosing it in a coil of insulated wire
itting a current from your battery.

Sm.

-**Magnet.**—Your coil will be of no use
the purpose of magnetising your pieces
ich, however, retains its magnetism for
ime, that it would be of no consequence
other battery will not harm your coil, and
e the strength of the intermittent current.

F. C. V.

-**Magnet.**—You cannot magnetise by
ce its current is alternately in one direc-
en in the other. Better use a single-cell
alone. You will get a stronger shock
o cells; but you must not use more than
you will break down the insulation of

S. Bottone.

—**Indian Jugglery.**—The feat you
vas either a conjuring trick, pure and
ich seems to me, if the facts were as
d, simply incredible), or else it was
d by so-called occult means. I use this
ant of a better. If it was a conjuring
is I mean a feat that could be performed
y and recognised materialistic means—
I think, if you had investigated the
e time, have had no difficulty in proving
*erandi*. It was, however, more probably
d by so-called occult means, proving the
forces at present unknown to science,
ignored by it. That these phenomena
ere is overwhelming evidence, and it is
in the day to deny their existence. If
you are interested in the subject, the best way is to study it yourself. If you investigate the matter patiently and without prejudice, you will come to the conclusion that whatever these mysterious forces are, there is no doubt that they exist. A. W. G.

[73203.]—**Lead-Poisoning.**—Since you do not state how the lead gets into the water, how do you expect to obtain an answer to your query? It is very obvious that you must remove the cause.

Sm.

[73203.]—**Lead-Poisoning.**—From repeated experiments, conducted for a large filter-maker, I have proved the absolute removal of lead from water by passing once through a filter. The same conclusion has been arrived at by several eminent analysts. I should, therefore, strongly advise Mr. C. Holt to adopt the remedy.

E. Wightman Bell, F.C.S.

[73203.]—**Lead-Poisoning.**—This is caused by acids which dissolve lead from the pipes and cisterns and so form poisonous salts of lead. This acid is produced by fermentation or slow decomposition of the infusions of vegetable matters contained in water obtained from moorlands and peaty gathering-grounds. The remedy is an efficient filtration to destroy this vegetable infusion, which will also remove the colour. I shall be pleased to give any particulars of a suitable filter to do this, on knowing the quantity of water required per day. I have advertised my address.

C. E. Gittins.

[73204.]—**Enamel White.**—See answer to 73191 for the foundation. The white enamel, I rather suspect, consists of very fine silica, borax, oxide of lead, oxide of tin, French chalk, and bone ash—i.e., bone calcined to whiteness. There is a patent pulverising company in Nine Elms-lane who supply a great quantity of very finely-powdered silica in the form of glass, and I expect that they are suffiiently up to their work to make a selection in material for various purposes. I believe a deal of it is used in colours. Whether they supply it in colours for frit for enamelling, I don't know. It is fired in a muffle furnace, of which a sketch was given in the "E.M." some few weeks ago.

Jack of All Trades.

[73207.]—**Pitting of Boiler-Tubes.**—You might put a little soda in; but when you clean out, if you can get at them, give them a thin coat of drop black, mixed up with Brunswick and turps. Well clean them first. Jack of All Trades.

[73207.]—**Pitting of Boiler-Tubes.**—This is probably due to the acid in the water (see reply to query 73203.) In your case a little soda put in the boiler, say with the feed-water, so as to make it alkaline, will prevent it. The boiler should be washed out from time to time, so that a too concentrated solution of soda should not be formed, as this will corrode the brass fittings.

Chas. E. Gittins.

St. George's House, Eastcheap, London, E.C.

[73208.]—**Casting Rosin.**—Can be poured into a tin mould. Sm.

[73208.]—**Casting Black Rosin.**—Get a glazed earthenware mould, breathe in it, and when your rosin will run nicely, pour in; it must not be too hot. Jack of All Trades.

[73209.]—**G.E.R. Locos.**—"Regulator" will find No. 230 illustrated in a back volume; but as I have not mine by me at present, I am unable to tell him more. Mr. Worsdell built eleven engines of the 230 type. The leading particulars are as follows:—Bogie-wheels, 3ft. 1in.; coupled wheels, 7ft.; high-pressure cylinder, 18 by 24; low-pressure cylinder, 26 by 24. Heating surface: Tubes, 1,083·5; firebox, 117·5; total, 1,200sq.ft. Area of firegrate, 17·3sq.ft. Boiler: Length of barrel, 10ft. $5\frac{1}{4}$in.; diameter outside, 4ft. 2in.; number of tubes, 201; $1\frac{3}{4}$in. dia. by 11ft. $9\frac{1}{4}$in. between tube-plates. Working pressure, 160lb. Weight of engine:—

| | Empty. | | | | Full. | | |
|---|---|---|---|---|---|---|---|
| | tons | cwt. | lb. | | tons | cwt. | lb. |
| On bogie-wheels.... | 13 | 7 | 0 | .... | 14 | 15 | 2 |
| ,, driving ,, .... | 14 | 3 | 2 | .... | 14 | 16 | 2 |
| ,, trailing ,, .... | 13 | 12 | 1 | .... | 14 | 18 | 0 |
| | 41 | 2 | 3 | .... | 44 | 10 | 0 |

Capacity of tender, 3,200 gallons of water and 5 tons of coal. The valves are worked by means of Joy's valve gear. The engine is fitted with the Westinghouse automatic brake. Wheel-base:—Bogie centres, 6ft. 3in.; centre of rear bogie-wheel to centre of driving-wheel, 7ft. $7\frac{1}{2}$in.; centre driving to centre of trailing, 8ft. 9in. The respective performances of eleven of these compounds and eleven of the 562 class, for three months ending May 21, 1886, were as follows:—

| | Compound. | Ordinary. |
|---|---|---|
| Train miles run.......... | $109,469\frac{1}{2}$ | 64,671 |
| Engine ,, ,, .......... | $112,754\frac{3}{4}$ | $66,656\frac{1}{4}$ |
| Coal consumed .......... | 28,767cwt. | 19,547cwt. |
| ,, ,, per train mile | 29·4lb. | 33·8lb. |
| ,, ,, ,, engine ,, | 28·5lb. | 32·8lb. |

Glasgow. Meteor.

[73211.]—**Bichromate Cells.**—To Mr. Bottone.—The bichromate cell, no matter what size, gives nearly two volts. The current depends on the resistance in circuit. The right fluid to work your battery with consists of:—Bichromate of potash 6oz., water 1 quart, sulphuric acid 6oz. Hence, your four cells will take 72oz. of bichromate, dissolved in 12 quarts of water, to which you must add, pouring in a fine stream, 72oz. of oil of vitriol (sulphuric acid). Use when quite cold. The battery will light well a 6-volt lamp for about three hours, and will give, when coupled in series, about 7·2 volts. See my lists for approximate castings for motor. Such a battery would work a motor giving about $\frac{1}{2}$-man-power. You will find in my book, "Electrical Instruments for Amateurs," an account of the terms "volts," "ampères," and "watts."

S. Bottone.

[73213.]—**Accumulator Charging.**—The effect of charging them with so heavy a current would probably be to cause the "paste" to become detached from the grids, and to buckle the plates badly. S. Bottone.

[73215.]—**Board of Trade Exam.**—"Asmodeus" will get all information as to duties and particulars of all the subjects in two books published by Eyre and Spottiswoode, London; one "Weights and Measures: Inspectors' and Inspection Model Regulations, 1890," price 1s. 6d., and another "Weights and Measures Act, 1889: Examination of Inspectors of Weights and Measures, Notice to Candidates, and Heads of Examination," price 8d.

Carino.

[73216.]—**Microscope, Magnifying Power of.**—"The magnifying power in a compound microscope is the product of the respective magnifying powers of the o.g. and of the eyepiece. . . ." (Ganot's "Physics," section 594.) Now, the power of the eyepiece will vary to some degree with the eyes employed in the work; hence, the best method to determine absolute power in each case will be by use of micrometer, as given in section already referred to. But assuming, for approximate results, that the distance of first image from o.g. and that of distinct vision, as each 10in., we get:

$$1^\circ \text{ Power} = \frac{10}{1} \times \frac{10}{1\frac{1}{3}} = 75 \text{ (A. eyepiece.)}$$

$$2^\circ \text{ Power} = \frac{10}{1} \times \frac{10}{\frac{2}{3}} = 150 \text{ (B. ,, )}$$

$$3^\circ \text{ Power} = \frac{10}{\frac{1}{4}} \times \frac{10}{1\frac{1}{3}} = 300 \text{ (A. ,, )}$$

$$4^\circ \text{ Power} = \frac{10}{\frac{1}{4}} \times \frac{10}{\frac{2}{3}} = 600 \text{ (B. ,, )}$$

J. D. M.

[73217.]—**Tuberculosis.**—Koch was the discoverer of the bacillus; Ehrlich the inventor of the best stain for this. If you cannot get it from a chemist, get "Practical Histology and Pathology," by Dr. Gibbs. Publisher, H. K. Lewis.

F. R. S. E.

[73217.]—**Tuberculosis.**—The Koch-Ehrlich process consists in drying thoroughly in air, and then passing the cover glasses through a gas flame three times to hinder coagulation of the albuminoid material. Koch then stained with methyl blue and vesuvin; but Ehrlich discovered an improvement—viz., that in staining with aniline water tubercle bacilli withstood to an extent more than any other bacilli decolorisation by nitric acid. You will find particulars in Hueppe's "Methods of Bacteriological Investigation," translated by Dr. Briggs, published by Appleton and Co., of New York. A *résumé* is given in the "E. M.," Vol. XLVI. No. 1188. Swift's homogeneous $\frac{1}{12}$in. objective would suit well.

Plymouth. B.Sc.

[73220.]—**Proportion of Engine Parts.**—Make piston $\frac{3}{4}$in. thick; rod, $\frac{5}{16}$in. diam.; length, 5in.; connecting-rod, $8\frac{3}{4}$in.; steam ports, $1\frac{1}{8}$in. by $\frac{3}{16}$in.; exhaust, $1\frac{1}{8}$in. by $\frac{3}{16}$in., cut-off at $\frac{5}{8}$in.; flywheel, 16in. diam.; rim, $1\frac{3}{4}$in. wide; weight, about 30lb.; work at 40 or 50lb. pressure.

J. A.

[73222.]—**Spirit Lamp for Boiler.**—A circular lamp with twelve $\frac{1}{2}$in. wicks will raise steam, but not very satisfactorily, and is besides rather too expensive a method to fire with methylated spirit. Better to burn gas or fit up for a charcoal furnace, which will give far more satisfaction. J. A.

[73223.]—**Drain Ventilator.**—Carry up at one end of the drain a 4in. diam. pipe to a point not less than 3ft. above the highest window, and bring up the other end of the drain to the ground level, so as at all times to allow a free current of air through. If the surroundings permit, the ground-level opening should be at the upper end, and the 4in. outlet pipe at the lower end; but this can only be decided by careful study of the site, and it is well to remember that there is always some liability to smells from the ground-level opening.

Hall.

[73223.]—**Ventilating Sewer.**—Put a 3in.

pipe at the nearest point to the sewer within the curtilage, and bring it to a little above the ground level. This acts as an air inlet. Run a 4in. pipe at the farthest end of the house right up to or a little above the ridge. Siphon-traps must be used to each closet, but no siphons between the air inlet and the ventilating shaft must be used. If the closets are one above another, the soil-pipe may be carried to the ridge and used as the ventilating shaft, but still no siphon or trap of any sort must be used between the air inlet and the ventilator.

PUSS.

[73223.]—**Drain Ventilator.**—Take a 4in. stack-pipe up both ends.

JACK OF ALL TRADES.

[73224.]—**Ventilating Bedrooms.**—One must first know the product of six bedrooms divided by a passage.

SM.

[73224.]—**Ventilating Bedrooms.**—Put a Boyle's ventilator in one side or end, and a panel of perforated zinc or copper gauze wire in the passage.

JACK OF ALL TRADES.

[73224.]—**Ventilating Bedrooms.**—There are so many ideas of what constitutes satisfactory ventilation that without much more information it is difficult to give a suitable reply. If the air of the passage is pure and can be warmed, I should draw the supply thence through tubes, turned so as to throw the current upwards, and form the outlets by cutting into the chimney and in bath room, protecting myself from down-draught by Arnott's balanced valves. The area of inlet to outlet should be as six to five, and the size proportionate to the size of room, number of persons, gas burners, candles, &c.

HALL.

[73225.]—**Furnace.**—I should never use a furnace. I should do it with a coke oven, building a muffle chamber over the flue.

JACK OF ALL TRADES.

[73226.]—**Steel Rust.**—What you most need is to ventilate your room, especially if you use gas. By this you will have improved health and no rust.

W. P. W.

[73227.]—**Marking Ink.**—Get some logwood, and boil with some water, strain off, and evaporate it to a thick syrup; get some small iron wire, and dissolve in a few drops of nitric acid and a teaspoonful of water; then mix, put a little methylated spirit on the thick sediment when poured off, then mix.

JACK OF ALL TRADES.

[73227.]—**Marking Ink.**—"Saul" should look up some of the back numbers of the "E. M." In Vol. XLIII. the following is given as an indelible marking ink:—Gelatine, two grains; bichromate of potassium, two grains; nigrosine, ten grains; water, 2fl.oz. Dissolve the gelatine and the nigrosine in most of the water, and the bichromate in the remainder. Mix the two solutions in an amber-coloured bottle.

A. C. WALKER.

47, Renfrew-street, Glasgow.

[73228.]—**Examination.**—Procure Slingo and Brooker's "Electrical Engineering," and Gisbert Kapp's "Electrical Transmission of Energy."

S. BOTTONE.

[73228.]—**Examination.**—"J. T. B." will find "Electricity in the Service of Man" and "Practical Electric Lighting," by A. Bromley Holmes, most useful. The former treats pretty fully of transformers in a supplementary section added in 1889.

J. N. C.

[73229.]—**Electric Lighting.**—Don't try it. See my answer in this number to query 73193.

CORAL.

[73229.]—**Electric Lighting.**—To MR. BOTTONE.—Eight Leclanché cells will light a small six-volt of about 2½c.p. for about ten minutes, when the cells must be allowed to rest again for an hour. Leclanché cells are no use for more than a few minutes' work. You will see the kind of battery you require described in my book, "Electrical Instrument Making for Amateurs." You will find the information you require about lamps in my lists. See my advertisements in "Sale Column."

S. BOTTONE.

[73230.]—**Converting "Chaster" Motor into Dynamo.**—If you cannot get on more than 1½lb. of wire on the fields, you had better try a somewhat finer gauge, say, 23 or 24. But at best the machine would only light three 5c.p. lamps of about 8 volts, or one 10c.p. of about 15 volts. The machine would undoubtedly work better as a dynamo if it had heavier F.M.'s.

S. BOTTONE.

[73231.]—**Signalling.**—I see no reason against your proposal, provided the temperature remains constant; but you are aware that the length of your rod will vary with the temperature. 800 yards of iron will increase in length ·35 of inch for *every degree* Centigrade, which means a possible 7in. between winter and summer.

SM.

[73233.]—**Electro.**—No, certainly not. Iron is used for electro-magnets; steel for permanent magnets. Go to the nearest bookseller and expend a shilling on a book, as the latter part of your communication is self-evident.

SM.

[73233.]—**Electro.**—A piece of soft iron cannot be magnetised permanently. If the horseshoe, as described by you, be wound with cotton-covered copper wire, and a current of electricity be caused to circulate round the coils, the iron becomes powerfully magnetic and remains so as long as the current passes. If a steel horseshoe be substituted for the iron, the steel becomes permanently magnetic, and the coil can then be removed. Magnetising by the electric current gives the most powerful magnets.

S. BOTTONE.

[73233.]—**Electro.**—To begin with, you cannot magnetise iron permanently. Steel is the metal to make a permanent magnet of, and you can have it either in the "bar" or "horseshoe" form. The strength of a steel magnet will not be in the least degree increased by having copper wire wound round its poles. An electro-magnet is something like what you suggest in your query—i.e., a piece of soft iron rod bent into horseshoe shape, with copper wire wound round its poles. Read up Silvanus Thompson's or other works on Electricity and Magnetism. They will assist you out of your difficulty.

Newcastle-on-Tyne. PERCY REID.

[73233.]—**Electro.**—If "Electro" would say whether he requires a permanent or electro-magnet, he, no doubt, would get the desired information. It would be impossible to magnetise a piece of soft iron without it being coiled with insulated copper wire, and then it would only become a magnet during the time a current of electricity was passing through the coil. In answer to the second part of the question—i.e., which is the best for magnets, iron or steel; if for an electro-magnet, pure soft iron is the best; if for a permanent magnet, steel made as hard as possible. I would advise "Electro" to get the back numbers of the ENGLISH MECHANIC, also a few textbooks on magnetism and electricity. When he has digested them, he will not ask a question in such a ridiculous form.

13, Chipka-street, London, E. GEO. LOWE.

[73233.]—**Electro.**—No, it will not be a magnet at all. If you wish to make a small electro-magnet, one may be made in this way: First obtain a piece of soft iron about 5in. or 6in. long and ½in or ⅓in. diam., bend it in the shape of the letter "U," get two ounces No. 20 cotton-covered wire (can be obtained at any science depôt or electrical stores), and begin by cutting the whole quantity of wire in half, cover each pole of the iron core with about two layers of waxed paper (which you may make by soaking tissue-paper in melted candle), then wind—evenly, tightly, and carefully—on each pole your two pieces of wire, beginning at the bottom, leaving an inch for connecting to battery, and wind to the top, then back again over that layer, and so on, until the whole wire is wound. Wind the other pole the same way; now connect the loose end of one coil to the secured end of the other—i.e., the inch left out at beginning; now connect the other two ends to the two ends of a battery, and it is now an electro-magnet which loses its magnetism when either connecting-wire is disconnected from either battery terminal. Why don't you try and get hold of a book on electricity and magnetism?

F. C. V.

A TUSK 7ft. long and a tooth weighing over 7lb., supposed to have been part of a mastodon, have been unearthed at Monson, Iowa.

**Coral Growth on Submarine Cables.**—Submarine cables have before now rendered unexpected services to science, and the following is one of the latest:—Very little, it seems, is as yet known as to the rate of growth of corals, but some very interesting details have been published by M. Alexander Agassiz in the August number of the *Bulletin of the Museum of Comparative Zoology at Harvard College* with regard to a series of specimens which were taken in June, 1888, off the Havana and Key West cable, from a portion repaired in the summer of 1881; so that the growths could not be more than about seven years. It must be noted that this portion of the cable was laid at a depth of only from six to seven fathoms, and that the district in which it was laid was most favourably situated as regards food-supply to the corals. Some of the specimens belong to species whose rates of growth have not yet been recorded. Verrill mentions that the thickness of the *Orbicella annularis* coral formed in 64 years was not more than about 8in.; the specimens from the Havana cable grew to a thickness of 2½in. in about seven years. *Manicina areolata* has grown to a thickness of 1in.; while *Isophylla dipsacea* shows a still more rapid growth, projecting 2½in. above the cable. Of course it is quite possible that these corals are of less than seven years' growth, but it is not probable that more than a short time passed before some of the swarms of pelagic coral embryos which must have floated past the cable found a place of attachment thereon.

# UNANSWERED QUERIES.

*The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.*

| | |
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# QUERIES.

[73234.]—**Electric Light for Bicycle.**—I wish to light a bicycle lamp by means of electricity, and I shall be greatly obliged by any information as to the best means of doing so. Would it be possible to have an accumulator sufficient to light a 2c.p. glow lamp for a space of three hours, of a sufficiently small size to be fitted within the lamp? If you consider this a practicable plan, will you kindly give me particulars of the way of carrying it out? I should be glad to hear from any correspondent who has himself lit such a lamp as I have described.—R. L. WALKER.

[73235.]—**To Mr. Bottone.**—I have a dynamo, pattern and size described in your book "The Dynamo," which I drive with horizontal engine, 2in. cylinder and 2ft. flywheel. Will light two 7c.p. 15-volt lamps. Is it possible to charge accumulators with same? If so, could you please give me size, and some idea how to make them?—ROK.

[73236.]—**Boiler.**—Will "Jack of All Trades," or any one else, suggest a harmless remedy for the following curious behaviour of a vertical boiler? It is new, made of the best Yorkshire iron, and daily used with the utmost care; but the interior rusts on the surface of the metal, and a finely divided powder, evidently oxide of iron, falls to the bottom of boiler. The first gallon of water from blow-off cock is of an opaque red colour. Feed water is clean and pure, and soda freely used.—FIREMAN.

[73237.]—**Tremolo Stop for American Organ.**—Would any reader give sketch and instructions how to make a tremolo to American organ with knee swell?—OTTO.

[73238.]—**Vaporifer.**—I have a high-pressure boiler in my kitchen, with flow and return pipes direct to the water tank 25ft. above. In which should the water boil first, the boiler or the tank?—E. W. B.

[73239.]—**Electric Lady.**—Will some reader kindly instruct me how to make battery and connect wires for electric lady?—BAZAAR.

[73240.]—**White Letters on Glass.**—Can any reader inform me how the white letters are produced on glass (clear)? Hydroflouric acid eats into the glass without leaving it with a matt or opaque surface. I only want to produce small letters.—H. E. EATES.

[73241.]—**Dynamo Heating.**—Many thanks to Mr. Bottone for reply. I was in error in stating revolutions at 1,780; should have been 1,800. I have now reduced to 1,700. I find, as you suggest, that the armature does heat. I will try some of the lamps in series. I have three [illegible]-volt 16c.p. and one 50-volt 20c.p. lamps on. I should have mentioned that F.M.'s were of cast iron. Would it decrease heating if I substituted wrought-iron F.M.'s? The dynamo was made to give 8 ampères at 45 volts. I should like it to run five or six hours. I will be obliged for any hints, and thank you in anticipation.—NOVICE.

[73242.]—**Graining.**—Can anyone give a recipe for mixing graining paint for wainscot oak, and how to get the graining or top colour paint off easy when wet to show ground?—S. P.

[73243.]—**To Mr. Bottone.**—I have a small electro-motor with a Siemens H armature. The field-magnets are horizontal, and stand with one pole-piece above the other, 2⅝in. in height, limbs 2¾in. long (taking in pole-pieces). These are wound with what I should think is about No. 24 s.c. wire. Wire space ⅜in., wound with as much wire as can be got on the limbs. Armature 1[illegible]in. by ¾in., wire space ⅜in., wound conveniently full with same wire as fields; coupled up as a series motor. What would be the probable power of this motor, and what number of quart bichromates (chromic acid) would be necessary? It works well with one. Should the cells be in parallel or series? Could the above be used as a dynamo if coupled up in shunt? If so, what would its power be, and what lamp, if any, would it light? If not, could I make a dynamo, as advertised by you at 15s., from the rough castings without a lathe, as I am very anxious to have one?—G. E. NEWLAND-SMITH.

[73244.]—**Artist's Oil Colours.**—Can any reader inform me the way to make oil colours as used by artists, and what is the best article to keep them in, so that they will not become hard?—J. L.

[73245.]—**To Mr. Bottone.**—Will you kindly inform me the quantities of wire required for making a motor, and of what B.W.G., to drive a small sewing-machine, what the least voltage would be required to drive same at a moderate rate, say, 50, 60, or less revolutions per minute. My idea was to drive same as dynamo off my safety, turning cranks by hand-power, and charge accumulators with enough E.M.F. to set it as a motor when the sewing-machine is required to be worked.—ROTOR.

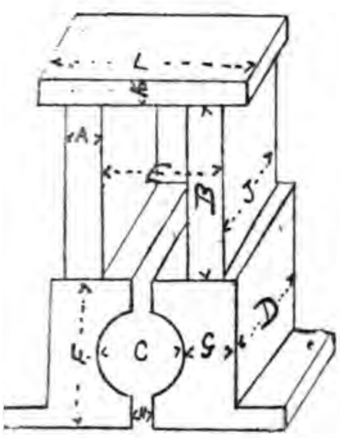
[73246.]—**Electrical.**—Having occasional use for electricity, I keep set up six cells, a kind of Daniell, but trong solution of salt and water in porous cells cs instead of sulphuric acid, as it gives me power ınd I find the zincs last much longer. But I cannot porous cells from "creeping" and falling of in I have ½in. of top and bottom of each cell soaked d paraffin wax. Zincs are amalgamated. How can t creeping? Also please say why I cannot prevent ı from burning away when set up as Daniell cells phuric acid and water (1 to 10). Even when well nated, they fizz and eat away at a great rate.—

.]—**Winding Electro-Magnet.**—Will Mr· or someone please answer the following queries: nding an electro-magnet, does the diameter of the he space over which the wire is spread have any , the strength of the magnet? If the wire was all m one end, would that make a stronger magnet 'ewer coils were wound over the whole length of ? I presume the thickness of wire makes no dif- 2. Would two bars of the same length, and coils equally form a horse-shoe magnet, if the ends nected by a thin strip of iron as a yoke? Which ost powerful—two separate bars or the same bars, s joined to form a horseshoe, and why? 3. How ake-and-break arranged in the toy known as the c see-saw"?—R. A. R. BENNETT.

.]—**Mandolin.**—Can I ask any of your readers can give me any information how to make a n, what it would cost to make a first-class instru- ıe wood to use, and tools?—K. C. B.

.]—**Voltmeter.**—I have read with interest 'or many years; also Mr. Bottone's "Dynamo: ade," both editions, and have made a dynamo cess. I read also the articles on "Electrical In- ts: How Made, &c.," by Mr. Bottone. I made from his directions, but the voltmeter was not a as I could not get the needle to budge 1-1000 of . I was determined to try again—this time the , described in "Ours" of 10th Oct., by the same the only difference was I used 36 German silver ered wire, instead of 40 German silver silk-covered e same result. Will Mr. Bottone or any other an help me in pointing to cause of failure, if it is ? I used ferrotype iron—such as used for tele- iaphragms, but burnt the varnish off before fixing ature, or what it might be called—the part that is to actuate the indicator point.—R. WATTS.

.]—**Dynamo.**—Would Mr. Bottone or Mr. :indly put dimensions on sketch of dynamo so as ı 30 volts at 4 ampères? The field-magnets to be



ght iron. Also what amount and size of wire to whether to be wound in shunt or series?—ETNA.

.]—**Diameters of Cylinders.**—I should feel if some of your numerous engineering readers xplain how the diameter of cylinders are measured ıal points, and the price of an instrument for ng same? How is the clearance ascertained in a ?—X. Y. Z.

.]—**Frightening Birds.**—Will some brother- ive me a sketch and particulars of a wind-work- ngement for frightening birds? I wish to erect pole in my orchard.—REMO.

.]—**Hon. E.I. Artillery.**—Will one of "ours" et me know where I can see the record of names who entered the Honourable East India Company's y? I believe the registers are kept.—CURIOUS.

.]—**Electric Railway.**—I am wanting to small model electric railway in a cheap but efficient Would Mr. Bottone or any kind reader assist informing me how to obtain the power to run How should I be able to reverse the direction of when running, as in the case of shunting and vements?—W. HOWE.

.]—**Electro - Magnet.**—Will Mr. Bottone ssist me what size electro-magnet shall I require me a pressure equal to a weight of 200lb. with ature 1in. from the face of the magnet? What of wire and battery power? Any shape magnet le.—T. R. T.

.]—**Coca Wine.**—Can any of your readers e with information as to how this should be made e coca leaves? Is the wine a decoction or an in- nd what are the quantities, and what other in- s should be used. I have purchased a bottle of , but the price is 4s. 6d. I see it is stated that glass contains a drachm of leaves.—VINUM.

]—**Gas or Steam-Engine.**—Will any of our nt engineers kindly inform me if a small gas- say, 2-man-power, would answer better than a gine and boiler of the same power in a small driving an ordinary 4in. back-geared lathe, 18in grindstone, and 14in. fan (separately)? Would a 2-man-power be powerful enough, as a small steam-engine and boiler wants so much attention? What is the relative parts of gas and air in the charge, and what is about the cost for running a 2-man-power gas-engine, with gas at 3s. per 1,000ft. per hour? I might add first-cost is not so much a consideration as the after economical working of the engine; and it is not wanted for a model, but for doing good work. Which is cheapest in working—gas or steam-engines for small power? An answer will greatly assist me, and I shall feel thankful for any hints.—LATHE-DRIVER.

[73258.]—**Fertilisation of Seeds.**—Can any botanical or microscopical reader tell me how to determine if small seeds are fertilised? I have heard it said that large seeds can be dissected, and by the appearance of the kernel fertilisation determined. Is this so?—E. A. A.

[73259.]—**Dynamos.**—Would Mr. Bottone or any of your readers kindly say what are the respective merits of a shunt and series-wound dynamo? For what kind of work is a shunt machine superior to a series, and why? I cannot find this clearly stated in any books I have read on the subject.—HASELEY.

[73260.]—**Lantern Pinion.**—Will "Bod" be kind enough to explain in detail the construction of the lantern pinion referred to in his reply No. 72855?—S. P. E. C.

[73261.]—**Problem.**—I should be obliged if any of your readers would give me a solution of the following problem in intermediate equations:—Three people—A, B, C—go to market to buy eggs. The eggs are being sold at two different prices. A bought 10 eggs, B bought 30 eggs, and C bought 50 eggs. Each spent the same sum of money. How many eggs at each price did each buy?—M. R.

[73262.]—**Lathe Cones.**—Would "F. A. M." please say which is best for a 5in. treadle screw-cutting and surfacing lathe for driving—whether strap or band, and the most suitable size of either, as I intend making one in my spare time? Any hints you may give will be thankfully received by—CONES.

[73263.]—**Bacteria.**—Will some kind correspondent briefly state which are the theories held at present concerning the curative properties of different attenuated cultures of pathological bacteria? Is it generally accepted that ptomaines kill the bacteria?—ANGLO-DANE.

[73264.]—**Telephones.**—Will Mr. Allsop be kind enough to recommend me a telephone which I can use at a lecture, and which is sufficiently loud-speaking to make the ticking of a clock tolerably well heard to the audience? —ANGLO-DANE.

[73265.]—**Three-Wire System.**—An exposition of this system of wiring, or reference, if it has been mentioned in this paper, would greatly oblige.—ANGLO-DANE.

[73266.]—**Skeleton Skates.**—Will some reader kindly tell me the best way to make a pair of skeleton skates? A working drawing would oblige.—VOLT.

[73267.]—**Drilling Square Holes.**—Could some reader kindly explain how square holes are drilled through metal?—VOLT.

[73268.]—**Electrical.**—Would some one kindly give me a few hints on the general manipulation of bichromate cells and Bunsen batteries, which I find very troublesome to keep in order? What are the names of those crystals which settle round the top of the porous pot of the Bunsens when put away uncharged for a week or so? Are they due to the fault that my carbon plates were not soaked long enough when cleaned, or what?—F. C. V.

[73269.]—**The Physical Basis of Music.**—In letter 31283, page 382, Vol. LI., "R. C. P." volunteered to give an account of the principles of harmony on the plan of the late Mr. Parkinson, which I should like to have seen. Would he kindly tell me where Mr. Parkinson's book is to be got and the price, as I am much interested in the subject? My address is advertised this week if he prefers to communicate privately.—J. EVERARD HUNT.

[73270.]—**Wheel-Cutting.**—Will some one kindly give me a rule for calculating the required wheels for screw-cutting? The leading screw of my lathe has four threads to the inch. I may say that I have just purchased Martin's "Tables"; but as they are calculated on the assumption that the leading-screw has two threads to the inch, they are useless to me.—M.

[73271.]—**Lantern Illuminants.**—To "Sm."—Thanks for your reply. I regret I did not make all clear in my query. The jets are blow-through, using one bag for oxygen and hydrogen from ordinary burner. I am wanting to adopt the chamber jet, and since your reply shall not use the etho-oxy system. When in the country I carry a bag of oxygen and a bag of coal-gas, and use my jets. It lasts about three hours. The bags are each 36 and 24 by 20in. wedge. What I am wanting to know is would the same bags be large enough for the chamber jets to last about two and a half hours? As the light is nearly double in power (by theory I suppose), do I want larger bags and more gas? From your reply I infer that the light being smaller I should not want larger bags. Also that pure hydrogen is best, leaving out the extra trouble. —SUDBURY.

[73272.]—**Electric Lighting by Water Power.**—The town I live in is situate on a tidal river of considerable size, spanned by a bridge of a dozen arches. At half-tide almost all the water, especially when ebbing, passes through one arch, 81ft. wide, so that there is a very large power at certain times. Could it be possible to utilise this power to drive a dynamo, so that the town could be supplied with the electric light? My idea is that a flat-bottomed boat might be moored in this arch with waterwheels underneath to drive the dynamo. Of course, as we are dependent on the tides which flow and ebb at different times, there would have to be some storage arrangement to supply light at times when the tides are turning, as then the waterwheels would not work. Have any of our numerous friends had experience in a similar case? If so, would they kindly state where, and give an idea of how it is worked?—ELECTRIC.

[73273.]—**Gas Balloon.**—Will some reader kindly give dimensions or capacity of a balloon equal to lifting from 1lb. to 2lb., the balloon to be filled with hydrogen gas?—JAS. FARRANT.

[73274.]—**Drilling Fine Holes through Glass.**—I want to drill fine holes through glass of about 1-10in. thick. The holes must not be larger than an ordinary pin. I have looked through back numbers, but have not seen any method by which this can be done rapidly and clean. I have to rivet pins in afterwards, and cannot allow more than three minutes per hole. I fasten the pins on with cement at present, but would feel safer if I can drill and rivet them in. I am told they can do them quickly at glass-works, but do not know anyone who can tell me the method and tools required.—GREEN.

[73275.]—**Gas Oven.**—I have in my kitchen an old-fashioned range with oven and boiler. The oven is not self-acting, but has to have a fire lighted under it whenever used, and as the mortar and rubbish used in setting the range have given way and stopped up the flue, the oven is quite useless. I have an idea of converting it into a gas oven. Will anyone who knows tell me if I can do this, and also how to proceed?—APOLLO.

[73276.]—**Safe Load of Beam.**—Can any of our scientific friends give a solution to the following problem? A beam will safely carry a stationary load of 5 tons with a deflection of 2in. From what height may a weight of 200lb. be let drop upon the same beam without deflecting it to a greater extent?—SCIENCE BOY.

[73277.]—**L. and N.W.R. Compounds.**—Will some reader inform me the average coal consumption of the L. and N.W.R. latest compounds when running express? What advantage, if any, have these locos. over the usual four-coupled ("Charles Dickens" class) employed on this line?—ZULU.

[73278.]—**Violin Cleaning.**—What shall I use to clean an old violin which has become black on the front? —F. W. HOLLAND.

[73279.]—**Crystoleum Painting.**—I thank "Sm" for his reply to my query; but considering the distance that separates us, would have been glad had he entered more fully into details. I have tried the spermaceti; also the white wax supplied with Keran and Son's sets with the same result—spots all over immediately after drying, and the superfluous spermaceti or wax has been rubbed off. Will feel obliged if some other readers will give their experience, for I am in a perfect fix. I would forward a C. de V. glass to any reader who would be kind enough to examine it.—RANGOONITE.

[73280.]—**Camera Obscura.**—Will any reader kindly say what kind of lens is used, and how the mirror is arranged? I want to make one and fix it upon a roof, and get the picture thrown upon a white table inside. Must the table be concave?—CORAL.

[73281.]—**Liquefying $CO_2$.**—Can "Jack of All Trades" or any other reader give me a few hints to construct an apparatus to liquefy small quantities of $CO_2$ gas?—KINO.

[73282.]—**Sensitometer.**—How should I proceed to make a Wernerke's sensitometer? Can one be procured ready made?—V. E. T.

[73283.]—**Examination.**—Will some one give me a few questions that have been asked by the Board of Examiners for mining certificate? Also name a good book for sinking and ventilation.—MINER.

[73284.]—**Stereoscopic Camera.**—Will some reader give instructions how to make a stereoscopic camera, and say would a pair of good achromatic object-glasses—one of an opera-glass—do for the lenses?—T. S.

[73285.]—**Coppering Carbon Plates.**—Will some of "ours" please inform me how to copper-plate carbons, so as to be able to solder to a metal, and what kind of battery will be best?—ONE IN A FIX.

[73286.]—**To Mr. Bottone.**—Would you kindly inform me if ebonite plates, about ⅛ thick, would do for a Wimshurst machine instead of glass, and should I get as good results? I have read your instructions in your book ("Electrical Instrument Making"), and wish to know if I used ebonite plates instead would they do?—LEO.

[73287.]—**Boiler.**—Will some reader kindly give dimensions for vertical boiler necessary to drive a 2½in. cylinder engine, the plates to be ⅛in. steel?—VERAX.

[73288.]—**Sussex Roads.**—What is the reason that many of the roads in Sussex are about 5ft. below the level of the adjoining fields?—ALFRED LLOYD.

[73289.]—**String Shrinking.**—Why do string and rope shrink when wet, while paper, more or less composed of same material, swells? Example: A sheet of paper is moistened to strain on a drawing board, while a tent-rope has to be slacked in wet weather.—ALFRED LLOYD.

[73290.]—**Tennis Balls.**—Is there any method of keeping unused lawn tennis balls through the winter, so as to prevent their becoming hard and losing their bound? —ALFRED LLOYD.

[73291.]—**Magic-Lantern Slides.**—Will any reader kindly inform me how to make slides for magic-lantern, and the processes of colouring them, and getting the outlines of pictures, &c.?—MAGICO.

[73292.]—**Ballistic Galvanometer.**—Can any electrical reader give me instructions for making same, the principles and uses of, or where I can obtain such information?—J. P. M.

[73293.]—**Collapsible Tubes for Paint, &c.**—1. What is the latest method of making above? I once saw some made by hydraulic press machine; but it made only one at a time, and that required drawing off the die. 2. What is capacity of present machines? Also power required and rough cost. 3. Some tubes are lead, others a composition. What is it? 4. How are the ends closed and folded? Can they be done several at once? Any information on this subject will oblige.—H. MATHER.

[73294.]—**Magneto Machine.**—To MR. BOTTONE.—You have an article on how to make a magneto machine in the "E. M.," Vol. XLVI. No. 1176. I am thinking about making one from that description, and I would like to ask you if it would not be possible to make the armature of that machine out of three pieces of iron, instead of filing it out of the solid piece of ⅞in. round iron, as described. I want to make it out of three pieces and fasten them together with counter-sunk screws, and what size wire would you say was the best to wind it with, No. 14 or 22? I shall be much obliged for any information.—FELIX.

[73295.]—**Electric Light.**—I want to light up my room with a 2½c.p. lamp. What is the best battery? How many batteries must I employ? What size must my elements be? Also what quantity of solutions? I want the lamp to light my room from one to two hours per day for two months, and must be as cheap as possible. Also how many volts and candle-power must I expect from a uni-direction machine with a magnet 8in. long, 1in. broad, and 1¼in. thick, with an armature 3ft. long and 1ft. diam.? What wire ought I to wind the armature with for electric lighting purposes? I should be very much obliged to any of "ours."—A BEGINNER.

[73296.]—**To Mr. Allsop or Mr. Bottone.**—I recharged a battery for an alarum bell about two months ago, and the other day I went to see about it because it was not ringing near so loud, and when I went to the battery the zincs were covered with salammoniac. I tested for short-circuit, but found everything right. The bell is a relay one, and it is in the next room to where the housemaid sleeps. Therefore she has to dress and go to stop it. The cells are just the common Leclanché ones, but the largest size. Do you think that the zincs get covered on account of the bell ringing too long? What do they put oil in battery cells for, and does it hurt them at all?—E. WILSON.

[73297.]—**Photographic Exposure.**—I have an International (Lancaster's patent ½-plate) camera and instantaneous shutter, and a movable scale engraved on lens tube with movable diaphragm. How must I use it, when taking instantaneous pictures? Must the diaphragm be open to largest opening always, dull or bright, and only to be used when shutter is off for portraits and cap is used, and how must I find out the right exposure? Is there any table or apparatus to be bought? Also, now the weather is rather dull, what should be the exposure with above camera for a dull day and for a day when sun is brightest? A few words would be of great value to others besides. Also time to copy a photo. out-doors and in sunshine as we get it now.—INTERNATIONAL.

[73298.]—**Telephones.**—I have been much interested and very much instructed as an amateur in this fascinating subject by your articles, and have, by their help, constructed very successfully two pairs of magnetic telephones—one pair larger than the other—and transmitters of the Hunning type as described, which are perfect but for one thing: the hissing noise in the transmitters, which seems a fault I cannot remedy, although I have tried many ways. With my telephones I can hear a breath almost, certainly a whisper, into transmitters at other end when no hissing is going on; but the transmitters of this form cannot be left stationary and talked at: they must be held up and occasionally shaken to separate the particles of carbon. I have therefore constructed two other forms of transmitters from your sketches, the grid-iron pattern used by the Post Office—and that with carbon pencils suspended in lead frame, the name of which I do not at the moment remember. Both of these are perfectly satisfactory; but, from my experience, require an induction coil, and this brings me to the main point of my letter. In using induction coils in conjuction with these carbon transmitters, should the telephones have permanent magnets or soft iron cores only, and should the telephones, if magnetic, be connected to a particular end of I. coil, or is it of no consequence? Which of secondary wires goes to north pole of telephone? The Gower-Bell telephone or receiver is described as a "powerful horseshoe magnet" with soft iron cores. By this I understand a magnet that is not permanent. Then, as to winding bobbin for the telephones, I find some that I first made with a diaphragm of 1¾in. and about ¾oz. No. 36 wire give better results than later productions which measure 3in., and have double that quantity of wire. Can you give any rule for quantity of wire. The magnets are permanent, 4in. in length. I am not sure that quantity of wire is the real cause of difference, but it may be that diaphragm of large ones are too large. At page 177 of "E. M.," No. 1335, the drawings of batteries are shown at the two stations as if connected up zinc of last cell of No. 1 instrument with zinc of that distance station, instead of to carbon, as I have always understood it should be. It seems zinc to zinc, carbon to carbon, instead of the reverse. I can get no result coupled up like this. Hints or information will oblige.—S. J. B.

AT Port Huron, Mich., it is said there is a scheme to cut a third tunnel under the St. Clair River to Sarnia, to be used by street cars, foot passengers, and waggons. The Grand Trunk will begin work on their second tunnel soon.

**The Band Saw.**—English mechanics, says an American paper, are said to depend much upon a tool which is but little used in America—namely, a band-saw for metals. Its construction, as described, is similar to that of a heavy band-saw, with a third carrying wheel for the saw, the object of this being to remove the up-moving side of the blade from the vicinity of the table, and thus leave a deep throat through which a large piece of work can be passed or a wide plate turned. This third wheel is placed at the back of the machine, about midway in the vertical height of the saw blade, the temper of the saw is slightly harder than that of those used for wood, and the teeth are sharpened straight across the blade by a cutter, with its teeth at the right height to suit the teeth of the saw blade. This tool is used for cutting off the spines from steel castings, the ends of bolts, to saw up steel, iron, and copper plates to any form, and to rough out the jaws of eccentric rods and other forgings which would require the use of slotting machines, and it cuts as well on a circle as upon a straight line. The blade is lubricated with soap and water, and in a cut 6in. long through a steel connecting-rod jaw it works freely and satisfactorily. Not infrequently circular-saws of large dimensions are used for the same purpose, and, being mounted on heavy frames and fed carefully up to their work, cut off large pieces of steel, leaving nearly a smooth surface on the face of the cut.

## ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

### HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** **Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

### CHRISTMAS DAY.

To complete publication before Christmas Day, it will be necessary to send the ENGLISH MECHANIC to press much earlier than usual next week. All advertisements must reach the Office by 5 *p.m.* on *Monday, December* 22, at the latest, and correspondents and advertisers are respectfully asked to send all communications possible by the preceding Saturday.

**The following are the initials, &c., of letters to hand up to Wednesday evening,** Dec. 17, **and unacknowledged elsewhere:—**

J. C.—"E.M." Reader.—A. T.—F. C.—C. W.—Pivot.—T. Weeks.—W. W. M.—Marine Modeller.—New Chum.—A. S. C.—Hathaway.—Ja Ha.—C. A. Jones.—E. J. P.—G. Howard.—J. Vickery.—Dutchman.—S. Bottone.—Mast and Block Maker.—F. M.—Ignorance.

A CONSTANT READER OF THE "E. M." (The best material to use in mending the seams of a macintosh is the "potent" solution sold at the shops. It is mostly india-rubber dissolved in bisulphide of carbon; but the naphtha solution will do as well. You must clean off "several kinds of glue" you have been trying—through constant reading, was it?)—NEON (Look in No. VI. this volume, p. 116, and refer to the indices for references to many recipes. Do not understand the use of the term "anneal" in connection with the waterproofing of paper. If you mean the Willesden paper, that is cured or waterproofed by means of cupro-ammonium; but merely passing paper through melted paraffin-wax will render it waterproof.)—J. T. (Do you mean for colour-blindness, or what? However, you stand no chance of becoming a locomotive driver unless you work your way up from the position of a cleaner. "Over-reading" would probably affect the eyesight; but what is "over"-reading? One thing is certain: if you have not strong distant vision, you need not attempt to get on to any railway in the running department.)—C. K. D. (The work is out of print, we think; but you might obtain a copy by advertising in the Wanted Column.)—PUZZLED. (The "Tables of Affinity" are to be found in the "Book of Common Prayer," and any clergyman or registrar will answer the question.)—MANGOE. (The recipes for chutney will be found in Nos. for Sept. 30 and Oct. 7, 1887. Recipes are also to be found in any good cookery-book.)—C. T. P. (Probably the twig did not move in your hands because you were acting bonâ-fide. It is not at all remarkable that the twig turned when the expert held your wrists. To understand the matter you must study psychology.)—KINO. (Diamonds of a small size by Mr. Hannay, and rubies by MM. Feil, of Paris; but the cost of production is too great to render them of commercial value. See indices of back volumes.)—LENS. (It has been given. You can obtain all general information about the British Astronomical Association from Mr. P. F. Duke, Hendon, London, N.W.)—MECHANIC. (It is mixed with sugar and treacle, and cooked in a sealed tube or other receptacle. The plates are cheaper to buy and better. 2. See "Hints," above. 3. Any compact motor will do; but what good purpose will it serve, looking at the weight that must be carried? See indices of back volumes and recent numbers.)

**Mr. Crowe's Remarkable Case.**—He obtained one of Harness' Electropathic Belts, which completely cured him in a few days. Writing from The Hill, Wickham Market, he says:—"I have been free from pain since the first week of wearing your belt. The original of his and thousands of other similar reports may be personally inspected, and the belts may be seen scientifically tested, at the Electropathic and Zander Institute, 52, Oxford-street, London, W., where the Medical Battery Company's officers may be consulted daily without charge, either personally or by letter. Pamphlet and book of testimonials free.

## TERMS OF SUBSCRIPTION.

PAYABLE IN ADVANCE.

6s. 6d. for Six Months and 11s. for Twelve Months, post free to any part of the United Kingdom. For the United States, 13s., or 3dol. 25c. gold; to France or Belgium, 13s., or 16f. 50c.; to India (via Brindisi), 15s. 2d.; to New Zealand, the Cape, the West Indies, Canada, Nova Scotia, Natal, or any of the Australian Colonies, 13s.

The remittance should be made by Post Office Order. Back numbers cannot be sent out of the United Kingdom by the ordinary newspaper post, but must be remitted for at the rate of 4d. each to cover extra postage.

Messrs. JAMES W. QUEEN and Co., of 924, Chestnut-street, Philadelphia, are authorised to receive subscriptions for the United States for the ENGLISH MECHANIC, at the rate of 3 dols. 25c. gold, or Thirteen Shillings per annum, post free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the receipt of the subscription. If back numbers are required to complete volumes, they must be paid for at the rate of 3d. each copy, to cover extra postage.

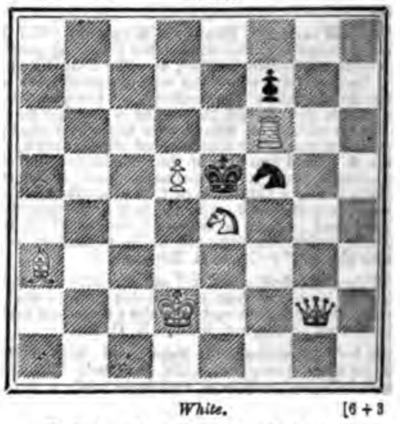
Vols. XXIV., XXX., XXXII., XXXVI., XXXIX., XL., XLII. XLIII., XLIV., XLV., XLVI., XLVII., XLVIII., XLIX. L., and LI., bound in cloth, 7s. each. Post free, 7s. 9d.

## CHESS.

ALL communications for this department must be addressed to "J. PIERCE, Knollside, Yawl, Lyme Regis, Dorset."

### PROBLEM MCCXXXIII.

*Black.*



*White.* [6 + 3

**White to play and mate in two moves.**

SOLUTION to 1231 will be given next week, on account of the error in diagram. The Black Bishop at K-B sq should be a White one.

### NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1231 by Biene, W. Jay, C. P. I., W. A. Clark, and J. H. Eastwood; to 1230 by J. Kistrek, E. Perrin, W. Jay, White Knight, F. W. N. Lambert (very pretty indeed), D. Mackay, and J. H. Eastwood.

D. McLEOD CRAIK.—If in 1230, 1. $\frac{\text{R-K 2}}{\text{Q takes R (ch)}}$.

W. A. CLARK.—It was difficult to select the best among so many excellent positions. We trust the award will give general satisfaction.

THE following is the judges' award in the recent Two-move Problem Tourney in the *British Chess Magazine*:—First prize, Lt. H. von Duben, Landskrona, Sweden; second prize, Herman Jonsson, Partilled, Sweden; third prize, Geo. Hume, Nottingham; fourth prize, J. A. Ros, Elmestad, Sweden. The Swedish composers have thus taken three prizes out of the first four. The fifth prize is won by A. F. Mackenzie, Kingston, Jamaica; the sixth by A. P. Silvera, Oracabessa, Jamaica; and the seventh by A. F. Mackenzie. There were 26 competitors, including some of our first composers. We append the first two positions. Both are very fine. No. 1—White: K-K B 4; Q-Q Kt 2; R's-Q 6 and K R sq; B-K Kt 3; Kt's-Q R 4, Q-Kt 6; P's-Q R 3 and Q 2. Black: K-Q B 4; R-Q Kt sq; B's-K sq and K-Kt 8, Kt-Q R 3; P's-Q 5, K 3, K Kt 4, and K R 7. White to play and mate in two moves. No. 2—White: K-Q B 7; Q-K R sq; R-Q Kt 5; B-K B 4; Kt's-Q R 5, Q B 5; P's-Q 2 and 6 and K 6. Black: K-Q 5; B-Q R 7; Kt-K Kt 5; P's-Q 6 and K B 4. White to play and mate in two moves.

IN the Two-move Sui-mate Tourney the prize winners are 1. J. Keeble; 2. Geo. Hume; 3. Rev. J. Jespersen; 4. B. G. Laws. Honourable mention: A. Bolus, G. Hume, J. Keeble, and J. A. Ros.

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*** It must be borne in mind that no Displayed Advertisements can appear in the "Sixpenny Sale Column." All Advertisements must be prepaid; no reduction is made on repeated insertions, and in cases where the amount sent exceeds One Shilling, the Publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

The address is included as part of the Advertisement, and charged for.

Advertisements must reach the Office by 1 p.m. on Wednesday to insure insertion in the following Friday's number

## NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a PINK WRAPPER, as an intimation that a fresh remittance is necessary if it is desired to continue the subscription.

**Rupture and Truss Torture is Terrible.**—Secure the Sherman method and avoid both. Call on or address J. A. SHERMAN, Hernial Specialist, 64, Chancery-lane, London. The photographs of extraordinary cases before and after cure to be seen at his offices are marvellous. His book, post free, 7d.—[ADVT.]

**Holloway's Pills give potency to the nervous** system, which is the source of all vital movements, and preside over every action which maintains the growth and well-being of the body. They are most unfailing antidotes to indigestion, irregular circulation, palpitation, sick headache, and costiveness, and have thereby attained the highest reputation.

English Mechanic
LD OF SCIENCE AND ART.
*AY, DECEMBER* 26, 1890.

## ATIC BOILER-FEEDERS.

ervation of a fairly constant
level is a very important condi-
satisfactory working of a steam-
w far the absolute normal level
arted from in either direction,
ailing serious inconvenience or
for each boiler depend upon its
gn, a much larger range being
in some types of construction
rs. If the water level falls below
imit, burnt furnace crowns,
distortion, or even complete
ensue; and, on the other hand,
water level will encourage
l keep the steam in a wet condi-

it is obvious that a means of
a constant water level in a steam
reat desideratum, and in some
s, absolutely necessary to the
ing and durability of the boiler.
-boiler suitably proportioned to
the pressure and temperature
actically constant, and therefore
er ought to be supplied in exact
the quantity of water passing
and any leakage that may exist.
ically constant service of feed-
t practically answer the condi-
d; because the consumption of
ary, and the loss through safety
vary, even if the most perfect
oking is in use, for then varia-
alorific value of fuel cannot be
y dealt with in such a manner
e uniform evaporation. Under
istances, one conclusion only can
and that is—that the feed-water
e boiler must be regulated by
water in the boiler.

condition has been recognised by
tors; but the majority of them
oked collateral conditions which
to avoid waste of fuel, and some
ed feeding contrivances of which
xcessive, either in manufacture
nt attendance. To review even
ese inventions would occupy far
han is at our disposal, and would
edifying than a very brief notice
fects, typically considered, with
pointing out the practical course
ed, so far as such a matter can be
eated.

gement of hollow valve, of a box
ing between two port faces in
that it will fill with water at
pressure on one side, and dis-
water so received at boiler pres-
other side, is a very simple
t, and might at first sight be
solving the question under con-
f the valve is so arranged as to
practically constant water-level
. Such an arrangement generally
charging water from the boiler
ises in the slightest degree above
level, so that at each alternate
is first a supply of cold water,
lischarge of hot water, and there-
of heat, for the water thus dis-
only be returned to the boiler,
ower temperature or by a pump
eans involving consumption of
s method of feeding boilers has,
ne advantages, if the details are
igned, to which we shall refer
.

earliest days of boiler-con-
wn to the present time, float
as been found useful, and has
been largely adopted. In the old days of low-pressure boilers (7lb. per square inch), which could be fed by gravity from tanks at moderate heights, a properly-arranged float was sufficient to secure a constant level; but with the advent of higher pressures, when a sufficient head of water was not always at hand, the float could only be used to actuate feed-pumps, and in later years to control injectors. The proper arrangement of floats in high-pressure boilers is a matter that should be generally understood, for such devices, properly designed, are of great service; but, ill-designed, are worse than useless.

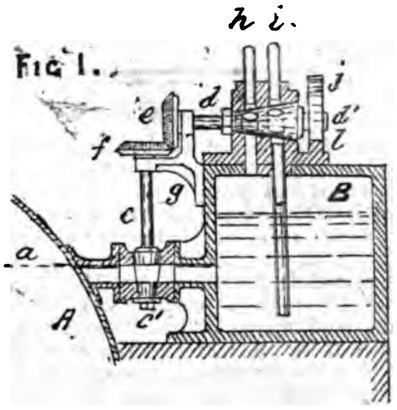


FIG 2.

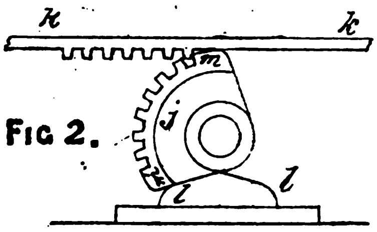
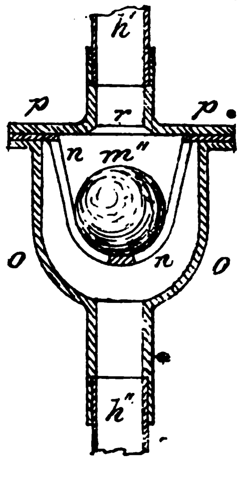


FIG 3.



A steam boiler's float should always be solid to prevent the possibility of collapse, and it should be so counter-balanced as to be almost submerged. The material of which it is composed must be of a nature unchangeable by water and steam, and not liable to attract deposits of scale.

One disadvantage of float apparatus consists in the slowness of its action—it is, of course, essential that on the slightest fall of the water level the feed appliances should be set in action, and in order to attain this end some ingenious contrivances have been designed.—Some of these consist essentially of a float placed in a pipe which enters the boiler, and descends vertically to the normal water level, where it terminates in an open end. The idea is that while the water is sufficiently high to cover the end of the pipe, the pipe will keep full of water, and so support the float at its upper end; but upon the water falling below that level, the water will run out of the pipe and at once give the float a considerable fall, and immediately set in action the feed apparatus with which it is connected. The emptying of the pipe will certainly follow the fall of water level, but its refilling on the restoration of its normal level is a matter of uncertainty; it pre-supposes the condensation of steam within it, and if the pipe remains at the same temperature as the steam within the boiler, such condensation will not occur. In order, therefore, to render such an arrangement effective, the vertical pipe should be outside the boiler, and it would be advisable to cause the feed water, on entering the boiler, to pass through a casing surrounding the float pipe, so as to insure condensation of contained steam, and therefore a refilling of the pipe as soon as the water in the boiler rises above its open end. Another contrivance for starting and stopping feed apparatus supersedes the use of a float. A vessel of convenient size is supported on springs, and connected with the boiler by flexible tubes in such a manner that the vessel is free to move vertically between certain limits, and the water surface within it is always at the level of that within the boiler. If the water level falls, the quantity of water in the vessel will be reduced, and also its weight; therefore the vessel will be lifted up by the springs, and by suitable connections start the feed pump. As the water level rises, the vessel will gradually settle down to its normal position, and stop the further supply of feed water.

The salient fault of a great many automatic boiler-feed appliances lies in their being unnecessarily complicated and expensive, and such complication further renders them very liable to derangement. The object of automatic regulation of feed being to take this duty out of the hands of an attendant, it is obvious that if the apparatus itself requires special looking after the purpose for which it is made is frustrated, for if the work must be done by the attendant, the simplest appliance, a plunger pump or an injector, is the best to be used, and of these the pump is the more certain in its action, for, on starting, an injector usually requires adjustment, which must be effected manually.

We will now return to that class of boiler feeders in which the water is received in an intermediate vessel at atmospheric pressure, and subsequently allowed to flow into the boiler at boiler pressure, and describe a form which will maintain a practically constant level, and not require the waste of hot-water referred to previously.

In Fig. 1 A represents part of the shell of a boiler in transverse section, and B a vertical section of an automatic boiler-feeder connected with it; *a* indicates the level above which it is not desirable for the water to rise. The feeder consists of a tank or receiver, B, which has one inlet and two outlets, each of which is controlled by an ordinary two-way cock. Two of these cocks are carried by one stem, *d*, and may conveniently be made in one piece; they control the water supply which flows by gravitation down a pipe, *i*, from an elevated tank and an air and steam escape pipe, *h*, through which air and any steam that may be in the receiver escape as the water flows in. The pipe *h* must be arranged to prevent waste in case of overfilling of the tank B; for this purpose the pipe may be carried up into the supply tank overhead; but it is not desirable to let the pipe *h* fill with water, as it would do in such an arrangement if the chamber B over-fills; therefore it is better to use a check-valve, a convenient form of which is shown to an enlarged scale at Fig. 3. As near the bottom of the pipe *h* as is convenient a valve-box, *o o*, *p p*, is inserted, the two ends *h' h''* of pipe *h*, being screwed, or otherwise secured, to the top and bottom of the valve-box, as shown. In normal working, a sphere, *m''*, is supported in a cage, *n n*, which cage is formed with a ring that is bolted between the flanges of the parts $oo$ and $pp$ forming the valve-box. So long as air only, or air mixed with steam, passes up pipe $h$, the ball-valve $m''$ will rest in its cage; but should water rise in the pipe, it will be floated up against a seating, $r$, turned or ground to fit it, and thus check the further rise of water. The two cocks on the spindle $d$ turn together, and communication between the pipes $h$ and $i$ and tank B is simultaneously opened and closed. In the position shown in Fig. 1 these cocks are closed, and a cock of communication, $c'$, between the tank B and boiler A is opened. It is essential that this cock should be shut when these controlling pipes, $h$ and $i$, are open, and *vice versâ*; otherwise we should be having steam and water blowing to waste up the pipes $h$, $i$ as soon as boiler pressure was admitted to chamber B.

In order that the several cocks may be worked in proper sequence, their spindles $d$ and $c$ are connected by bevelled spur-wheels, $e$ and $f$, of equal diameters, keyed on the spindles $d$ and $c$, of which the ends are supported in bearings carried by a bracket, $g$, fastened on to the side of the tank B. The opening or closing of each cock requires one-eighth of a turn of its spindle; therefore, by giving the spindles a quarter-turn, one valve is closed and the other opened. This movement is given to the cocks through a toothed quadrant, $j$, actuated by a short rack on a reciprocating rod, $kk$, and keyed on to a projection, $d'$, which is practically an extension of the spindle $d$. The rack and quadrant motion is shown to an enlarged scale at Fig. 2. It is necessary that the movement of the quadrant $j$ shall be intermittent, in order to leave intervals of time for the charging and discharging of the chamber B, therefore a much longer stroke is given to the rod $kk$ than is necessary to turn the quadrant through a quarter of a revolution. After arriving at the position shown at Fig. 2, the rod $kk$, during the remainder of the stroke, rides upon the projection $m$ of the quadrant, which may be there fitted with an anti-friction roller, to save wear and unnecessary resistance. On the return stroke, after the quadrant is drawn over the smooth part of the rod, $kk$ will ride upon a projection, $m'$. The motion of the quadrant is limited in each direction by rests, $l$, which are covered with indiarubber, or with leather, to prevent concussion and rebound. The rod $kk$ is worked from any convenient running shaft, and at a speed determined by the requirements of the boiler and the capacity of the intermediate chamber B. According to the adjustment of the rod $kk$, the intervals of rest can be varied, for it is evident that if the rack does not act on the quadrant at mid-stroke, the rest before its outstroke action will not be of duration equal to that after such action. By making the rack adjustable longitudinally upon its rod, these periods may, by trial, be very nearly brought in accordance with the most perfect action of the apparatus. We have shown how the tank B is filled through pipe $i$, while air and steam escapes through pipe $h$; let it now be supposed that cock $c'$ is opened, the others being, of course, closed. If the water in the boiler is below the level $a$, as soon as communication is open, steam flows into the chamber B, and water into the boiler, until the water-level reaches $a$, when the water will seal the opening, and no more water leave B, because no steam can pass in to occupy the top part of that vessel. Should water be drawn back into B by partial condensation of steam, the opening to cock $c'$ is at once uncovered, and the water-level restored; in fact, while the cock $c'$ is open a constant flow into the boiler occurs, balancing the constant expenditure by evaporation. It is, in view of this condition, desirable that cock $c'$ shall in regard to the cocks on spindle $d$ remain open as long as possible; therefore, in proportioning the apparatus, it should be arranged to fill as quickly as possible, so as to extend to the maximum the interval during which cock $c'$ remains open.

Now it is evident that when this contrivance is used, the line $a$ represents the fixed upper water-level, and thus a security against priming is afforded, which is very important. In some inventions that have been patented and are in general appearance somewhat similar to our illustration, a communication is opened between the steam space of the boiler and the intermediate chamber, the result of which is that the water-level in the boiler may reach that in the intermediate chamber, and therefore exceed the high-level limit. This will necessitate the removal of surplus water, and as such water will be at boiler pressure and temperature, a loss of heat ensues.

## REVIEWS.

*Asbestos: its Properties, Occurrence, and Uses.* By ROBERT H. JONES. London: Crosby Lockwood and Son.

ASBESTOS now occupies so important a position in the industrial arts that many will be glad to have such a work as that provided for them by Mr. Jones. Scattered through the scientific and technical serials, and through the *Transactions* of societies there are many papers containing valuable notes on asbestos, the peculiar properties of which are well known, if it has not hitherto been so widely utilised as it might be. Mr. Jones is one of those who believes that in the future there will be few branches of practical mechanics, art, or industry in which asbestos will not find a place, and a useful place; and he has accordingly gathered into a handy and readable volume all the information available. Asbestos is certainly one of Nature's puzzles, for it is a sort of mineralogical vegetable (if there can be such a thing), at once fibrous and crystalline, elastic and yet brittle, a "floating stone," but properly treated, as capable of being spun and woven as cotton or flax, or any other textile material. It is safe to say that no one knows in how many parts of the world asbestos can be found, but the best known districts are in Italy and in Canada; some of the asbestos from the former country resembling as nearly as possible floss silk, while others have more of a rocky or "lump" character, but all eminently useful in their ways. The author has presented us with a most interesting book, full of information and freely illustrated, and one which may be commended to the attention of all who wish to learn the facts about that curious mineral, asbestos, which has been known (and yet so little known) for many centuries.

*A Treatise on Electro-Metallurgy.* By WALTER G. MCMILLAN, F.I.C., F.C.S. London: C. Griffin and Co.

THIS work is at once theoretical and practical, for it contains all that the operator needs to know, while at the same time it provides him with facts which he can utilise if he has the requisite brain-power or the inventive faculty. The author has wisely treated the subject in a technological, rather than in a technical, manner, recognising the fact that the operator who has to use a brush or a polishing dolly, for instance, will soon find out how best to use those appliances, while he may be ignorant of the principles on which he works. The author has, in fact, as he puts it, aimed at a combination of theory and practice, and those who wish to practise the art of electro-metallurgy will find in the pages of his book as much information as they need to carry on the work with satisfaction to themselves and others.

*The System of the Stars.* By AGNES M. CLERKE. London: Longmans and Co.

MISS CLERKE is well known as a graceful, instructive, and accurate writer on matters connected with celestial science, and the work before us will certainly add to her fame. Miss Clerke says that "sidereal science has a great future before it," and that astronomy is essentially a popular science. So believing, she has presented the public with a work on the stars which will, we think, become very popular wherever students are found, especially as it is freely illustrated, and contains a number of reference notes which will be useful to others besides beginners. Miss Clerke has had "assistance" from many famous professors or students, and has thus been enabled to make the volume a complete description of the starry heavens. The frontispiece is a reproduction of the photographic chart of the Pleiades taken by MM. Henry, of Paris, while Mr. Roberts has permitted the use of some of his marvellous photographs. The volume is a welcome addition to the astronomical library.

We have also received—*Electricity in the Service of Man* (London: Cassell and Co.), a new edition of Ritter von Urbanitzky's work, which has been revised and enlarged by Dr. Walmsley, and provided with an introduction by John Perry, F.R.S. Originally translated by Dr. Wormald, it is now an excellent, popular, and practical treatise on the applications of electricity, and is excellently adapted to the wants of those who have not time for exhaustive study, but wish to make themselves acquainted with the facts of electrical science.——*Electric Bell Construction*, by F. C. ALLSOP (London: E. and F. N. Spon), is an extended and revised reprint of the articles which appeared lately in our columns, and no doubt many readers will be glad to have the information in this handy form.——*Electro-Motors*, by S. R. BOTTONE (London: Whittaker and Co.), is intended for the use of amateurs and practical men, and readers will, no doubt, recognise the value of the information.——*Metal Turning*, by a "Foreman Pattern Maker" (London: Whittaker and Co.) is a useful handbook for amateur or apprentice, as it is written by one who speaks from years of actual experience of the practice of the workshop.——*Electric Light*, by JOHN W. URQUHART (London: Crosby Lockwood, and Son), is the fourth edition of a work describing the method of treating dynamos, batteries, accumulators, and lamps, and is useful to all interested in the actual work of electric lighting.——*The English and American Mechanic*, by FRANK VAN CLEVE (London: E. and F. N. Spon), is a new and enlarged edition of a well-known manual, which has been revised by Mr. Emory Edwards. It is literally full of useful information, presented in a handy form, and suited to the wants of the manufacturer and the intelligent craftsman.

## ASTRONOMICAL NOTES FOR JANUARY, 1891.

IN accordance with our annual custom, we commence our Astronomical Notes for the New Year with such remarks as may be necessary to make them intelligible to the ordinary amateur observer; and in the case of the tables we, as heretofore, have appended to each one which appears to require it, a description of its construction and mode of use, furnishing, moreover, wherever it is necessary, numerical examples fully worked out.

Before proceeding to a description of Table I., however, we propose to make a few remarks upon two points, which we trust may save a good deal of useless correspondence. Imprimis, then, we have been asked to issue these Notes two months in advance, in order that they may be utilised by our Australian readers. But a moment's consideration will show that separate and special ephemerides would have to be computed for our Antipodes; for that all the nearer celestial objects change their places notably as viewed from stations so widely separated both in latitude and longitude as those in England and Australia. In

; as those of the phenomena of Jupiter's a great proportion visible at Greenwich cur when the planet was beneath the .e horizon ; while, in the case of occul- f stars, the Moon in the Southern ; would go wide in the sky from those ıe would cover as viewed from Green- he second subject on which we propose .s this : At intervals, long or short, we tters asking what we mean by saying and such a planet is "invisible," when spondent saw that planet with the naked e previous night? Our answer is very Our ephemeris of a planet is given ng as there is a reasonable chance on a ; of an observer detecting any superficial n it. When its angular diameter is too it is too close to the horizon after dusk, airly be said to be invisible for the f the observer with the telescope, and . Let us take Mars as an illustration. below that he is, for the observer's invisible, though, as a matter of fact, .ot set until between 9 and 10 p.m. ; ameter subtends an angle, at the end t week of the New Year, of 6·7", or that l by a halfpenny 2,561ft. (853½ yards) ıat sane man, we would ask, would, ese circumstances, attempt to observe ı a telescope?

' said which, it is time to turn to our —that of the Sun—in column two of l be found, for every fifth day of the ıe instant which should be shown by a Greenwich regulated to indicate Mean ıen the Sun is on the Meridian (or due d a sundial marks 0h. 0m. 0s. What ıacs call "the Equation of Time," or ıt to be added to, or subtracted from, ıt of apparent Solar Noon, is calculated leridian of Greenwich, but may, for purposes, be employed for any other the United Kingdom, since its most point, Valentia, is only 41m. 23s. West wich (less than 0·69 hour), and the in the equation for one hour is but Jan. 1, and diminishes to 0·36s. by the antity the largest and most perfect sun- olly impotent to show. Columns three give the Right Ascension and Declina- Sun (to the nearest second of time respectively) on the days specified, lean Time clock at Greenwich marks s. Finally, column five furnishes the ension of the Meridian, or Sidereal the nearest hundredth of a second, at instant.

### The Sun.

| | At Greenwich Mean Noon. | | |
|---|---|---|---|
| hs. | Right Ascension. | Declination South. | Sidereal Time. |
| s. | h. m. s. | ° ′ ″ | h. m. s. |
| 4·83 PM | 18 47 9 | 23 0 41 | 18 43 23·99 |
| 2·12 ,, | 19 9 9 | 22 30 8 | 19 3 6·78 |
| 8·11 ,, | 19 30 58 | 21 48 30 | 19 22 49·57 |
| 9·06 ,, | 19 52 31 | 20 56 15 | 19 42 32·36 |
| 2·22 ,, | 20 13 47 | 19 54 3 | 20 2 15·14 |
| 6·02 ,, | 20 34 44 | 18 42 37 | 20 21 57·93 |
| 9·78 ,, | 20 55 20 | 17 22 41 | 20 41 40·71 |

antity tabulated in the last column Time at Mean Noon) is one often by the observer for the instant of n Noon at his own station ; and this btained by the addition of 9·8565 r every hour (and proportional parts es and seconds) when the place is to of Greenwich, and by their subtraction to the East. For example: What is al Time at local Mean Noon at Belfast y 11? The longitude of Belfast is west of Greenwich. So we say:— 23m. 40s. : : 9·8565s. : (what we shall 3·88784 seconds. Now turning to the ve, we find that the Sidereal Time wich Mean Noon on January 11th is . 49·57s., and adding 3·89s. to this, to the precept (Belfast being west), we ı. 22m. 53·46s. as the Sidereal Time at ean Noon on the day specified. Or ıat we required the Sidereal Time at Mean Noon on the 26th of January.

### Occultations of (and Near Approaches to) Fixed Stars and an Occultation of Neptune by the Moon.

| Day of Month. | Star's Name. | Magnitude. | Disappearance. | Moon's Limb. | Angle from N. Point. | Angle from Vertex. | Reappearance. | Moon's Limb. | Angle from N. Point. | Angle from Vertex. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | h. m. | | ° | ° | h. m. | | ° | ° |
| 5 | 2 Libræ | 6 | 5 28 a.m. | Bright | 164 | 182 | 6 25 a.m. | Dark | 262 | 271 |
| 7 | ω¹ Scorpii | 4 | 5 20 ,, | Bright | 161 | 191 | 6 6 ,, | Dark | 249 | 275 |
| 7 | ω² Scorpii | 4½ | †6 8 ,, | S.S.W. | 205 | 230 | | | | |
| 13 | τ¹ Aquarii | 6 | 6 29 p.m. | Dark | 106 | 78 | 7 11 p.m. | Bright | 196 | 163 |
| 13 | τ² Aquarii | 4 | 7 28 ,, | Dark | 63 | 28 | ‡8 24 ,, | Bright | 243 | 205 |
| 17 | ξ¹ Ceti | 4½ | 3 29 ,, | Dark | 81 | 112 | 4 33 ,, | Bright | 215 | 236 |
| 17 | ξ Arietis | 5½ | 11 5 ,, | Dark | 57 | 18 | 12 6 a.m. | Bright | 259 | 219 |
| 18 | B.A.C. 755 | 6 | 12 2 a.m. | Dark | 108 | 69 | 12 47 ,, | Bright | 211 | 172 |
| 19 | ω¹ Tauri | 6 | 11 44 p.m. | Dark | 59 | 20 | 12 48 ,, | Bright | 275 | 233 |
| 20 | NEPTUNE | — | 3 13 a.m. | Dark | 128 | 90 | 3 50 ,, | Bright | 213 | 179 |
| 22 | B.A.C. 2154 | 6½ | 3 46 p.m. | Dark | 64 | 103 | 4 41 p.m. | Bright | 279 | 321 |
| 23 | ω Geminorum | 6 | 5 25 a.m. | Dark | 173 | 134 | 5 39 a.m. | Bright | 202 | 164 |
| 25 | γ Cancri | 4½ | †3 27 ,, | S.S.W. | 200 | 161 | | | | |
| 27 | 42 Leonis | 6 | 3 14 ,, | Bright | 96 | 76 | 4 24 a.m. | Dark | 322 | 290 |
| 28 | ν Virginis | 4½ | 10 56 p.m. | Bright | 118 | 155 | 12 7 ,, | Dark | 296 | 328 |
| 31 | 65 Virginis | 6 | †6 59 a.m. | NE by N | 31 | 7 | | | | |

†Near approaches. ‡ The Moon has set.

Yarmouth is 6m. 52s. east of Greenwich; and, as before, we say: as 60m. : 6m. 52s. : 9·8565s. : 1·128s. Subtracting this, Yarmouth being east, from 20h. 21m. 57·93s., we finally get 20h. 21m. 56·80s. as the Sidereal Time at Yarmouth Mean Noon on January 26th, 1891.

Solar activity is now permanently re-established, and the sun should be watched for spots, faculæ, &c., whenever he is visible.

### The Moon

enters her Last Quarter at 10h. 11·9m. a.m. on the 3rd, and is New on the 10th at 3h. 24·5m. in the afternoon. She will enter her First Quarter at 6h. 17·5m. in the early morning of the 17th, and be Full 25·3 minutes after the midnignt of the 24th.

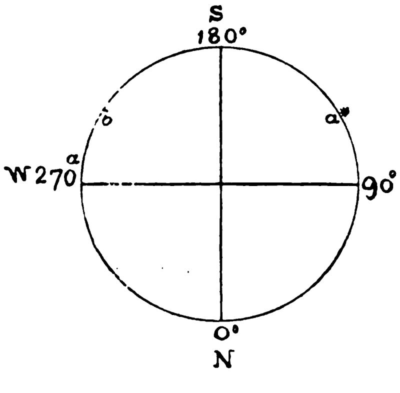
| Day of Month. | Moon's Age at Noon. | Souths. |
|---|---|---|
| | Days. | h. m. |
| 1 | 20·4 | 4 34·5 a.m. |
| 6 | 25·4 | 8 8·5 ,, |
| 11 | 0·9 | 1 4·9 p.m. |
| 16 | 5·9 | 5 35·4 ,, |
| 21 | 10·9 | 9 42·5 ,, |
| 26 | 15·9 | 1 3·8 a.m. |
| 31 | 20·9 | 4 33·7 ,, |

The Moon will be in conjunction with Venus (4° 19′ South of that planet) at 6h. p.m. on January 7th; with Mercury at midnight on the 10th (Mercury 5° 57′ North), with Jupiter at 8h. a.m. on the 12th (Jupiter 3° 59′ North); with Mars at 3h. p.m. on the 14th (Mars 4° 58′ North); and with Saturn at 10h. a.m. on the 28th (Saturn 3° 15′ South).

The opening year finds the Moon in Leo, but on the confines of Virgo, which last-named constellation she enters at 3 p.m. on the 1st. It is not until 5 a.m. on the 5th that she quits Virgo for Libra, and she is travelling through Libra until 2 a.m. on the 7th, at which hour she reaches the western edge of the narrow northern spike of Soorpio. It takes her 11½ hours—i.e., until 1h. 30m. the same afternoon, to cross this, and she then emerges in Ophiuchus. She remains in Ophiuchus until 11 p.m. on the 8th, when she quits it for Sagittarius. Here she remains until 6 a.m. on the 11th, when she enters Capricornus, which she traverses by 9 p.m. on the 12th, then leaving it for Aquarius. She finishes her journey through Aquarius at 8 p.m. on the 14th, and then enters Pisces. As she is travelling through Pisces she, at 10h. a.m. on the 15th comes to the boundary of Cetus, which constellation she then enters and continues in until 11 a.m. on the 16th, when she re-enters Pisces, only however to plunge into another outlier of Cetus at 9 a.m. on the 17th. When she finally quits this at 6h. p.m. on the 17th it is to emerge in Aries. She leaves Aries for Taurus at 2h. 30m. a.m. on the 19th, and Taurus in turn for Gemini at 2 a.m. on the 22nd. Her passage through Gemini occupies her until 5h. a.m. on the 24th, when she quits it for Cancer. She is in Cancer until 9 p.m. on the 25th, at which hour she passes into Leo. She remains in Leo until 9 p.m. on the 28th, and she then, for the second time this month, enters Virgo. She is still engaged in her journey through this great constellation when the month terminates.

The first four columns of the table above explain themselves. The fifth, headed "Moon's Limb," indicates whether the limb at which the disappearance takes place is the bright or the dark one; column nine giving the same information with reference to the reappearances. From new moon to full moon disappearances occur at the dark limb and reappearances at the bright one; and *vice versâ*. In columns six and seven, and ten and eleven, by "Angle from N Point" is meant the arc included between the star when in contact and the point of intersection of the limb with a circle passing through the north pole of the heavens and the centre of the moon's image; and by "Angle from Vertex," the arc between the star at contact, and the point where a circle passing through the zenith and the moon's centre cuts her limb: in other words, the *top* of the moon as seen with the naked eye.

A figure will illustrate this. Here N is the



true north point of the moon's circumference (the bottom as seen in an equatoreal with a Huyghenian eyepiece), and the angles are measured right round from 0° to 360°, through east, south, and west. Hence a star disappearing at *a* would be said to do so at an angle of 120° from the N. point; and were it to reappear at *b*, it would be said to do so at an angle, from the N. point, of 240°,—and so on.

### Mercury

Is an evening star during the first ten days or so of January; but coming into inferior conjunction with the sun at 6 p.m. on the 13th, afterwards becomes a morning star. His angular diameter increases from 7·6" on Jan. 1st to 10" by the 12th, diminishing to its original dimensions by the last day of the month. He sets soon after 5h. 30m. p.m. on the 1st, and is skirting the horizon for some time previously, so that he is but poorly placed for the observer. At

### Approximate Times of the Greatest Eastern Elongations of Saturn's Five Inner Satellites, visible at Greenwich.

| Day of Month. | Satellite. | H. | Day of Month. | Satellite. | H. | Day of Month. | Satellite. | H. |
|---|---|---|---|---|---|---|---|---|
| 2 | Enceladus | 12·8 a.m. | 14 | Mimas | 3·1 a.m. | 22 | Tethys | 12·0 p.m. |
| 2 | Tethys | 5·8 ,, | | | | 23 | Enceladus | 10·9 ,, |
| 4 | Tethys | 3·0 ,, | 15 | Mimas | 1·7 ,, | 24 | Tethys | 9·3 ,, |
| 5 | Rhea | 6·9 ,, | 16 | Mimas | 12·3 ,, | | | |
| 6 | Tethys | 12·3 ,, | 16 | Mimas | 10·9 p.m. | 28 | Enceladus | 1·5 a.m. |
| 6 | Enceladus | 3·4 ,, | 17 | Enceladus | 2·5 a.m. | 28 | Mimas | 6·4 ,, |
| 9 | Dione | 5·5 ,, | 17 | Mimas | 9·5 p.m. | 29 | Mimas | 5·0 ,, |
| 10 | Enceladus | 6·0 ,, | 19 | Tethys | 5·4 a.m. | 30 | Mimas | 3·6 ,, |
| 11 | Dione | 11·1 p.m. | 20 | Dione | 4·1 ,, | 31 | Mimas | 2·2 ,, |
| 12 | Mimas | 5·9 a.m. | 21 | Tethys | 2·7 ,, | 31 | Dione | 2·7 ,, |
| 12 | Enceladus | 11·8 p.m. | 21 | Enceladus | 5·1 ,, | | | |
| 13 | Mimas | 4·5 a.m. | 22 | Dione | 9·7 p.m. | | | |

the end of the month he rises about 6·18 a.m., but is in as poor a position as a morning star as he was as an evening one.

| Day of Month. | Right Ascension. | Declination South. | Souths. |
|---|---|---|---|
| | h. m. | ° ′ | h. m. |
| 1 | 20 7·4 | 20 37·9 | 1 23·8 p.m. |
| 6 | 20 8·4 | 19 6·5 | 1 5·1 ,, |
| 11 | 19 50·5 | 18 25·6 | 0 27·6 ,, |
| 16 | 19 23·5 | 18 37·0 | 11 41·1 a.m. |
| 21 | 19 4·9 | 19 16·9 | 11 2·9 ,, |
| 26 | 19 1·7 | 20 4·1 | 10 40·0 ,, |
| 31 | 19 11·2 | 20 43·0 | 10 29·8 ,, |

Starting thus in the confines of Sagittarius and Capricornus, the major part of the looped path indicated in the above ephemeris lies in the former constellation, but it does not pass near any conspicuous stars.

### Venus

Is a Morning Star throughout the month, and though low down, is a most conspicuous object before sunrise over the South-Eastern horizon. She attains her greatest brilliancy on the 8th. Her angular diameter dwindles from 45″ on the 1st, to 28·8″ by the end of the month.

| Day of Month. | Right Ascension. | Declination South. | Souths. |
|---|---|---|---|
| | h. m. | ° ′ | h. m. |
| 1 | 16 17.9 | 16 49·4 | 9 34·9 a.m. |
| 6 | 16 25·7 | 16 53·3 | 9 23·0 ,, |
| 11 | 16 36·4 | 17 10·6 | 9 14·0 ,, |
| 16 | 16 49·5 | 17 36·7 | 9 7·4 ,, |
| 21 | 17 4·6 | 18 7·2 | 9 2·8 ,, |
| 26 | 17 21·4 | 18 38·5 | 8 59·9 ,, |
| 31 | 17 39·7 | 19 7·4 | 8 58·5 ,, |

At the beginning of the month, Venus will be in the confines of Libra and Scorpio, and having crossed the northern spike of the last-named constellation, will describe the remainder of her path in Ophiuchus. As is the case of Mercury, she approaches no conspicuous stars.

For the reason given in our introduction, we neither give ephemerides of

### Mars nor Jupiter

but may just add, in connection with the latter planet, that the observer may perhaps catch the ingress of the shadow of Satellite I. on the 5th at 5h. 28m. p.m., and that on the 6th Satellite I. will reappear from eclipse at 5h. 0m. 24s.; as will Satellite III. at 5h. 10m. 44s.; while finally the egress of the shadow of Satellite II. will occur at 5h. 12m. p.m.

### Saturn

In so far as the time of his Meridian Passage is concerned, is a Morning Star; but as he rises on the 1st about 9h. 50m., and on the 31st about 7h. 45m., he is very fairly observable before midnight. His angular equatorial diameter increases almost imperceptibly, from 18·28″ to 19·08′ during January. The closing up of his ring system is now very perceptible.

### Saturn.

| Day of month. | Right Ascension. | Declination North. | Souths. |
|---|---|---|---|
| | h. m. | ° ′ | h. m. |
| 1 | 11 15·9 | 6 53·0 | 4 33·7 a.m. |
| 6 | 11 15·7 | 6 55·7 | 4 13·9 ,, |
| 11 | 11 15·3 | 6 59·5 | 3 53·8 ,, |
| 16 | 11 14·8 | 7 4·2 | 3 33·6 ,, |
| 21 | 11 14·1 | 7 9·9 | 3 13·3 ,, |
| 26 | 11 13·3 | 7 16·4 | 2 52·8 ,, |
| 31 | 11 12·3 | 7 23·7 | 2 32·2 ,, |

The short retrograde arc indicated in the above ephemeris is described between $\sigma$ and $\chi$ Leonis.

The above table gives the approximate Greenwich Mean Time at which the five inner satellites of Saturn will attain their greatest elongations east of the planet, and is intended to assist the student in their identification.

Titan, Saturn's chief satellite, is so large and conspicuous an object as to be visible in the smallest telescopes, shining, as it does, as a star of the 8th magnitude. It will attain its greatest elongations east of Saturn at 5·6h. a.m. on the 2nd, and again at 4·9h. a.m. on January 18th. Hyperion is only visible in the very largest telescopes, and Mimas cannot be perceived with less than 6½in. of aperture. Japetus may be identified by its considerable distance from the planet. It is at its brightest when to the west of Saturn.

### Uranus

Will not be fairly observable until the spring; but

### Neptune

Is visible all night long. Save in large instruments, he is not easily distinguishable from a star of about the 7·5 magnitude.

| Day of Month. | Right Ascension. | Declination North. | Souths. |
|---|---|---|---|
| | h. m. | ° ′ | h. m. |
| 1 | 4 11·3 | 19 25·3 | 9 26·4 p.m. |
| 6 | 4 10·9 | 19 24·4 | 9 6·3 ,, |
| 11 | 4 10·5 | 19 23·6 | 8 46·3 ,, |
| 16 | 4 10·2 | 19 23·0 | 8 26·3 ,, |
| 21 | 4 9·9 | 19 22·5 | 8 6·3 ,, |
| 26 | 4 9·7 | 19 22·2 | 7 46·4 ,, |
| 31 | 4 9·5 | 19 22·0 | 7 26·6 ,, |

The short retrograde arc indicated by the above ephemeris lies to the north-west of the Hyades, and a little to the south of the 5-mag. star $\omega^2$ Tauri.

### Minima of the Variable Star Algol

will occur on January 3rd at 1h. 11m. a.m., on the 5th at 10h. p.m., on the 8th at 6h. 49m. p.m., on the 20th at 6h. 14m. a.m., on the 23rd at 3h. 3m. a.m., on the 25th at 11h. 42m. p.m., on the 28th at 8h. 31m. p.m., and on the 31st at 5h. 20m. p.m., as well as on other occasions, when daylight will render the phenomenon invisible.

### Shooting Stars

may be especially looked for on the night of January 2nd, when they appear to radiate from a point in the north-eastern part of the constellation Boötes. Showers may also be expected on the 5th, 9th, 17th, 22nd, and 25th.

### Greenwich Mean Time of Southing of Sixteen of the Principal Fixed Stars on the Night of January 1st, 1891.

| Star. | Souths. h. m. s. |
|---|---|
| $\alpha$ Andromedæ .. .. .. | 5 18 27·55 p.m. |
| $\alpha$ Cassiopeiæ .. .. .. | 5 49 56·45 ,, |
| Polaris .. .. .. .. | 6 34 20·87 ,, |
| $\alpha$ Arietis .. .. .. | 7 16 25·37 ,, |
| $\alpha$ Ceti .. .. .. .. | 8 11 49·78 ,, |
| $\alpha$ Persei .. .. .. | 8 31 44·23 ,, |
| $\gamma^1$ Eridani .. .. .. | 9 8 2·75 ,, |
| Aldebaran .. .. .. | 9 44 39·97 ,, |
| Capella .. .. .. .. | 10 23 32·11 ,, |
| Rigel .. .. .. .. | 10 24 11·76 ,, |
| $\alpha$ Leporis .. .. .. | 10 42 46·24 ,, |
| $\alpha$ Orionis .. .. .. | 11 4 3·43 ,, |
| Sirius .. .. .. .. | 11 54 59 68 ,, |
| Castor .. .. .. .. | *12 42 9·89 a.m. |
| Procyon .. .. .. | *12 48 5·86 ,, |
| Pollux .. .. .. .. | *12 53 8·09 ,, |

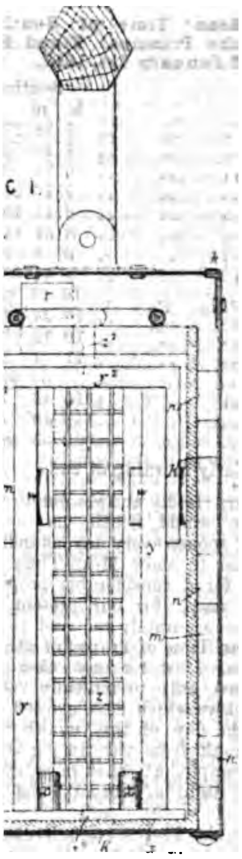
* Early morning of 2nd.

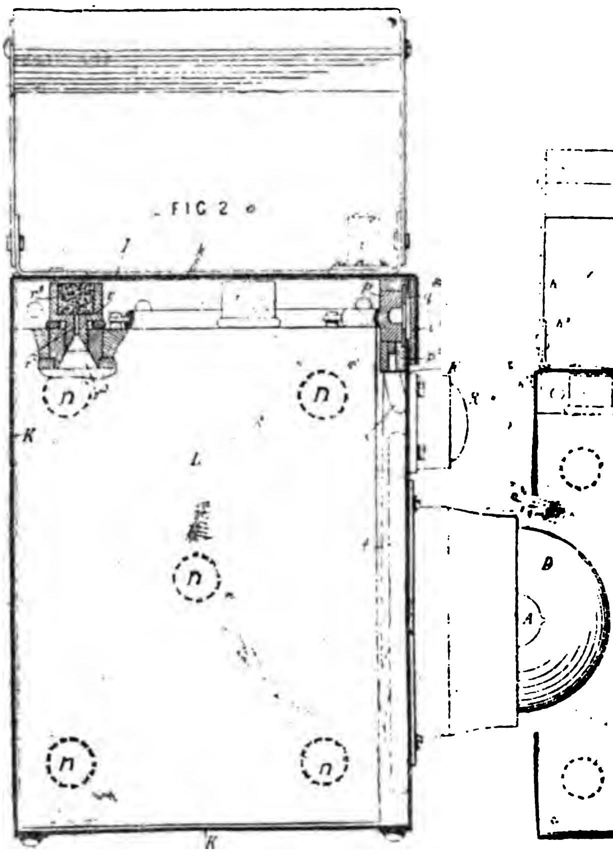
Were the stars rigidly and absolutely "fixed," any given one would South 3m. 55·91s. (o 235·91 seconds) sooner every day, as indicated by a clock regulated to show Mean Time. This i so nearly true for a considerable proportion o them that we may, for our present purpose assume it to be accurately so; and to find the Greenwich Mean Time of Transit of either of the stars in the above list for any other night in January, we have only to multiply 235·91s. by the number of days which have elapsed since the 1st—i.e., by the day of the month − 1, and subtract the result from the time given in our table. For example, at what hour will Sirius South on the night of January 21st? Here we say, 21 − 1 = 20; and 20 × 235·91s. = 4718·20s., or 1h. 18m. 38·20s. If, then, from 11h. 54m. 59·68s. we subtract 1h. 18m. 38·20s. we get 10h. 36m. 21·48s. as the Greenwich Mean Time of Transit of Sirius on the night of January 21st, a result just 0·04s. in defect of the actual instant of its meridian passage. With some stars the discrepancy might have been slightly greater, with others a little less—and discrepancy increasing a little as we approach the Pole; but Polaris crosses a wire so very slowly that, in practice and for the purpose of rating an ordinary clock, this may be neglected.

Let us now further suppose that we wish to know the Local Mean Time of Southing of any of the Stars in our table. This we obtain by subtracting 9·8565 seconds for every hour of longitude (and proportional parts for minutes and seconds) when our station is West of Greenwich, and by the addition of that quantity when it is situated to the East. For instance, at what hour in Local Mean Time will Aldebaran South at Holyhead on January 1st? Holyhead is 18m. 36s. west of Greenwich, so as in the example given above under the heading of "The Sun," we say, as 60m. : 18m. 36s. : : 9·8565s. : (what we shall find to be) 3·06 seconds. Subtracting, then, 3·06s. from 9h. 44m. 39·97s., we obtain 9h. 44m. 36·91s. as the Holyhead Mean Time of Transit of Aldebaran on the night specified. Had we required the Folkestone Mean Time of Southing of that star on the same night (Folkestone being 4m. 40s. East of Greenwich, we must have added 0·77s. to our 9h. 44m. 39·97s., and hence obtained 9h. 44m. 40·74s. as the instant sought.

## MINERS' ELECTRIC LAMPS.

AMONGST recent patents for portable electric lamps, especially those intended for the use of miners, we note one for which protection has been granted to the Mining and General Electric Lamp Co., Limited, D. G. Fitzgerald, and A. E. Hough, the object being to provide a strong and compact lamp, more efficient and more readily charged than those at present in use. According to this invention the casing K of the lamp (Fig. 1) is made of a strong material or metal, preferably steel, with a lead lining or coating to prevent it being injured by the electrolyte. To apply the lead to the steel, the surface of the steel i thoroughly cleaned, and then it is heated and solder is applied, and then the casing is dipped i molten lead. Or an alloy of lead may be used i place of the lead. The elements and electrolyte are contained in a vessel L (constituting a cell o cells), preferably of vulcanite or ebonite, and o such a size as to leave a space ss (Fig. 1) between its outside and the inside of the casing K, and i




- FIG 2 -

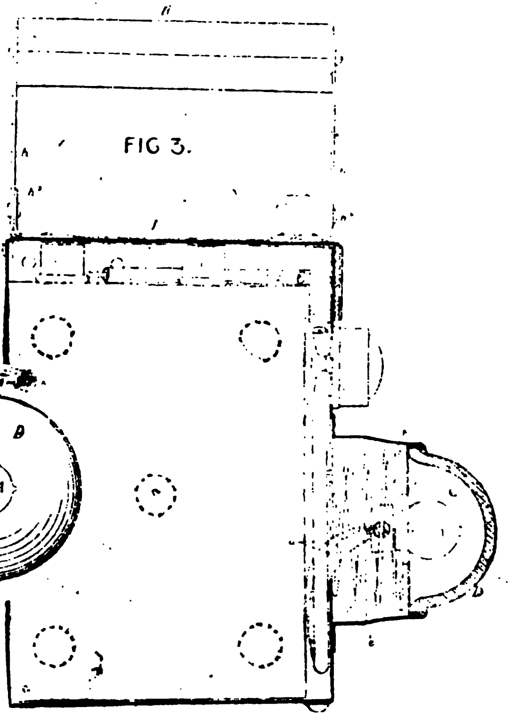


FIG 3.

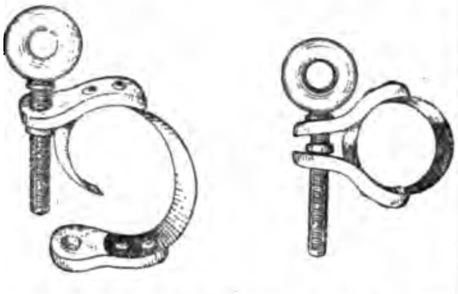
indiarubber or other elastic or yielding nay be placed, or secured, as indicated at the cell, or cells, and their contents, nted from being injured by any blow casing K may receive. Only the sides he sides and the end opposite that at lamp proper is situated, or both ends rovided with the elastic arrangements

The outer casing K is covered by a er I, preferably of the same material as ;, and capable of being slidden into, and place in grooves, or turned down parts, upper part of the casing K. This lid may be secured by a fastening, as at *i*. I is provided with a depending piece vith vulcanite, ebonite, or other insuterial $i^2$, which, when the cover is in ress and protects the charging contact e of which is shown at *p*) which are pre- lead. They are secured in the insuterial $p^2$ in the casing, as shown, and onvenient position for being brought to electric contact with the leads from ance for charging the battery. The onnections from the battery to the lamp ably of lead insulated, and those from to the contact pieces *p* are carried up he insulating material $p^2$. Where the ns pass through the casing K and the or ebonite or other insulating material, in the case, if the case be of metal, larger than the conductors, so as to sk of short-circuiting with the metal of ;, and for the same purpose, where conuch as the contacts *p* are near to the ng, a piece of insulating material may ned, as at *q*. R is a switch attached to casing to break and complete the lampd the charging circuit as desired. The A (Fig. 2) and its protecting glass D of any suitable shape or description. nts in the cell or cells may also be of le kind: for instance, they may conentral cylinder *z* of spongy lead and which may be covered by a perforated celluloid or other non-conductor, the elements *y* being carried by a bridge vulcanite, ebonite, or other insulating assed on to a stem $z^3$ projecting from l cylindrical element, a lower stem hich rests in an insulated footstep piece ottom of the cell; or they may be of ad in the form of a plate held by a f copper, but the patentees do not nselves to any particular form or on of elements. $x^3$ are projections of material, and *w* are discs constituting distance pieces for keeping the electrodes properly separated. The connections from the charging studs *p* to the lamp A and battery respectively may be burned together, or they may be made by screwing the stem of the charging studs and passing the ends of the connections over the screwed stem projecting inside the battery, and then screwing a nut on the stem to clamp the connections. The openings through the top of the cell or cells for charging it, or them, with electrolyte and allowing of the escape of gas, may consist of a cup or screw piece *r* passed through the top of the cell, and having a perforation $r^2$, with an inward part $r^3$ of a conical form with the narrow end upwards to prevent the exit of liquid but allow of the escape of gas. The cup part $r^4$ at top may contain a material such as cotton wool. When the battery is to be charged, the switch R is turned so as to break the contact between the conductors *s t*, so that the circuit to the lamp from the battery is broken; the cover I is removed, and the lamp is placed on a stand so that the contact pieces *p* come into contact with the terminals from the apparatus by which the storing current is supplied. A modification of this invention is described in a patent granted to the above-named company and W. Moscrop, in which the incandescence lamp bulb itself or the protecting glass which covers it, or both of them, are so arranged that they are held in their protruding position by a spring or springs (Fig. 3) which on a blow or pressure upon either or both of them occurring will allow either or both of them to yield and so prevent their fracture or render them less liable to fracture than would otherwise be the case. This may be effected by placing behind the protecting glass, or behind the reflector through which the bulb protrudes, the spring or springs, so that the glass can retreat to within its casing on the occurrence of a blow or of undue pressure. To allow of the bulb yielding, flexible leads may be attached which secure it to an annulus or perforated plate situated in the casing of the protecting glass forced forward by the spring or springs whereby the bulb is protruded through the opening in the reflector so that it will retreat into the recess behind it on the occurrence of a blow or undue pressure. When a sliding lid for the body of the lamp is used, provided with a handle, the patentees add a projection, which when the lid is slidden into place and the handle is turned up, engages with the body part of the lamp, so that the lid is not liable to be accidentally slidden off if it should have been left unlocked. The elements may be of any desired kind, but they are preferably of what is known as "lithanode," and the connections to the peroxide element may consist of a washer or washers of platinum pressed into close contact with the plates by means of elastic washers and bolts and nuts. A platinum wire may form the connection of the element with a leaden strip which is used to conduct the current to outside the cell.

The drawing (Fig. 3) represents a vertical section of a miner's lamp with the improvements. In this drawing the protecting glass and the bulb are both shown capable of being moved back on the occurrence of a blow or pressure which would otherwise be liable to break them; but it is to be understood that they may both be so arranged or if desired either the protecting glass or the bulb alone may be so arranged. A is the bulb of the lamp, which is attached to the flexible leads *a* from the battery of the lamp. The bulb A is secured to and protrudes through a central opening in the insulating disc *b*. D is the protecting glass which is held in the casing *e*, the front edge of which is turned inwards or so formed as to retain the glass D; *f* is the reflector. Between the disc *b* and the lamp casing the spring *c* is interposed. On the occurrence of any blow or undue pressure upon the glass D, the spring *c* will yield, and the glass D will retreat to within the casing *e*. If this glass should be broken, then any blow or pressure upon the bulb will also cause the spring *c* to yield, and the bulb will retreat. If the bulb only is to be made capable of retreating on the occurrence of a blow or undue pressure, if the glass D be broken, then it will simply be necessary to secure the glass and reflector rigidly in the casing *e*. The handle H of the lamp is attached to the sliding lid I, and one of the uprights *h* provided with a piece, $h^2$, projecting beyond one of the centres $h^3$ on which the uprights turn. When the lid is slidden into place and the handle is turned up, the projection $h^2$ takes up such a position (as shown) that it forms a stop bearing on the lamp body to prevent the lid I from being slidden off until the handle is turned down, thus preventing the lid accidentally coming off if the lock *i* which secures the lid in place be not fastened.

## THE "GRIP" CLIP.

THE illustrations annexed show a useful little screw-clip for securing indiarubber tubing to gas-pipes, which is especially useful in the case of compressed-gas cylinders, or where there is a liability for the tubing to be forced off or accidentally knocked off. The engravings show the clip open and closed, from which it will be seen that it adapts itself to various sizes of tubing and pipes, and avoids the necessity of tieing on with wire or string, which is often ineffectual in the case of glass tubes. The flat steel spring can, by means of the screw, be made to "grip"



the rubber, and so secure a gas-tight joint. This clip, which has been patented, is being introduced by Mr. Steward, optician, 406, Strand, and will commend itself to all who have to work with flexible tubing attached to stopcocks and other apparatus.

## DEMAGNETISING WATCHES.

THE accompanying illustration shows a method of removing magnetism from watches, which is simple, and is said to prove effectual. This ingenious scheme is due to Mr. P. D. Richards, of West Medford, Mass. As is clearly shown in the illustration, the apparatus consists merely of a compound horseshoe magnet placed erect with its poles upwards, and a suitable support placed at some distance, perhaps 2ft. or 3ft. above it. From

this support is suspended, by a twisted thread, a cardboard tray in which is placed the watch to be demagnetised. When in position the supporting thread is allowed to untwist, and the watch is gradually removed from the magnetic field. The same results could be obtained, by the use of an electro-magnet energised from a battery or other source of current, as well as by employing permanent horseshoe magnets; but those who have to attend on dynamos have already discovered that a watch can be easily demagnetised by submitting it to magnetisation in all positions. It appears that when thoroughly magnetised—saturated, so to speak, the watch goes as well as ever.

## LOW-SPEED MULTIPOLAR DYNAMOS AND MOTORS FOR CONTINUOUS CURRENTS.*

THE many practical advantages of a lower rate of speed in dynamo-electric machinery have long been recognised, yet until recently few attempts have been made to secure it. The widespread use of the electric motor has, however, rendered low speed a feature of great importance, in that it so greatly simplifies the application of the machine to all classes of work, in most cases obviating the necessity of counter-shafting or similar speed-reducing mechanism.

The writer is aware of a prevailing opinion that serious difficulties are encountered in the attempts to manufacture this class of machines on a commercial basis; but believing the difficulties to be surmountable, he devoted several years to a careful study of the subject, with the result that he designed a type of machine in which he believes the desired end is attained without the introduction of any element of danger or the sacrifice of a single feature essential to a thoroughly practical machine.

In the light of this experience it is proposed to consider briefly some of the principles which govern the action of multipolar machines, and to demonstrate that the obstacles which have heretofore stood in the way of low speed may be, and have been, overcome.

The prime function of an armature conductor is the generation of an electromotive force, the value of which is proportionate to the number of magnetic lines of force cut by it in a given time. Now the number of lines cut per second is dependent upon two factors—(1) the total number of lines of force in the magnetic circuit, and (2) the number of times they are cut per second. As our aim is to generate a given E.M.F. at *lower* speed than is usual, it is evident that the quantities in either or both of the above factors must be increased. In the case of the first we are limited by the saturation point of iron, which prevents our indefinitely increasing the strength of the magnetic circuit without adding abnormally to the weight and size of the machine, and even were it possible to do this, an increased exciting current would be required, which would detract directly from the total efficiency. We turn, then, to the second factor, and, paradoxical as it appears at first, it is here we find the solution of the problem. How are we to cause an armature-conductor to cut a given number of lines of force a greater number of times per second without increasing the speed? In the ordinary two-pole machine the armature-conductor crosses the magnetic circuit and cuts all the lines of force twice during a complete revolution—viz., where they enter the armature core at one pole and where they leave it at the other. Now if we so dispose the magnetic circuit as to cause the lines of force to enter the armature core at one point, to leave it at another, to *enter it again at a third point and to leave at a fourth*, it is obvious that the conductor will cut all the lines at four points in each revolution, and that it will therefore generate the same E.M.F. at one-half the original speed. If we increase the number of poles to six, we shall obtain the same effect at one-third the speed, &c. This, then, is the principle of construction by which we secure low speed.

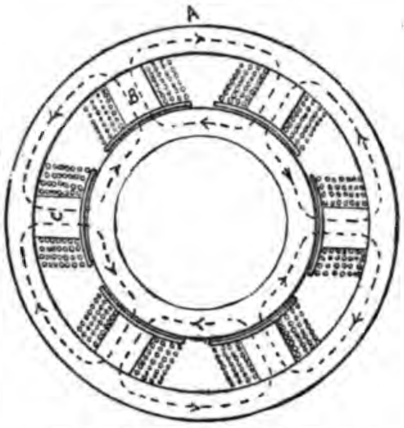


FIG. 1.—Typical Six-Pole Dynamo.

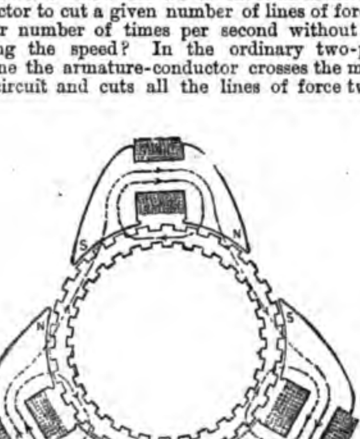


FIG. 2.—Perret Six-Pole Dynamo.

It should be noted that we do not increase the number of lines of force in the magnetic circuit; we do not add to the turns of wire in series on the armature; we do not increase the amount of either copper or iron in the entire machine; but we simply cause the armature-conductor to cross the magnetic circuit as often in one revolution as it ordinarily does in two or three revolutions, as the case may be. The writer wishes to emphasise these points, as there seems to be some misunderstanding in regard to them. We do not *wind an armature to run slowly*, but we design the machine for low speed. The resistance of our armature is no higher than that of a high-speed machine of the same power:
its current capacity is not reduced; in fa
shall see later, it is increased. The efficie
lower, the regulation no less perfect, and th
and bulk no greater. We see, then, that
the multipolar machine is perfect; conseq
any difficulties have been encountered in its
operation, they must be due to some fault
struction, to a consideration of which the
of the reader is now invited.

If we take as an example a motor havi
pole field, and imagine the same in actio
that the distribution of potential is such a
the equivalent of three ordinary armature
on the one ring and connected to the com
which has three times as many segments
a two-pole machine. Each of these windi
the wire lying under one pair of poles, ha
the same number of turns as an armature
pole machine, but of smaller wire, and ca
one-third of the total current, the thr
together in multiple. This being the c
relative difference in the strength of t
magnet poles will cause an unequal distri
potential and current in the armature. T
my opinion, the most important point t
sidered in the designing of such machine
equality is sure to cause trouble.

In a bi-polar machine there is but one
the lines of force, which circumstance insu
poles; but in the multipolar type, as o
constructed, a variation in the magnetic
tivity of any part of the circuit will
inequality.

Fig. 1 represents a form commonly
multipolar fields. It will be seen that an
blow-hole or hard spot or other imperfecti
casting at A would choke some of the l
ceeding from B, and they would theref
through C, and cause a difference in the
of the poles. Cast iron should therefore be
from the magnetic circuit; there should be
and the number of magnetising coils shou
small as possible.

Fig. 2 is a diagram of the magnetic circu
machine designed by the writer. In this c
tion there are but three magnets, each being
magnetically from the others, excepting
the medium of the armature core, and co
isolated from the framework of the machine
are formed of plates of soft sheet iron, w
punched to the required shape, and strung
on non-magnetic bolts by which they are
to their supports. A single magnetising c
two salient poles, and as each magnet is b
large number of plates a uniform magne
ductivity is secured. By this method of c
tion all danger of any inequality in the str
the poles is avoided, and a magnetic circuit
joints and of the lowest possible resistance is
It is understood, of course, that in all c
number of ampère turns on each magnet
equal.

As the mechanical effort or torque is gre
low-speed than in a high-speed machine, ext
should be taken to secure a substantial me
mounting for the armature upon the shaft,
for the wires upon the core. The armature
fore built up on eight insulated steel bolts, t
of which are secured to non-magnetic spider
in turn are keyed to the shaft. The wires are
in longitudinal channels on the periphery
armature core which holds the coils rigidly i
and entirely prevents that minute shifting
wires which certainly is the cause of so
"break-downs" and "burn-outs" in arm
The driving force in a motor and the resistin
in a dynamo is exerted by the armature-cond
and we should always provide a positive mec
connection between them and the core; fricti
not suffice. The importance of this point
understood by Kapp, who writes: "In
machines the friction produced by the b
hoops is alone relied on to carry the wires t
the field; but experience has shown this
insufficient. Even if the wires are not bodi
off the armature by the magnetic resistance
field, they shift and work on the surface
core; and it is only a question of time w
insulation will be destroyed, and the machine
down."

We have a choice of two methods of coupli
armature circuits together in multiple, one o
is by the use of six brushes distributed arou
commutator 60° apart, three negative and
positive, and the other consists of a system
connections in the armature or commutator
connects those coils, which are simulta
undergoing the same induction, those in a s
machine being 120° apart. By this means
pair of brushes suffice, and these bear on th
mutator at points diametrically opposite, ex
in a two-pole machine. This method is pr
when copper brushes are used, and I have
simple system of cross connections at the
the commutator, in which all danger of
circuiting is avoided; but the carbon bru
peculiarly adapted to the method first de
that it forms one of the simplest and most
means of commutation that can be devised

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* By FRANK A. PERRET, in the *Electrical World.*

igh resistance of the carbon brush, as ordinarily onstructed, has prevented its universal adoption, ut the construction of this machine permits the se of three pairs of brushes, each pair carrying ut one-third of the total current, and the resistance s greatly reduced by reason of the increased contact surface.

In a two-pole machine the armature current is ivided equally between the circuits, while that of six-pole machine splits into six. This the writer onsiders in most cases an advantage, as the current-arrying capacity is increased by reason of the reater surface exposed to radiation, and the achine will consequently bear a greater overload ithout injury, while the wire is not so large as to e unmanageable. In many machines of the two-ole type a stranded armature-conductor must be sed, because a single wire would be too stiff and ould heat too much; in a multipolar machine hese troubles are avoided.

A great deal has been said and written in respect o the difference of potential that should be allowed o exist between adjacent commutator segments, ome writers having advanced erroneous opinions n this point to the disparagement of multipolar achines. One tells us that 10 volts should be the imit, because "10 volts will just form an arc," hile another puts the limit at 19 volts and gives he same reason.

Now an arc has to be started or "drawn," and he only time this can happen is when the brush onnects two adjacent bars as they pass under it. ut this only takes place at the so-called neutral oints where the difference of potential between djacent bars is almost nothing.

Theoretically, this difference of potential is simply he product of half the total current and the resistance of the coil connected to the two bars. We e, therefore, that we should not take for a basis f calculation the average difference of potential etween adjacent bars, for the reason that the .M.F. of each coil is continually varying from ero to maximum and down to zero again. A very lear description of this action will be found in the ourth chapter of S. P. Thompson's "Dynamo-lectric Machinery," together with the methods sed in determining it, and I commend a perusal f this to the writers referred to.

In a machine wound for 220 volts and having 22 ils acting in series, we do not find a uniform ifference of potential of 10 volts between adjacent ommutator bars, but those coils which are passing he poles are generating 15 or 20 volts, while those n the neutral zone are generating practically othing. In some of the most widely used close il machines in this country the average difference f potential between adjacent segments is far reater than the limits given by the above-entioned writers. In one of these it is 27 volts, another 50 volts, and in others it is still higher; ut these machines give no trouble whatever. Let e not be understood to favour the use of a small umber of commutator sections; I simply wish to how that no one is limited to 10 or to 19 volts verage potential difference between adjacent bars.

In the machines of my own design, which I have artially described, the number of sections in the ommutator is 96, of which 16 act in series. At an .M.F., of 220 volts, they average, therefore, 13¾ olts each, and at 500 volts total E.M.F. they will verage 31¼ volts.

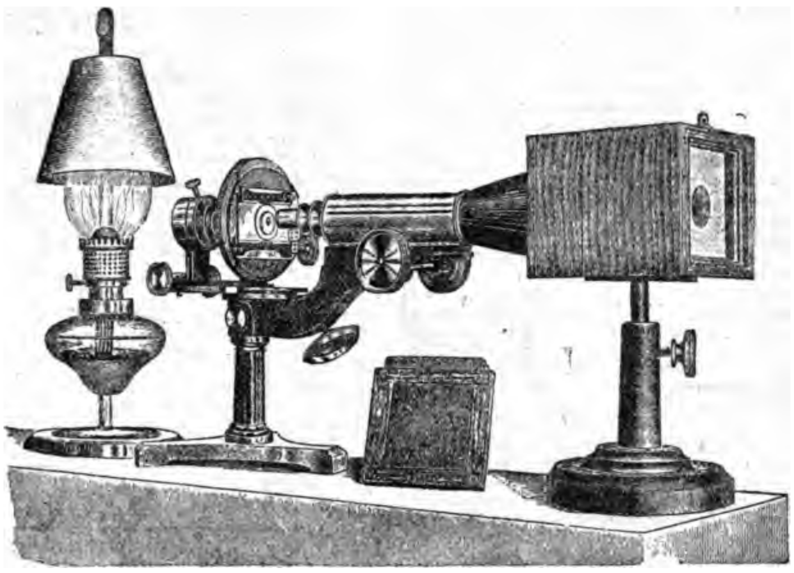
As bearing upon some of the statements which I ave made, I present the following details of my and 20H.P. machines, which fairly represent em all: 10H.P. 220-volt motor, speed 600 revolutions per minute; weight, 900lb.; resistance of armature, ·19 ohm; resistance of shunt, 175 ohms. wenty H.P. 110-volt dynamo (compound), speed, revolutions per minute; weight, 1,300lb.; resistance of armature, ·029 ohm; resistance of shunt, ohms; resistance of series coil, ·007 ohm.

It will be seen that a low-speed multipolar achine is not necessarily a heavy one, but that on e contrary it may be made very light. The writer s recently built several 25H.P. series-wound otors which weighed 1,300lb. each, and ran at a eed of 500 revolutions per minute. If one of ese were so wound as to run at 1,000 revolutions r minute, it would develop 50H.P., and weigh ly 26lb. per H.P. For traction purposes these otors are designed to run as slow as 450 revolutions per minute, and weigh about 70lb. per H.P.

In regard to their practical operation, I will mply say that the first machines which were nstructed a year ago have been in constant and tisfactory use ever since, and they have proved emselves to be in every respect the equals of the gh-speed machine.

# A HANDY PHOTO-MICROGRAPHIC CAMERA.*

ALTHOUGH photography in conjunction with ordinary microscopical observations (in other rds, photo-micrography) has undoubtedly grown usefulness and popularity among workers with the microscope during the past five years, there can be no doubt that its aid is very sparingly employed —a fact greatly to be regretted. For it is quite self-evident that the value of any microscopical research would be greatly enhanced, not only to the observer himself, but to his readers (in the event of his work being published), by full and accurate illustrations. Very few microscopists are competent draughtsmen, or capable of making drawings of objects under the lens, at all correctly, or even presentable as illustrations thereof. And a drawing thus made is always permeated more or less by the imagination of the artist; so that the greater his skill in that direction the more likely is he to introduce features, not as rendered by the tube, but as he thinks he sees them. To be sure, photographic reproductions of many microscopic objects are in a majority of cases not by any means perfect, or what one could desire, but they are vastly superior to almost any drawings in their accurate delineation of the various features of the specimen. The saving of time is another most important feature, as a dozen negatives may be taken in less time than that required to make a single careful drawing.



In the old "wet-plate" days the comparative insensitiveness of which precluded the use of a lamp as the illuminator, only those possessing a well-filled pocket-book or having access to the resources of a Governmental or college laboratory could avail themselves of the aid of photography in connection with the microscope. But the modern gelatine "dry plate" has placed in the hands of everyone a cheap and efficient means of doing the highest class of work readily and perfectly. The very highest powers may be used with the light from an ordinary petroleum lamp. I have a print from a negative of Pleurosigma angulatum magnified 2,400 diameters, by Spencer's $\frac{1}{10}$ homogeneous objective, the illuminant being an ordinary single-wick, coal-oil lamp. It is the work of Dr. J. E. Baker, of Wyoming, Ohio, and is fully equal to the best work of Zeiss's apochromatics, with the highest sources of illumination and every appliance of modern skill and ingenuity, regardless of cost, that have been given to the microscopical world during the past six months.

Why, then, has the use of photography not become more general among microscopists? Simply from the fancied difficulties of the necessary but simple manipulations required, and from the real one of the absence of any form of camera which could find a regular and permanent home upon the work-table, occupying no more space than the microscope itself, and always ready for immediate use. The latter is a most important requisite. How frequently does the student find, in the course of his observations upon living and other tissues, features that are vital towards proving the truth of his researches, but so evanescent, that the lapse of a few minutes may suffice to obliterate them? If, then, there be at his elbow a small, simple camera which can be at once applied to the microscope without the slightest alteration of the latter, save inclining the body to a horizontal position, using the same source of illumination, be it diffused daylight or that of the ordinary lamp, has he not a boon within his reach, which a few years since would have been deemed impossible? And are not his thanks due to the fellow-worker whose own wants found expression in the original of the "Handy" photo-micro camera?

My friend, Mr. H. Wingate, of Philadelphia, has long been an ardent worker with the microscope, his studies being almost exclusively confined to the minute fungi belonging to the family of Myxogasters. He is exceedingly skilful with the pencil, and his drawings of these minute organisms, their spores, &c., are at least equal to any that have ever come under my observation. But, being actively engaged in business, the time wasted in making these drawings was a large tax, and he determined upon calling in the aid of photography; and there being absolutely no camera in the market to meet his requirements, he proceeded to construct one. Procuring a plate-holder of the proper size, he built the camera to suit it, after the plan of the man who carried the bung-hole to a cooper-shop to have a barrel made for it. His materials were some heavy, blackened cardboard, and an old piece of a steam-fitting some four inches long; his tools, a pocket-knife and a glue-pot, with the brains to use them. With these crude appliances he produced a camera, adapted to his microscope, and capable of doing the highest class of work. He uses a Zeiss $\frac{1}{18}$th homogeneous lens constantly; and frequently makes a dozen or more negatives of an evening therewith.

Upon seeing this little affair, I was at once struck with the conviction that if it could be produced in a form adaptable to any microscope, it would fully meet the long-felt want of just such an instrument. The result was the construction of the "Handy" camera, which has already been supplied to many institutions of learning and to private workers.

The camera consists of a mahogany box about 2⅝in. square, corrugated and blackened on the inside to prevent any reflections of light. A solid cone of some 4in. in length, tapering to receive the tube of the microscope, is attached to the front of the box. Preferably, this cone-front should be in bellows form, as in the sample sent; but being rather more costly than the solid cone, many will be satisfied with the latter. In the one case the bellows responds readily to the movements of the microscope tube in focussing; in the other the tube must slide readily into and out of the solid cone. At the opposite end of the box is a groove, in which the plate-holder and frame containing the focussing screen slide. The former carries two plates 2½in. square, amply large for all ordinary illustrations. Should larger-sized pictures be required, they can be made by enlarging upon bromide paper.

The focussing-screen is made of very thin crystal glass, most carefully ground by hand, presenting the smoothest surface obtainable by this means, but still quite too coarse for the exact focussing of delicately-marked objects. In fact, the focussing-screen is mainly useful in procuring even and full illumination of the field, and in properly centring the object. The final fixing of the exact focus is done by means of a focussing-glass used in conjunction with a disc of thin cover-glass attached to the ground surface of the screen by means of Canada balsam.

The camera is mounted upon a stout metal rod, which slides into the upright shaft of a very heavy japanned base, and can be secured at any height to suit that of the microscope (when the latter is inclined to a horizontal position) by means of a milled head. The base is shod with thick felt cloth, so that it may be placed upon any polished table-top without scratching the latter, and at the same time remain firmly fixed in the position it may be placed in.

And this is all there is of it: Simple, compact, always ready for immediate service, and occupying no appreciable space upon the work-table. Although primarily intended for use with the microscope body inclined to a horizontal position, it may be as readily adapted to the latter in a vertical one, when the character of the objects (as those mounted in fluids) may require. My own method has been to remove the camera from its base and mount it upon the top of an open box containing the microscope. An opening in the top of the box allows the cone to be slipped over the tube of the microscope, and in this manner I have made very successful negatives of blood corpuscles in rouleaux in their own serum; yeast spores in fluid, &c. A correspondent in Boston writes me that he has mounted the camera upon a firm retort stand for the same purpose. Many methods of using the instrument in an upright position will doubtless present themselves to the worker therewith.

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* By W. H. Walmsley, Philadelphia, Pa.

The illumination may be effected by reflection from the mirror as in ordinary work, or by removing the latter and placing the lamp behind the stage, and in a direct line with the optic axis. It must be carefully centred in order to illuminate the field alike in all portions. Condensers of various kinds—bull's-eye, achromatic, Abbé, &c.—can be used as desired, but with moderate and low powers. The best results will be obtained by the employment of simple diaphragms of various sizes to suit, and so placed as to come close as possible to the under surface of the slide upon which the object is mounted. All extraneous light should be excluded so far as possible, and none be allowed to enter the objective other than the rays which illuminate the specimen. Opaque objects may be photographed quite as successfully as transparent ones; but the time of exposure will be very greatly shortened by employing direct sunlight as the illuminant, if possible.

The eyepiece may be removed or not, as the observer may elect. Following after the teachings and practice of the late Dr. J. J. Woodward, I have almost invariably worked without it, using an amplifier where sufficient magnification could not be obtained with the objective alone. In using medium and high powers, I have not found the eyepiece objectionable; but with low powers, it certainly detracts from sharpness of definition, so that my preference is decidedly in favour of the amplifier, where an increase of power beyond that obtainable with the unaided objective becomes necessary. If possible, however, always use the latter alone. The short tube-length, alone possible (when using the "Handy" camera), renders the employment of amplifier or ocular necessary, if enlargements beyond three or four hundred diameters are to be made, since the limit of a $\frac{1}{16}$th used direct is less than 350°.

The corrections of most modern objectives as to visual and actinic foci are so nearly identical, that no difficulty will be experienced in obtaining sharp definition of any subject if a little care be used. But it may not be amiss to say the student's series of Bausch and Lomb are the best, by all odds, of any I have ever seen or used at all approaching them in moderation of cost. I have numerous remarkable examples of their work, which I have never seen excelled by lenses of equal powers, no matter what their cost. It certainly is not necessary to go abroad in these latter days to get the best in the optical as well as in many other directions.

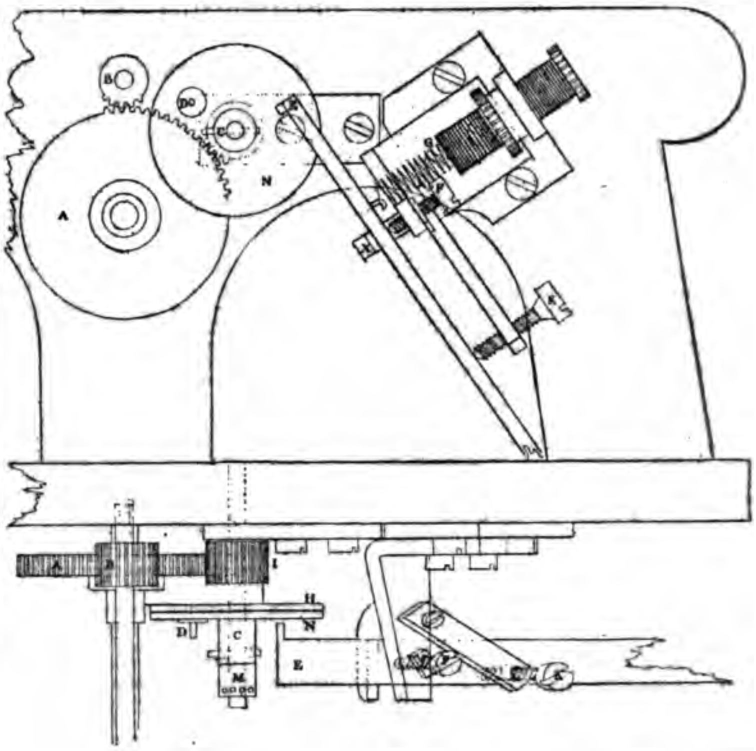
The dry plates for the "Handy" camera are furnished by the makers in two degrees of sensitiveness to suit every variety of subject. They are readily developed by any of the methods used for gelatine plates, my own preference being given to hydroguinon, or a mixture of that with eiokonogen, as giving the clearest results, clearest details, and sharpest contrasts with any desired amount of density. Their cost is but 25 cents per dozen; certainly cheap enough to tempt any one to their use.

In conclusion, a few words upon various printing methods. Presuming that every microscopist who ventures into the realms of photography will do his own printing, a few hints may prove useful. There can be no doubt of the beauty and perfection of a good, properly-toned, and finished print upon albumenised paper. This is conceded. But comparatively few amateurs will ever succeed perfectly in the operation of sensitising the paper and toning the print, whilst most of the ready-sensitised paper on the market is an abomination and a snare. Therefore discard this method of printing, unless prepared to do first-class work.

Passing by platinum as being both expensive and uncertain, excepting in the hands of an expert (although its beauty and perfection cannot be too highly extolled), let us consider for a moment the decided claim of bromide paper, as being the best material for printing in our class of work. Using the smooth surface-paper and developing with ferrous oxalate, we get a perfect print, rendering the most delicate details with the crispness and clearness of a steel-plate engraving, which indeed it most closely resembles in very many instances. The exposure is made by lamplight, so that one is entirely independent of time or weather, and the finished print is absolutely permanent; as much so, it is reasonable to believe, as a carbon print. If the sheet be allowed to dry spontaneously, it will present the appearance of an ordinary plate engraving. If a polished surface be desired, all that is necessary will be to float the paper, print side down, upon a sheet of polished hard rubber; to squeeze it into optical contact, removing all superfluous moisture, and when quite dry it will peel off the rubber-plate with a beautiful polished surface, greatly increasing the delicacy of detail in many subjects, especially diatoms. Most decidedly my preference is given to this form of printing.

But there is another method which, at the risk of being laughed at, I am inclined to gently urge. I refer to the ferro-prussiate, or more commonly named "blue prints." This method of printing is tabooed in many instances, "blue prints" being vigorously proscribed in the albums of the Postal Photographic Club; but, for all that, it has decided advantages and merits for the work we are considering. It is cheap, as the paper may be purchased ready sensitised, at very trifling cost, and it requires no skill or experience in the using. It is merely necessary to expose to bright sunlight until sufficiently printed (a few experiments will determine this), and then to wash in several changes of water; the result being a bright, permanent blue print upon a clear, white ground, with excellent detail, excepting in the most delicate structures.

The negatives made with the "Handy" camera are of a convenient size for printing lantern slides by contact. A print on glass is certainly the most perfect of any that possibly can be made, and the importance of this method of demonstration has long since been conceded. Gelatine plates coated on thin glass with special slow emulsions, are furnished by several makers, and any microscopist can readily make his own lantern-slides with a little expenditure of time and patience.



## ON AN ELECTRICAL CONTROL FOR DRIVING CLOCKS.*

By H. C. Russell, B.A., F.R.S., Astronomer Royal, Sydney.

AT the present time any method which promises to control driving clocks for photographic telescopes satisfactorily is worth discussion, because the complete solution of the difficulty of getting uniform motion for telescopes is very much to be desired, and I hope this will be sufficient excuse for bringing the following notes before you.

The method about to be described does not profess to give absolutely uniform motion, but it does claim so to correct the motion every second as to prevent any error greater than $\frac{1}{100}$ of a second of time. The two photographs herewith (in the R.A.S. Library) will show the general design of the clock; but since any form of clock would serve the purpose, provided one wheel in its train turned in one second, I need not waste time in describing it, except to say that uniform motion is obtained by using two pendulums, and that this forms seems to be peculiarly suited to the method of control, for two reasons—first, because uncontrolled it gives remarkably steady-going; and, secondly, because the pendulums are heavy and are not affected by the momentary stoppage of the driving-screw
(which is connected with the train b
which takes place every second.

In selecting a method of controlling thi
clock, it seemed to me better to have the
the clock uniformly gaining and stop
every second, rather than have one
uniform as possible and correct it wh
slow, because in the former method all t
and working parts are bearing in one dire
if the screw is stopped by the control, the
on, and takes the screw on with it, the
is set free by the action of the control. T
motion which takes place between the tra
screw each second has surprised me very
exhaustive experiments show conclusive
the driving clock is gaining one second
from that to so small a quantity as one i
control will catch it and put it right
second, provided that the control clock
contacts with perfect regularity, and
battery power is sufficient to work the c
instant contact is made. Certainly if i
correct it the exact amount every second,
cannot be detected by the means used in t
experiments.

Referring to the photographs, it will be
the screw for driving the telescope has
a wheel 9in. in diameter, on the rim of
worm which has 240 teeth, and as this i
to turn in four minutes, it is worked
screw which turns round in one second; o
of this screw is a disc (N in the diagra
while it can be forced along it by a scre
to adjust the friction between N and H,
turn round it. On the same screw is an
(H) of like size attached to the wheel (I,
and, excepting the friction between N an
to move round the screw. I has the sam
of teeth as B, the axis of which is connec
to the two pendulum governors, and,
driven by the wheel A. The friction b
and N is sufficient to carry the screw
against all the friction of moving the la
scope, of which the moving parts weigh
E is a continuation of the armature of
trolling magnet, and in the position sho
diagram it catches the pin D, which is fi
disc N, and stops it, until the current
controlling clock pulls E down on to th
So long as D is held, I, and of course H,
attached to it, go on with A and B, and d
is released it is carried on by the friction
H and N, as the currents come through th
every second, D is released once every se
stopped if it makes a revolution in le
second. Now, since the screw working
240-worm wheel is rigidly attached to N,
that once in every revolution it is exactly
time, because it cannot pass E until the si
the control clock comes; and by adjusting
of the driving clock it may be made to
formly each time in a little less than one
that the pin D just strikes E as it is pu
by the control, and it is surprising how
error in the time of rotation of D can be
in this way. Some idea of the linear am
may be got from the fact that in its re

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* Extracted from the *Monthly Notices*, R.A.S.

# SCIENTIFIC NEWS.

THERE is not much likelihood of Zona's comet being picked up now, even with large telescopes, and few observers seem to have seen that discovered by Dr. R. Spitaler, of Vienna, on November 16. Dr. Spitaler discovered his comet (*f* 1890) while looking for Zona's comet with the 27in. telescope, and observed it again on Dec. 4. On Dec. 6 Herr C. F. Pechüle picked it up while observing at Copenhagen; but described it then as very small and faint. There was no physical connection between the two comets.

Names have been given by M. Charlois, of Nice, to the small planets discovered by him during 1889-90. Nos. 283, 284, and 285 (Feb. 8, May 29, Aug. 3, 1889), have been named Emma, Amelia, and Regina, while Nos. 289, 293, 294 (March 10, May 20, July 15, 1890) have been named Nenetta, Brasilia, and Felicia.

We understand that the British Astronomical Association has now more than 400 members—a phenomenal success, considering the short time which has elapsed since it was first suggested.

The death is announced at Perth of that distinguished writer on, and student of, physico-geological subjects, Dr. James Croll, F.R.S., in his 70th year. Dr. Croll had been suffering for a long time from a mortal malady, but remained at his work almost to the last. Without any of the advantages of early scientific training, Croll raised himself from a very humble social position to that of a recognised authority in his special subjects, notably those connected with the relation of climate to geological phenomena. Some years ago, by the influence of Sir A. Ramsay, Croll, then resident in Glasgow, was appointed an officer of the Geological Survey of Scotland, but he was never in "affluent" circumstances. Although best known by his work on "Climate and Time," he was the author of several others, such as "Climate and Cosmology," "Stellar Evolution," and the "Philosophy of Theism.' Dr. Croll was also a copious contributor to the *Philosophical Magazine* and other scientific journals of papers relating to glacial phenomena, oceanic currents, and geological time. The originality of his views frequently brought him into controversy with scientific men, who, differing from his opinions, learned to respect him as a doughty antagonist, who had something to say and knew how to say it.

Sir W. Thomson, the new president of the Royal Society, who has also filled that office in the Royal Society of Scotland, is to be asked to sit for his portrait, to be placed in the University of Glasgow, subscriptions being sought mainly from citizens of Glasgow and the West of Scotland, as well as from old students.

The retiring president of the Royal Society, Sir. G. G. Stokes, has been an office holder for thirty-six years, chiefly as one of the secretaries, and an influential committee has been appointed to obtain a portrait for the gallery of the Society in commemoration and recognition of his long service.

The Friday evening lecture at the Royal Institution by Lord Justice Sir E. Fry, F.R.S., will be on "British Mosses" (Jan. 30), and that by Dr. E. Klein, F.R.S. (Feb. 20), will be on a subject which has latterly attracted much attention—"Infectious Diseases, their Nature, Mode, and Cause of Spread."

The remedy employed by Drs. Behring and Kitasato in their experimental investigations of diphtheria and tetanus, is the trichloride of iodine, which, injected subcutaneously in animals inoculated with the respective viruses, is found to not only check the disease, but to render the animals proof against subsequent infection. It is also stated that a ten per cent. solution of peroxide of hydrogen will confer immunity in the case of diphtheria. Dr. Koch's remedy is now awaited with much interest; but, as has been previously stated, he will not make it known until satisfied as to its efficacy.

It has been mentioned that a committee of the Royal Horticultural Society has been appointed to investigate the action of fog on plants. Meantime the secretary of the Royal Botanic Society, in answer to questions, has stated that from observations made in the Society's houses, fog is felt severely by those tropical plants which naturally are most exposed to sunshine. Plants whose home is in forests or under tree-shade do not so directly feel the want of light; but London or town fog not only shades the plants, but contains smoke, sulphur, and other deleterious agents, which are perhaps as deadly to vegetable vitality as absence of light. Soft, tender-leaved plants, and aquatics, such as the *Victoria regia*, suffer more from fog than any class of plants in the Society's houses.

It is proposed to establish at the National Liberal Club a Philosophical Circle for the discussion of questions which may be considered to come into that category.

Dr. Peters, the well-known geographer, has, it is stated, accepted invitations to deliver addresses before the Geographical Societies of Edinburgh, Glasgow, Aberdeen, and Dundee. He has also been invited to lecture before the British East Africa Company.

According to some of the American papers, Mr. E. H. Cowles has discovered a new method of extracting aluminium, a process which he is reported to have described as simple in operation, and almost theoretically perfect. It is further stated that this process dispenses with the electric furnace; that alterations are being made at the existing works, and that a new company is being formed to work the process near Niagara, where the 12,000H.P. required can be obtained cheaply.

If aluminium could be produced in large quantities at a low price, it would be utilised for many purposes, especially if anyone could devise a satisfactory method of brazing it. The recent explosion of another large copper steam-pipe on board a well-appointed vessel shows that copper is not to be depended on, for the rent in the pipe was not at a joint, but in the copper itself. The pressure carried was 160lb., which is now common enough in steamships, so that the subject demands the serious attention of marine engineers. At the large electric-light works, Deptford, copper tubes are used which are subjected to pressure of 180lb. to 200lb.; but they are put up on a system devised by Mr. Ferranti, are of comparatively small diameter, and are "drawn," so as to avoid the risk supposed to to be attendant on a brazed joint.

The *Thunderer* has been fitted with triple-expansion engines of 7,000H.P. by Messrs. Maudslay, and is to have some new guns which are calculated to send a projectile weighing 500lb. through a 21in. wrought-iron plate at a distance of 1,000 yards, the powder charge being 250lb.

Those who take an interest in Transatlantic steamships know that the veesels of the White Star line have a good record; but as showing what can be done it may be mentioned that the *Adriatic* has made 154 round voyages between Liverpool and New York without the least disablement in the engine-room.

The cause of the blue or violet flame seen when salt is thrown on a clear fire has been the subject of controversy; but Mr. A. P. Smith considers it is due to chlorine, and not to copper, as suggested by M. Salet, or to carbonic oxide, as is often supposed.

Prof. Brückner, of Berne, says there is a climatological period of 35 years for the whole globe, but most distinctly marked in the interiors of continents. According to the professor, 1880 was the centre of a cold, wet period, 1860 the centre of a warm, dry period.

The causes of boiler explosions are very much of mysteries to the average coroner's jury; but the following, recorded by the *American Machinist*, is certainly an exceptional instance. Our contemporary says:—We had thought that the talented and versatile newspaper reporter had invented about all the possible causes of boiler explosions; but a new one comes from St. John, N.B., where a boiler exploded "with great violence" (as they nearly always do), killing six men and wrecking buildings. The despatch says:—"From what can be learned, the boilers were low, the water was turned on, and the person in charge neglected to turn it off, with the result that the boilers overflowed and exploded."—From this it will be seen that it is very dangerous to allow boilers to overflow.

THE underground system of telegraphs of the German Empire has a total length of 3,600 miles, and has cost £2,100,000.

# LETTERS TO THE EDIT

*[We do not hold ourselves responsible for the opi*
*our correspondents. The Editor respectfully request*
*communications should be drawn up as briefly as poss*

*All communications should be addressed to the Ed*
*the* ENGLISH MECHANIC, 332, *Strand, W.C.*

*All Cheques and Post-office Orders to be made pa*
J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Corresponden*
*speaking of any letter previously inserted, will ob*
*mentioning the number of the Letter, as well as the*
*which it appears.*

"I would have everyone write what he knows
much as he knows, but no more; and that no
only, but in all other subjects: For such a pers
have some particular knowledge and experience
nature of such a person or such a fountain, th
other things, knows no more than what everybo
and yet, to keep a clutter with this little pittance
will undertake to write the whole body of physick
from whence great inconveniences derive their or
—*Montaigne's Essays.*

◆

## SPEECH OF LOWER ANIMA EQUATOREAL. — ALTAIR ON PRIME VERTICAL.—IS THE COVERED WITH ICE?—COI ATING A TELESCOPE PLACED CENTRICALLY ON ITS AXIS.—S WITH BRIGHT-LINED SPECT OUT OF ALMS' WAY.

[31893.]—IN connection with letter 31868 (
I seem to remember that Mr. Francis Galton,
invented, not very many years ago, a
graduating whistle, by the aid of which he
the shrillness of notes prior to their be
inaudible to the human ear. He found, I
that there was a marked difference in di
people as to the pitch of the note which the
tinued to hear; some holding without
difficulty sounds of such exceeding shrillnes
be wholly and absolutely inaudible to othe
myself know people who cannot, under any ci
stances, hear the cry of the common bat. I s
like to see Mr. Kincaid's idea carried out (of
on the assumption that his acoustics are corre

"E. E. M." (query 73162, p. 341) had
stick to colza-oil for his lamp, as the moment
small lanterns as those used for illuminatin
field in telescopes, get hot—which they very
do—kerosine will boil and bubble, and the
will spread from the wick to the whole o
burner. The field of my own telescope is li
by an (of course) elliptical plate of very thin
gilt. It is placed diagonally in the tube, and
forated centrally with an elliptical hole, of w
the minor axis is equal to the diameter of the
of rays from the object-glass where it p
through the diaphragm.

I think that Mr. J. L. Park (query 73166, p.
need only hunt through your back indices to
what he wants. I remember writing tw
three papers on the use and adjustments
equatoreal in your XVth Volume, since which
have been innumerable communications on
subject.

As I presume that you will follow your a
custom of furnishing worked-out examples in
"Astronomical Notes" next month, I need n
all events for the present, trouble myself abou
first part of query 73206, on p. 342; but with
ence to the second, will very willingly show
Elliott how to find out for himself when Alta
be in the prime vertical, or due west, at Green
suppose on December 26th. First we must fi
when the star souths, which we do thus—

| | h. | m. |
|---|---|---|
| R.A. of Altair, 1890, Dec. 26...... | 19 | 45 |
| From this we take Sidereal Time at mean noon .................... | 18 | 19 |
| | 1 | 25 |

| Sidereal Time. | | Mean Solar Time. h. | m. | s. |
|---|---|---|---|---|
| 1 hour | = | 0 | 59 | 50·1704 |
| 25min. | = | 0 | 24 | 55·9044 |
| 40sec. | = | 0 | 0 | 39·8908 |
| ·99sec. | = | 0 | 0 | ·9873 |
| | | 1 | 25 | 26·9529 |

So that Altair will south at Greenwi
1h. 25m. 26·95s.

Next we have to find the hour-angle of th
when it is due west, or on the prime vertical
this we do from the formula—cos. hour
= tan. declination × cot. lat. Let us put th
figures. The declination of the star is 8° 34′
The latitude of Greenwich 51° 28′ 38″. So w

| ° | ′ | ″ | | |
|---|---|---|---|---|
| 8 | 34 | 46 | tan. | 9·1785995 |
| 51 | 28 | 38 | cot. | 9·9009595 |
| 83 | 6 | 6·3 | cos. | 9·0795590 |

and 83° 6′ 6·3″ turned into time = 5h. 32m.

we add this to the time of the star's
passage, thus—

| | h. | m. | s. |
|---|---|---|---|
| | 1 | 25 | 26·95 |
| | 5 | 32 | 24·42 |
| y get | 6 | 57 | 51·37 |

as the instant at
ltair will be due west at Greenwich on
r 26th.

it in any way pledging myself to all Mr.
's details in his interesting paper in this
*Knowledge* (a considerable portion of which
oduce on p. 331), I am bound to admit
hypothesis is eminently a common-sense
l that his views as to lunar glaciation are
ively free from many of the objections
e patent in the case of those of Mr. Peal.
ay, when Mr. Peal wrote (in letter 31806)
, that "under the assumed temperature,
is probably as rigid as so much glass, and
us like ours," he apparently ignored the
viscosity resolves itself into a question of
; and that Tresca succeeded in causing
to flow.

. de Boë, F.R.A.S., an occasional corre-
in these columns, describes (in the number
*Terre* for December 1st) a very simple and
method of collimating an instrument
excentrically on its axis, as apparently
nd Belgian altazimuths and zenith circles
possesses such an instrument in the shape
ating circle of some 10½in. in diameter, and
ption applies to this. Obviously, if such a
re to be used as a surveying instrument in
on work, the traveller would scarcely care
himself with a collimator, a mercury bath,
it is to enable the necessary collimation to
in the absence of such adjuncts, that M. de
levised his simple plan. He first measures
ossible accuracy the amount of excentricity
trument. In the case of his own this is
e then constructs two marks identical in
shape, and with a width exactly equal to
ntricity. These marks are erected on
e instrument is placed in an open space
lear distance of 100 yards to the north
h of it. Having levelled it, one of the
placed at 100 yards or so to, say,
h, and the circle so turned that the
wire in the telescope is on the eastern
he mark. Clamping the horizontal circle,
ope is turned over on its axis through 180°,
course, it is pointing north. Now, the
mark is so fixed that its eastern edge is on
al wire. The horizontal circle is then un-
and the whole instrument turned round its
xis until it points this time to the western
the south mark. Finally clamping the
l circle, the vertical one (of course with
ope) is turned over once more towards the
f there is no collimation error, the central
l exactly coincide with the western edge of
ern mark. If not, it is corrected for half
ence. Obviously, this process may be
until the collimation is perfect. If it has
yone in reading this that the horizontal
ght itself be employed in collimating the
the answer is evident—viz., that the
l circles of such instruments only read to
in rare cases to 15") by the aid of a vernier—
y much too large to be neglected in collima-

-three years ago MM. Wolf and Rayet, of
Observatory, dicovered three small stars
s, which, in the spectroscope, showed
right lines upon a continuous spectrum.
has each of them a very bright band in the
of it. In 1873, and again in 1883, Vogel
account of the spectra of these stars, his
ons in the last-named year having been
h the Grubb 27in. refractor at Vienna. I
opose to enter into any technical account
bservations: it is enough to say here that,
to a statement previously made by Secchi,
ced to show that the bright lines, including
band, whatever they were due to, were
carbon. But in 1888, in the Bakerian
ve find the lecturer referring this bright
ne of those convenient South Kensington
" (of which the magnesium one has so
come to such ignominious grief), "the
bon fluting." It is almost unnecessary to
, assuming the bright band really to
n coincident with this carbon fluting,
have formed "the main argument
r of the conclusion" that bright-
s "were nothing more than swarms of
s a little more condensed than those we
nebulæ." The physicist, the chemist, and
omer, then, must each and all regard with
rest a paper read before the Royal Society
ber 11 by our first living English spectro-
d his gifted wife, Dr. and Mrs. Huggins,
lescription of their own observations of the
the three stars in question. I would most
urge everyone interested in the question of
ysics to read this most able and pains-
per for himself. To attempt to give anything like a *précis* or abstract of it would be to do it grave injustice: it must be read in its entirety to be appreciated; but I may just say that it shows, in a manner which admits of no doubt or cavil whatever, that this bright blue band in the spectra of the three Wolf-Rayet stars and in another one, is not coincident in any way with the blue carbon band of the Bunsen flame. I may just add that Dr. Copeland, alike with Vogel, corroborates their conclusions. Surely this persistent blundering at South Kensington opens a curious question as to the source of its origin. Perhaps the most simple explanation, in the present state of our knowledge, lies in insufficiency of dispersion and redundancy of assertion; but, really, if this sort of thing goes on, the value of the expensive work recently issued on the "magnificent theory" (of Meyer) will be reduced to the price of its covers—or thereabouts.

A friend of mine, a Cambridge man *pur sang*, has expressed his surprise at the ignorance which can alone have prompted me to speak (in paragraph four of letter 31856) on p. 333 of "a great and wealthy body like the University of Cambridge," and has been at some pains to explain to me that while many, or most, of the *Colleges*, which, in their aggregate, make up that University, do possess great wealth, the University itself, quâ University, is in a state of grinding poverty. Well, admitting this to be so, it but very slightly modifies my views as to one of the two chief seats of English learning, publicly figuring as the recipient of aid from an American lady, for the purpose of purchasing an instrument essential to the completeness of the fitting of its observatory. Suppose that a regiment (in which every man had, say, £700 a year at least, beyond his pay) wanted an epergne for their mess table: what, I wonder, would outsiders say, if they accepted a gift of one from some charitable endowment, on the ground that the mess-fund was at a very low ebb indeed? If the University of Cambridge is in that state of destitution that it cannot afford to buy a spectroscope, it appears to me that it would have been more dignified to do without it.

**A Fellow of the Royal Astronomical Society.**

## CALCULATION OF SOLAR ECLIPSES.

[31894.]—Mr. Grigg's letter (No. 31805) ought to have called forth a reply from me long ago, but my mind has been fully employed with other matters. I thank him for his thanks, and the delicate way in which he has drawn my attention to the small error incurred by substituting cos. $\pi$ for cos. $a$. The formula with this correction reads $\tan. \delta'' = \dfrac{\tan. \delta'}{\cos. a}$ and corresponds exactly to Loomis' $\tan. \delta' = \dfrac{\tan. \delta}{\cos. a}$ as $\delta$ stands for the true Dec., $\delta'$ for the apparent Dec., and $\delta''$ for the corrected apparent Dec., the accents being so arranged by me as to avoid confusion. I think Mr. Grigg will see that small correction of the apparent Dec. is needed if he looks at Table XVIII. page 385, of Loomis' work, for where the diff. of R.A. between the two bodies is considerable, the correction may amount to as much as 30".

In conclusion, let me say that I hope Mr. Grigg will favour us with a description of his illuminating apparatus, as requested by the Editor.

**H. P. Slade.**

16, Westcott-street, Hull, Dec. 17.

## GLACIATION OF THE MOON.

[31895.]—I have observed from time to time in your columns a number of letters on the subject of the supposed glaciation of the moon. I believe that it is in my power to throw considerable light on the subject, and at least to narrow the limits within which there is room for doubt and discussion. I expect to be accused of egotism and presumption, but I shall state nothing except what I know; and if I may seem to be disposed to dogmatise, I can only declare that I will not advance anything but what I can demonstrate. If I touch upon matters beyond my personal experience, I will take care to indicate them clearly.

To save needless argument, I will assume that all controversialists are agreed on one point—namely, that the moon has either no atmosphere or an inappreciable one. This is one of the things which I do not pretend to know, but I accept the proofs adduced by others. There are in every discussion certain postulates which are not disputed, and this is one of them. There is just one more upon which I must insist—namely, that the physical properties of water are the same in the moon as they are on the earth. This will be readily conceded by the authors of all the theories about the supposed glaciation of the moon, because their theories are based upon it.

With the concession of these points I am in a position to assert positively that there is neither water nor ice in the moon, for the simple reason that it is a physical impossibility that there can be any. To prove this, it is only necessary to show that neither water nor ice can exist in a vacuum in our laboratories. This would be self-evident if it were possible to command a vacuum sufficiently capacious to receive the vapour as quickly as it is formed. Such a vacuum is supposed to surround the moon. In an artificially-created vacuum on the earth the space is rapidly filled with the vapour and the evaporation is stopped, so that the residual water or ice seems to be permanent; but if the vacuum be maintained either by continuous pumping or by connecting the vacuous space with a sufficiency of vapour-absorbing material, such as sulphuric acid, the evaporation goes on until the whole of the water or ice has disappeared. The fact that water or ice cannot exist in a vacuum is thus demonstrated. I know that this is the fact, because I have tried the experiment, without sulphuric acid, a score of times. Those who doubt the statement may easily try the experiment for themselves.

Water boils at the freezing temperature under a pressure, expressed in inches of mercury, of 0·17, and water cannot exist on the moon unless there be an atmosphere with a pressure greater than that.

In addition to the astronomical reasons for believing that the moon has no atmosphere or an exceedingly attenuated one, I would point out a physical reason tending to the same conclusion. If there be an atmosphere of, or containing, the vapour of water in the moon, the clouds formed prior to a fall of snow should be visible from the earth, as they would conceal or obscure the sharp outline of the moon's features usually observed. The same effect would be produced by lunar fogs or mists.

So far, I hold myself responsible for the accuracy of my statements. What I am now about to submit I offer with diffidence, because I am not skilled in the mathematics of gravitation. I see it stated that gravity at the surface of the moon is only one-sixth of what it is at the surface of the earth. I am only surprised that the difference is not greater. Taking it at one-sixth, an atmosphere of watery vapour with a pressure of 0·17in. of mercury should be as dense as steam on the earth exerting a pressure six times greater, say, 1in. of mercury, or one thirtieth of the density of steam under the pressure of the earth's atmosphere. The question thence arises, Is there an atmosphere of such density surrounding the moon? I leave the consideration of this question in other hands.

I have one more suggestion to make—under correction. Gravity is the power which restrains the indefinite expansion of an atmosphere in space. This being less at the surface of the moon than at that of the earth, the moon's atmosphere (if it has one, and whatever may be its density) should extend further into space than does that of the earth. In a line connecting the earth's centre with that of the moon there must be a point, much nearer the moon than the earth, at which the opposing gravities are balanced. If that point lies within the moon's atmosphere, the earth must rob the moon of its atmosphere, and consequently of its water, and that quickly. If this be so, it follows that the moon may have never had an atmosphere, or that it has been withdrawn as quickly as it was formed. Further investigation may show that all the satellites in the planetary system are in the same predicament as the moon.

I need only add that I shall be well pleased if the experts in the mathematics of gravitation will look into these suggestions and add to them, and I shall be still better pleased if they take the matter entirely into their own hands. I shall, however, be ready to reply to those who may call in question the facts which I have stated on my own responsibility.

**Ja. Ha.**

## BRITISH ASTRONOMICAL ASSOCIATION.

[31896.]—If I am not too late, perhaps I may be allowed to suggest to the above-named society that a section of the same be formed for the purpose of testing object-glasses and mirrors of telescopes which may be submitted to them by members of the association.

There are, no doubt, many amateurs who live in out-of-the-way places, and who would gladly avail themselves of this opportunity on payment of a small fee. Such a test by competent men would set at rest any doubt whether the fault lay really in the o.g. or the speculum, or whether imperfect definition was due to some other cause, such as derangement of the mirrors, eyepieces, &c. I think this would prove a boon to many, and would set at rest many a doubt. I hope the matter will be taken up by the association.

**T. D.**

## THE ASTRONOMICAL TELESCOPE.

[31897.]—In his reply to query 73155, page 323, "A Fellow of the Royal Astronomical Society" comes down, I think, rather hard on the astro. telescope with only a simple convex lens for its object-glass. This is unquestionably greatly inferior to the achromatic; but, at the same time, it is greatly superior to the unaided eye. And while the one may be constructed for an outlay of a few shillings only, to construct the other we must go into the pounds; and I can assure "F.R.A.S." that this is quite beyond the reach of a great many of the readers of this paper, as I know from the many communications which I have received in reference to other subjects, and these, I think, should be catered for, as well as those more fortunately situated.

How well I remember the first instrument of this class that ever I constructed! The object-glass of this I made out of a spectacle-glass ("F.R.A.S.," please be merciful with this, and spare its humble maker from the proverbial thousand of bricks); I had no other. This I mounted in cardboard, and stopped down the aperture to about ⅝in. linear; the tubes I made of paper, and for the eyepiece I made use of one (Huyghenian) from a small compound microscope that I possessed (power would be about 12), and from observations which I made with even this simple and imperfect instrument I derived much pleasure: it at once showed me the mountainous character of the lunar surface and its jagged terminator, and I think that an instrument of this class properly constructed is capable of showing much to interest the observer, as it will show most of the simpler phenomena of the heavens, such as the shadows of the lunar mountains and cavities, the crescent of Venus, Jupiter and his moons, and bring to view many stars which are invisible to the unaided eye. So that, I think, even in the present state of optical science, and notwithstanding the fact that achromatics are now produced so very much cheaper than formerly, the poorer classes at least who are anxious to possess a telescope for celestial observation, cannot quite afford to discard such an old friend as the simple astro.

I think if "A. T." (query 73155, p. 323) will stop down the linear aperture of his object-glass to about 1⅝in. and use a Huyghenian eyepiece with field-lens 2·4in. and eye-lens 0·8in. focal length, placed 1·6in. apart, he will obtain a clear picture of the moon. This combination will give a power of about 40, which I think is sufficiently high for a simple object-lens of 48in. focus to preserve clearness.

Sheffield. **W. H. H.**

## THE GLOW.

[31898.]—I AM surprised not to have seen in your last numbers any mention of the reappearance of the glow which, some time since, excited so much curiosity and discussion. For several weeks it reappeared in a remarkable intensity, and different colours. Yesterday, 14th, it was of a very brilliant pinky-violet tint, embracing the whole sky, being deeper on the horizon, and much whiter in the direction of the sun. **Ch. Rabache.**

## A SPLENDID METEOR.

[31899.]—THIS was seen by me on Sunday, the 14th inst., at 9.40, and was a grand sight. It travelled, at a moderate pace, apparently (as far as I could judge) in a direction from Capella (Auriga) to Cepheus, and, as A. E. Spencer describes, resembled the soft gleaming of a Bengal light. The nucleus, if I might so term it, was of orange, if not bright-red colour, and its train a bright, brilliant bluish white. No noise was noticed; but the railway terminus being only a stone's throw away, it would probably have escaped notice.

Southampton. **A. E. Bannister.**

[31900.]—IN reply to Mr. Spencer, I had the good fortune to see the large meteor of the 14th inst. I was about three miles north of Woodbridge, Suffolk, and had an uninterrupted view of this meteor. It first appeared at 9.40 in the south-east about 10° from the zenith, and, passing in a slightly slanting direction downwards, disappeared at about 20° above the horizon in the W.S.W. About eight minutes afterwards I heard a heavy sound similar to the discharge of distant artillery. The rushing sound was not heard, and must have been imagined, or his senses deceived Mr. Spencer, and could not have been simultaneous with its appearance, unless Mr. Spencer is prepared to prove that sound travels with the same velocity as light.

In size it appeared to me one-third the diameter (visual) of the moon, and gave a light more brilliant in proportion.

Woodbridge, Dec. 20. **Wm. London.**

[31901.]—I HAD the good fortune to witness the meteor—or rather, the effect of it—described by Mr. A. E. Spencer (letter 31878, page 353), about the time stated on Sunday last, the 14th inst. I was walking towards Harrow, on the London and Harrow road, between Stonebridge and Wembley. The night was piercing cold, somewhat foggy, and dark. Suddenly I seemed enveloped in a soft cloud of light, as if a grand electric light were turned on at an elevation, which illuminated the road and the hedges with the hoar frost on them, rendering everything visible for a short interval. It took me so by surprise that I at first fancied it was a brilliant rocket gone astray; but suddenly realising that it must be a meteor, I turned quickly in the direction of London; but was, unfortunately, too late to catch a sight of the meteor itself. The country was perfectly quiet, but I did not detect the slightest sound when the brilliant illumination appeared.

I do not think anyone could realise the splendour of the sudden and unexpected illumination of the surrounding objects or the beautiful softness of the light, and although in the habit of walking much in the open country after dark, I have never seen anything approaching it in even the slightest degree, and, indeed, was unaware that such brilliant meteors were ever seen.

I regret my inability, through not having seen the meteor itself, to furnish any further information on so interesting and unusual an appearance.

Dec. 20. **A. Marson.**

[31902.]—IT was also my good fortune to observe the meteor on the 14th inst. described by Mr. A. E. Spencer (letter 31878). At the time I was in the Archway-road, one hundred yards north of Highgate Railway Station. From my position the meteor appeared nearly due east, and about 60° above the horizon. Its motion was diagonal from right to left, and its path subtended an angle of about 10°. The light appeared with a sudden brilliant flash; it rapidly diminished when the meteor had travelled half its course, then again blazed out with greater brilliancy than ever. Its illumination was equal to that of the moon on a clear night when about at first quarter, and its colour was like that of magnesia in combustion. A short train of sparks was left behind: these did not travel so fast as the meteor. What does this imply?

I have had good opportunities of observing meteors for the last twenty-one years. I have never before seen one equal to it in size and brilliancy, and only on one occasion anything approaching it.

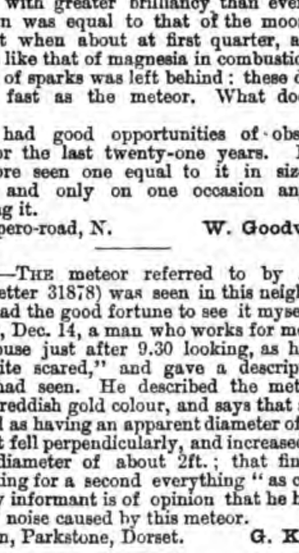
19, Prospero-road, N. **W. Goodwin.**

[31903.]—THE meteor referred to by A. E. Spencer (letter 31878) was seen in this neighbourhood. I had the good fortune to see it myself, but on Sunday, Dec. 14, a man who works for me came into the house just after 9.30 looking, as his wife said, "quite scared," and gave a description of what he had seen. He described the meteor as being of a reddish gold colour, and says that at first it appeared as having an apparent diameter of about 6in., that it fell perpendicularly, and increased to an apparent diameter of about 2ft.; that finally it burst, making for a second everything "as clear as day." My informant is of opinion that he heard a "hissing" noise caused by this meteor.

Newtown, Parkstone, Dorset. **G. Kent.**

## PITCHING CLOCK-WHEELS.

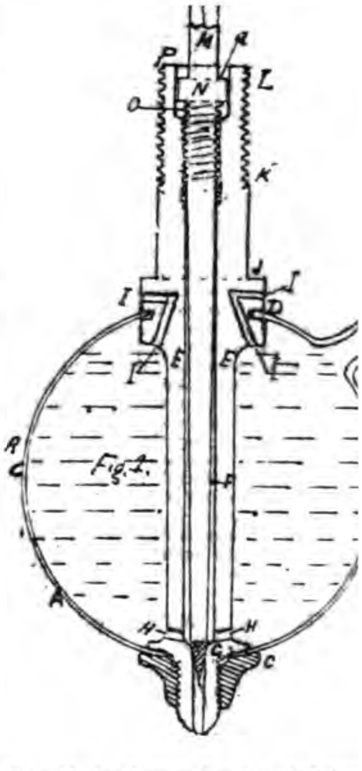
[31904.]—I HAVE seen London jobbers use a tool similar to that shown in the figure for getting the correct depth between wheels and pinions when they were without a depth-tool. It consists of a two-armed gauge, each arm having holes of varying sizes, each *pair* of holes being equidistant from the centre A. The pinion arbor or the pivot (whichever was most convenient) was placed in the holes, the depth adjusted by moving the arms, and the distance of the holes apart transferred with the dividers to the clock wheel. Instead of the holes being left small, they might be opened large to take transferable brushes, with varying sized holes. There is another way of pitching depths which I do not see mentioned yet, probably because of its tediousness. In this method the depth is guessed, and the holes put in a piece of scrap metal, taking care to pitch *too deep*. The metal is then stretched by being hammered, till the holes are at the proper distance apart. This distance is then transferred to the clock-plate with the dividers.



If a depth is too shallow, or too deep, w
in" the frames, it can be shifted, if not
without stopping up and redrilling the
little hole is drilled close to the pivot-hole
outside if too shallow, and the inside if
Into this hole a pin is hammered hard an
This has the effect of moving the h
great many depths are altered in "clock
Clerkenwell" in this way. **C. A.**

## AUXILIARY POWER FOR TRIC

[31905.]—IF carbon dioxide is used,
would be an advantage, put between the
valve and supply to engines, as it is thre
times as expansive as air. Perhaps son
friends who gave us an answer respectin
would kindly tell what it would expand
150° or 200°. With this I forward an enla



of the acid chamber; and although I hav
sented this circular, or, more properly sp
globular, it can be made elliptic to the cap
1lb., but not forgetting that there must
lugs of rubber, moulded as shown at R and
spaces between for ventilation—that is, that
may pass by, and in, and through the ho
the which should be made as large and man
can get in, to balance the pressure, so
pressure can come upon this rubber recepta
communications with valve at bottom
to let the acid out at G, are at
This shell and spindle is made of good
rod brass, Delta metal, Prince's metal, or
metal, and when it is made should be
with pure tin. To do this, put it into ho
tallow, and make it hot until wiffles of sm
to and fro over the surface of the tallow.
another vessel with some melted tin in, co
tallow about ⅛in. deep; take from the tall
and transfer to the metal; let remain fo
moments, then transfer to the tallow
drain; then take out, and swing the met
tap it lightly until the holes are all free
free, put into tallow again, and proceed a
This chamber can be made out of the same
as the children's balls; the small one w
with the top of the spindle screwed, and w
adjustable through the screwed gland nut.
shown with the shell itself tapped to re
screwed spindle that is screwed under the
But it would be preferable to have
outside altogether screwed, and the
nut made to operate upon it for this
(1) The screw will have no drag upon it,
spindle would work more smoothly, and f
leaks, it being packed top and bottom of
keep all snug; (2) it would be a tedio
have to attend to this, and by this mean
weigh-beam fulcrummed upon a small p
in communicating with the acid valve an
of the reducing valve, it would be made a
as regards feed of acid, and, therefore, the
only be the valve to feed the engine to lo
Now the inside of the iron cylinder wo
protecting—it can be pickled and tinned; b
get a gill of boiled oil and 2oz. of native as

dotted lines *a b*, Fig. 6, to obtain Fig. 7, and from this point, with the aid of the original drawings, there is no difficulty in folding up the legs as shown and to complete the reptile.

Dec. 16. **G. E. Varden.**

## JAPANESE PAPER FROG.

[31912.]—The directions from *La Nature* for constructing this, given in the "E.M.," considering how difficult it is to describe properly a process of this sort so as to be clearly understood, are really very explicit; but it was making the third points, dias. 4 and 5, that gave me a good deal of trouble at first, as these are folded to the inside, as it were. I have, however, forwarded to New Zealand paper patterns showing development of process, which, I think, will be clearer than any amount of writing on the subject.

Cheshire. **H. S. C.**

## PIN-HOLE PHOTOGRAPHS.

[31913.]—The following remarks on the possibility of making "pin-hole" photographs appeared in a contemporary over the signature of T. Earp, and by the irony of fate they appeared in pages which also at a prior date contained much ridicule of the suggestion, which was taken up in your columns some time ago. There is not the slightest doubt that very good photographs indeed can be taken without the use of a lens by means of a pin-hole, and Mr. Earp says that, with respect to the opening, it will be found that a fine needle heated to redness, and just pressed through a piece of thin, hard cardboard, will pierce a hole of suitable size, any little burr being removed by burning it off with the side of the hot needle, the point of which, being again gently inserted in the opening, will make it clear and round. If it be convenient, the better plan is, of course, to get a watch maker to drill a hole in a thin piece of sheet metal, which, being blackened, as must be the cardboard, is ready for use. It may be attached to one of the lens stops by strips of thin gummed paper, or, if preferred, a piece of metal, &c., cut to the pattern of the stop, may be pierced centrally and used in its place.

The lenses being removed from the mount, the latter is placed on the camera, the focussing glass is pushed forward to within six inches of the pin-hole, and the image observed for sharpness. I have found that by turning the camera towards the sun, and getting his image as sharply defined as possible, especially if it can be observed through the branches of a tree, the approximately best position for the focussing glass is obtained. In finding absolutely the best position, the side-swing is useful, as, by setting a plate at an angle and exposing, the resulting negative will be a guide in enabling the experimenter to get the best possible results.

It must be borne in mind that as a rule the pin-hole should be as small as possible, for if the opening be too large a pleasantly sharp image cannot result.

The time of exposure for an Ilford ordinary plate may be four minutes for a tolerably open view on a fine day, and up to ten minutes, or even more, for the view of a shady lane. It is not easy to over-expose sufficiently to spoil the negative, as the very weak light does not readily pass through the film. Developing should be started with a minimum of alkali, and should be carried on tentatively, as I have found the shadows suffer if any more than the absolutely necessary proportion of alkali has been present.

If a finder is attached to a camera, it will be useful for centring the view, as unless exceedingly well illuminated, it is difficult to dispense with some such contrivance. The only difficulty in the operation is in the foccussing with the small amount of light available, and the chief things to avoid are placing the focussing glass too far from the opening and under-exposing.

If any further evidence is necessary as to the possibility of taking photos with a mere pin-hole instead of a lens, it can be found in the work done in Paris by professionals, and in this country by amateurs. The moral of the tale is—Try before you condemn. **Impecunious.**

## ETCHING GLASS.

[31914.]—A query (73240) on p. 362 asks how white letters are produced on clear glass. The answer has been given many times. The matt surface is produced by the fumes of hydrofluoric acid, the other parts being covered by a protective varnish. But hydrofluoric acid is going out of use, and a good job too, for it is possible to do all that is required by means of the sand-blast. Nevertheless, the following may be useful to those who prefer the old-fashioned method. It has been discovered by A. Lainer that comparatively cheap etching solutions can be prepared, which are equal in effect to the expensive fluorine salts.

1. Two solutions are first prepared, (*a*) consisting of 10grm. of soda in 20grm. of warm water, (*b*) consisting of 10grm. potassium carbonate in 20grm. of warm water. Solutions (*a*) and (*b*) are now mixed, and to the mixture is added 20grm. of concentrated hydrofluoric acid, and afterwards a solution (*c*) consisting of 10grm. of potassium sulphate in 10grm. of water is added.

2. Mix 4c.c. of water, 1½grm. of potassium carbonate, 0·5c.c. of dilute hydrofluoric acid, 0·5c.c. of hydrochloric acid, and 0·5c.c. of potassium sulphate. This mixture is treated with hydrofluoric acid and carbonate of potassium until it produces the required degree of opacity on being tried upon a piece of glass.

Herr Lainer considers that the addition of a small quantity of hydrofluoric acid to solution 1 brings about a fine granulated appearance on the surface. It appears that there is a still simpler process than either of these, which was invented by Herr Kampmann, of Vienna. In preparing an opaque etching fluid Kampmann uses a wooden vessel, the iron fittings of which are protected from the corrosive action of the acid fumes by a layer of asphaltous material. This vessel is filled to about one-fifth of its contents with strong hydrofluoric acid, which is then partially neutralised by cautiously and gradually adding some crystals of soda; more soda is added, and the mixture is stirred with a small wooden rod. The point at which the neutralisation of the acid should cease is indicated by the mixture frothing and becoming sufficiently viscid to adhere to the stirring rod. It is, perhaps, scarcely necessary to say that the acid fumes are highly injurious, and that this process should be carried on in the open air, in order to allow the vapour to pass rapidly away. The most hygienic and satisfactory process of all would be to carry on the operation in a "draught cupboard."

The contents of this wooden vessel now consist of sodium fluoride and the unneutralised hydrofluoric acid. This mixture is transferred to a wooden tub and diluted with from five to ten times its volume of water, according to the degree of dilution desired. It is objectionable to use the mixture in a too highly concentrated condition, for then the etched surface of the glass is irregular, coarse-grained, and apparently strewn with tiny crystals; if, on the other hand, the dilution is too extreme, the etched surfaces will be transparent instead of opaque. Either of these two conditions of the etching fluid can easily be remedied, for if it be too strong water must be added, and if too weak, a small quantity of hydrofluoric acid partially neutralised with soda. A good recipe for preparing a small quantity of this etching fluid is the following: 240c.c. commercial hydrofluoric acid, 600grm. powdered crystallised soda, 100c.c. water.

These etching fluids are best used by taking the following precautions. The glass is first thoroughly cleansed from all impurities, and is then provided with a rim of wax composed of the following ingredient: Beeswax, tallow, colophony, and powdered asphalte, kneaded together. The rim prevents the acid from spreading over those parts of the surface which it is not desired to etch. The glass is then etched for a few minutes with an ordinary etching solution (H.F.—1 : 10) which is then poured off, the surface being afterwards washed with water and wiped as dry as possible with a piece of sponge. The surface is then ready for the opaque etching fluid, which is poured on till it forms a thick layer. The operation is allowed to progress for one hour, when the liquid is poured away and the surface washed with water. Water is further allowed to stand on the glass until a thin film of silicate is observed to form; the film is then brushed off, and the surface finally cleansed with water, and the wax removed.

By varying the action of this opaque etching fluid or paste various degrees of opacity may be produced, and if the opacity be greater than that which is desired, the surface can be cleared to any extent by using the etching solution of hydrofluoric acid.

Probably the above may assist the querist, and it will be useful to those who still employ the acid method; but at the same time they may be recommended to try the sand-blast, which is really very simple. **Silex.**

## ETHER.

[31915.]—I have endeavoured to show (letter 31855) that the energy of an electrostatic charge is contained in the luminiferous ether. It follows, almost of necessity, that the ether must be the active agent in transmitting the energy of a current of electricity. I propose to give an independent proof of this fact.

Let us consider the case of a battery of negligible internal resistance, whose poles are joined by a fine wire of great resistance. Such a battery gives out energy at a definite rate, and the energy reappears in the wire as heat. The question then arises as to how this heat is transferred from the battery to the wire. This transference we may conceive to take place in two ways. (1) It may be conveyed by the bodily transfer of some medium that contains it, in the same way that the heat of a furnace is conveyed to a room along with the water in a hot-water pipe. (2) It may be conveyed by means of some kind of vibratory motion from particle to particle, in the same manner as sound conveys the energy from a vibrating body. Again, the energy may leave the battery by one of two channels (1) it may proceed by the wire, or (2) it may proceed directly from the battery to the wire across the intervening space. We shall discuss the former of these suppositions first.

Assuming, then, that the energy traverses the wire, the first thing to be determined is the direction in which it goes. It may enter the wire at the positive pole, or at the negative pole, or at both. As there is no known reason why the energy should enter at one end of the wire rather than the other, the most probable supposition to make is that it enters at both ends equally. This supposition is confirmed by what is known of the discharge of a Leyden jar through a long wire, where it has been experimentally determined that the current commences simultaneously at both ends, and lags behind at the centre. Taking it, then, as proved that the energy enters the wire at an equal rate at each end, we must next consider separately the cases of transmission by convection and transmission by wave-motion.

On the hypothesis of transmission by convection, we must have both a go and a return current. There must be a positive current of electric fluid setting out from one pole of the battery, and an equal negative current of electric fluid setting out from the other pole. The two streams must traverse the whole circuit from one end to the other; but, we may ask, how do two fluid streams contrive to flow in opposite directions through the same wire? How do they pass each other without mixing or stopping each other's motion? This objection to the supposition of a fluid current is insuperable. Although the electric current is commonly spoken of as if it consisted of two such opposite streams of electric fluid, I believe not many electricians at the present day actually take such a supposition to be a true statement of the actual fact.

If we imagine the energy to be transmitted by some kind of wave-motion, we get rid of the above difficulty. We may suppose that the molecules of the wire next the battery have imparted to them some peculiar kind of vibratory motion, which constitutes the electric current, and which in its progress along the wire is gradually turned into another kind of vibratory motion which constitutes heat. On this supposition, one half of the wire will receive energy from one pole of the battery, and the other half from the other pole, and at the centre of the wire the electric vibrations will vanish, having been all transformed into heat vibrations.

Now let us compare two batteries, one consisting of a single cell and a length of fine wire, and the other composed of $n$ similar cells coupled in series, and having its poles joined by $n$ times the length of the same gauge of wire. As the resistance of the cells is assumed to be negligible, the strength of the current is the same in both circuits. Now, let us fix our attention on a definite length, say 1in., of wire next one terminal of the battery. Call this short length of wire A B in the case of the battery of one cell, and X Y in the case of the battery of $n$ cells. Then, in any given time, the energy traversing X Y is $n$ times as great as the energy traversing A B. At any given instant of time, the energy contained by X Y is $n$ times as great as the energy contained by A B. But the physical properties of a body vary with the amount of any particular form of energy it contains. Hence, A B should differ from X Y in some one or other of its physical properties. But this has not been found to be the case. If, therefore, the energy of the electric current travels along the wire, it acts in a manner utterly unlike that of other forms of energy with which we are acquainted. I do not cite instances, because they must be familiar to every one. Now let us turn from the wire considered as the locality where energy is contained, to the wire considered as the seat of the transformation of energy. The energy of the current is being transformed into heat both in A B and X Y, and in both *at the same rate*. It is laid down by Professor Rankine as a general law of the transformation of all energy that "The effect of the presence in a substance of a quantity of actual energy, in causing a transformation of energy, is the sum of the effects of all its parts." The rate at which transformation of energy takes place must consequently increase with the quantity of energy present in a substance. In the instance under consideration, X Y contains $n$ times as much energy as A B, but the transformation goes on at the same rate, contrary to the above-quoted law. These arguments are quite independent of the particular manner in which we suppose the energy to be transmitted along the wire.

Let us examine the hypothesis of transmission by wave-motion a little more closely. We may assu the wire to be composed of two sets of particles, and N, the former set having that particular k of vibratory motion that constitutes heat, and latter set having the vibratory movement that c stitutes the electric current. We may suppose M set of particles to be the molecules constitut the substance of the wire, and the N set to co of finer particles filling up the interstices betw the molecules of the M set. On this suppos heat and current in the circuit consist in etic energy of atomic motion, the heat ed in the wire being produced by a transfer entum from the N set to the M set of s. The average momentum of the N set, or nveying the current, will be proportional to re root of the energy they are transmitting. ack to our illustration of the two batteries, t of particles in X Y will possess *n* times the energy of the N set in A B. Their average tum will be greater in the proportion of . But by the hypothesis supposed they lose tum *at the same rate*, a conclusion that is ilable with elementary mechanical prin- For the transfer of energy must take place action similar to a collision, and when two collide, the momentum gained or lost in- with their relative velocity. It is very diffi- conceive a form of vibratory motion free e mechanical objection above noted; the tion of a single set of particles for two sets nly increase the difficulty.

owever, we adopt the supposition that the is transmitted directly from the battery to across the intervening space, we get rid of e objections altogether. There is, more- nother very obvious advantage in adopting othesis, and that is that it accounts simul- ly for two sets of facts, viz:—(1) the ena in the wire itself, and (2) the pheno- the magnetic field surrounding the wire; s, if we suppose the energy transmitted by re, we require some further hypothesis to t for the magnetic field in its neighbourhood. sy to see that the elementary properties of gnetic field surrounding a straight wire are ly consistent with the supposition that the traversed by a series of circular waves con- with the wire and converging on it. If the tic field is actually caused by such a set of , it may be shown that its intensity should be ly as the distance from the wire, and such is ly the case.

If the energy is transmitted across the space n the battery and the wire, it traverses every f matter and a vacuum with equal readiness. we require to hypostatise an immaterial m as the agent of transmission.

G. J. B.

### THE AURORA BOREALIS.

16.]—In letter 31887, p. 354, we have a hat ambitious attempt to explain the pheno- of the aurora; but as it is clearly evident e writer lacks a personal acquaintance with ts brought forward, it may perhaps be worth to point out a few of the most conspicuous in his argument.

writer begins by defining a vacuum tube as h it necessarily consisted of a glass tube fitted rass caps and silver terminals. As such a uction would be almost useless for purposes arch, and as it is quite immaterial what the terminals are made of (so far as the mentioned in the present letter are con- ), this definition is rather insufficient.

striæ in the vacuo discharge are then dealt n such a way as to show the writer believes it essential to their formation that the tube contain a little vapour of some foreign nce, for instance, alcohol or turpentine, and supposition he proceeds to build up a theory ning their production, saying that the vapour ssary to give resistance to the current. Now resistance between the terminals of a mode- ized tube is something like 200,000 ohms, it is ite apparent why any further resistance should uired from the vapour.

en the only source of rarefaction was the old nical air-pump, the degree of exhaustion re- to show striæ in an air vacuum was almost d the power of the instrument to produce; so happens that hydrocarbon vapours and generally not only show the striæ effect very tly, but also show them at a rather lower in the exhaustion, and so by introducing such into the receiver, the results were much more obtained. But even then, the pressure shows the striæ best is barely reached by an shioned pump. For instance, such a pump roduce a vacuum equivalent to about 3 milli- of mercury, while in a coal-gas tube the faint striæ were noticed near + pole at a re of 5½mm., and only became well seen ghout the tube when the pressure was reduced m.

when we use mercury pumps, we are no limited by this range of possible exhaustion, hen we find that any gas will break up into without difficulty, with slightly varying cteristics depending upon the gas used.

are also told that the width of the darker between striæ is proportional to the current th, and that they may be seen to ascend the but, as a matter of fact, the size and shape striæ, the distance between them, and the l appearance of the tube, depend upon the re almost entirely, and as the same pressure is the same for weak or strong currents, the only alteration being in the brilliancy; and although striæ usually flicker a good deal, still no general advance up the tube can be perceived, and it is easy to arrange matters so as to obtain a column of sharp, clear striæ almost perfectly motionless.

It is quite true that there is a real, gradual progression from the negative to positive ends; but this effect can only be detected by the use of a revolving mirror, and cannot be seen directly.

Further on in the letter we find Crookes credited with the discovery of the rotation of the vacuo discharge round a magnet pole, an effect known for at least 40 years, and, I believe, due to De La Rive. What Crookes discovered was something quite different, which need not be discussed here.

The reference to Crookes's work is altogether inaccurate and misleading, and the writer has evidently never seen the effects he refers to. We can only briefly indicate their real bearing here, as the subject is too extensive for general treatment.

As an exhaustion progresses, we first get luminous effects varing in colour with the gas used and certain other conditions, which give characteristic line spectra.

At a considerably better exhaustion the light becomes fainter, the striæ disappear, and the lines of the gas are only faintly seen. Proceeding with the exhaustion, the tube again becomes brilliant; but this time it is certain portions of the inner surface of the glass itself which are giving off the light, and these luminous effects are exactly the same whatever the nature of the gas used.

With reference to these results, our contributor tells us that this phosphorescent light from the glass tube itself gives a green line in its spectrum, and that this green line is identical with the well-known aurora line.

Now I have before me as I write a number of tubes, some of which give a green phosphorescence of various degrees of brilliancy, others a blue phosphorescence, and others again give no phosphorescence at all when submitted to the discharge under exactly similar conditions. In fact, the nature of this glow depends upon the composition of the glass itself, and upon nothing else whatever.

Further, the spectrum of this phosphorescence is continuous, without any very conspicuous lines. At any rate, it certainly does not give the aurora line. Whether this line has ever been obtained from the vacuo discharge is doubtful, and I am inclined to think not. De La Rue was unable to detect it, although it certainly seems probable that it may eventually be obtained in this way. Lemstrom obtained this line by an artificial method; but then he created an actual aurora by covering a considerable area of ground with a large number of earth-connected points, thus facilitating a brush discharge between earth and sky.

Before we can hope to establish a complete theory, we must know something of the reasons which cause electrical discharges to appear as auroras round the poles, and as thunderstorms in lower latitudes. The increase in gaseous resistance caused by cold may also bear upon the subject, and is as yet imperfectly known.

Our contributor comes to the conclusion that the aurora is not entirely electric in its nature, but also magnetic. Of course, this is correct; but in this and other portions of his article it is apparent that he does not fully grasp the real connection between electricity and magnetism, and so does not see that all electric discharges, of whatever nature, are necessarily magnetic also.

The question of the actual nature of the aurora is, in fact, a very complicated problem. Many factors remain to be considered which cannot even be referred to here; but we have perhaps said enough to show that the present explanation can hardly be said to settle the question.

Leicester. E. E. B.

### BOOKBINDING—ERRATA.

[31917.]—On p. 315, letter 31854, in first line, for "fairly cast" read "fairly cut." In paragraph between Fig. 1 and Fig. 2, line three, for "cut away at the other 10in. from the handle," read "cut away at the other to form the handle." In line 9, for "edges" read "edge." In lines 10 and 11, for "level" read "bevel." In line 12, omit altogether "10in." In paragraph below Fig. 3, line 4, for "glued on" read "glued in."

I regret having omitted in my letter to thank "Practical Bookbinder" for his recent articles. I found them of great service. J. A. C.

ONE of the striking features of the agricultural returns for 1890 is the increased acreage devoted to orchards, market gardens, and the culture of small fruit. It seems that in the growth of small fruit alone, that is, strawberries, gooseberries, currants, &c., there are 4,300 more acres employed this year than last, and there never were so many acres of orchards in the country since records began to be kept. In 1873 there were not 150,000 acres of orchard in Great Britain, now there are 202,305.

## REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[72658.]—**Electric Lighter.**—Both "M." and "F. G. Ll." seem to have misunderstood this query. It is quite possible to obtain a spark that will not ignite gas if the terminals are brought close enough together. What I mean is, that I can obtain a short spark if I decrease the distance of the points to about $\frac{1}{32}$in.; but when I separate the points to the proper distance, the sparks refuse to pass. I am well aware that sparks of a certain length must be of certain strength. "F. G. Ll." is quite right that the gas ignites better when the lighter is held about 2in. above the burner; the reason why is obvious. HATHAWAY.

[72685.]—**Yew.**—My experience is like that of "Jack of All Trades." Some years ago I had to cut a yew. The bole or stem was about 10ft. long and 1ft. through, and perfectly sound; yet I could not get more than 1s. a foot offered for it, and I at last made a gate-post of it. Bows are never made of yew at present. I have found the same difficulty. Perhaps someone can explain it. C. M.

[72790.]—**Electrolysis of Water.**—Would Mr. W. John Grey consent to give exclusively scientific answers, as becomes a scientist of his high achievements, to the following purely scientific questions?:—(1) How many gallons of H and of O are obtained by the ectrolysis of one gallon of pure liquid water, at the temperature of 0° C.? (2) What is the temperature of such gases? (3) The elicited gases can be received either separately into two different vessels, or into one only. In the last case, will they mix or remain separate, and will O, in consequence of its much greater specific gravity, fall at the bottom and H float on the surface? (4) If they mix, what will be the physical law that will overpower and supersede the universal law of gravitation? (5) Will the gas mixture preserve the gaseous state, or, in consequence of their great affinity for one another, will the gases recombine into water? If they don't, what is the action of affinity? (6) The recombination of the gases can easily be obtained by several processes, among which is ignition. The latter elicits heat. The two gases being admitted at 0° C. temperature, wherefrom will such heat come? Which will be its physical constituent elements? Where placed? Their nature, numbers, and proportions? And what will be the degree of that heat? (7). Many talented chemists and physicists have seriously studied this curious question, but the results they have arrived at widely differ. Laplace and Lavoisier found 23,252 colories (gram. heat); Clement Desormes, 23,294; Despretz, 23,840; Dulong et Petit, 34,601; in 1843, Andrews found 33,612; in 1845, Favre and Silberman found 34,462; in 1860, Pelouze and Frémy found 30,000; in 1872, Thompson found 33,974; in 1877, Thon found 33,867; Schuller and Warter, 34,126; in 1880, Berthelot 34,500. Of course, these eleven differing numbers, all empirically obtained, cannot all be correct; but they can all be incorrect, or one may be right—in this case, which one? How can it be demonstrated so? If there is none correct, which is the right number, according to proper equations of the physical constituent elements? (8) According with the apparatus or process used, the heat is obscure or luminous, and its temperature differs in consequence. What relation is there between them and the cause thereof, the proportions of heat and light produced, and the physico-chemical elements thus combined? (9) According to textbooks the volume of O in water being 1, that of H is 2, their mixture 3, their density 6, in the gaseous state. In combining the volume is reduced to 2, not of liquid water, but of water vapour, of a density of 9. What becomes of the volume which seemingly disappears? (10) If left to cool, the produced water vapour condenses into liquid water; its volume decreases, according to textbooks, to about $\frac{1}{1700}$th. But science has no abouts. It must be, it certainly is, a fixed, invariable number, and as of necessity it is cubical, it cannot be $\frac{1}{1700}$, which is not cubical. What is the exact number easily demonstrated by the equations of equivalents of chemical and physical constituent elements, all adequate to the form, volume, and weight of atoms, the number of atoms forming a molecule, the form, volume, and weight of the molecule, the action on it of gravitation; the respective qualities and properties of the gases, vapour, and liquid water, heat and light, elicited in the operation, and their respective physico-chemical properties?

Morchaine, Somme, France. CH. RABACHE.

[72871.]—**Seaside Planting.**—It is not only the "salt in the air," it is the wind that causes failure. The only plan in many localities is to plant a screen of hardy sea plants, behind which the more sensitive ones can be sheltered. For the outer edge, next the water, perhaps nothing is better than sea buckthorn (Hippophae Rhamnoides) and common elder. If not too cold a place, tamarisk; next to these, willow, poplar, sycamore, blackthorn, whitethorn, elm, maple, &c. Inside these there is a great variety of trees and shrubs which will grow well; but, of course, more can be done in this way in the South of England than could be done in Yorkshire. Most of the following list would be suitable: Euonymus, evergreen oak, Bupleurum, privet, berberis, laurustinus, holly, bay. Of coniferous trees, Pinus pinaster, P. laricio, P. austriaca, P. insignis; and of climbing shrubs, ivy, Virginia creeper, jasmine, Lycium barbarum, periwinkle, honeysuckle, &c. This list might easily be added to; but in many places you must get the outer screen first. Tresilian.

[72886.]—**Manganese Nodules in Red Clay.**—I do not know about manganese nodules particularly, but many nodules are found in clay-ironstone beds, and certainly they have frequently formed round some organic body. They originated, probably, in the natural tendency of a substance in solution to precipitate when brought into contact with an object which probably exercises some influence on the solution or "slop"—possibly electrical or akin to what is called electrical.

S. P.

[72888.]—**Alabaster.**—If the columns are roughed down in the ordinary way of dealing with marble, they may be first rubbed over with pumice-stone, and then with dried shave grass, which will put a "surface" on them. The polishing then goes on with sifted slaked lime in a paste with water, and finishing with French chalk on a piece of soft felt. Putty.powder can be used for polishing. Num. Dor.

[72931.]—**Organette.**—Querist cannot well make an organette without special tools, as a tube-board is required similar to that found in A. organs; but having the reeds it is desired to use, an expert carpenter or joiner can readily bore the tubes and cut the grooves. A little bellows worked by a crank, which also actuates a roller to draw the "music" paper through, completes the fundamentals of the instrument, and the case may be anything desired. See the indices of back volumes, or number for April 11, 1879, for an idea. Organon.

[72936.]—**Boiler for a 4ft. Yacht.**—It is ridiculous to ask such a question. Any model maker can supply a boiler suitable for a 4ft. yacht, and there are hundreds of Replies which answer the question in back volumes. The boiler should be of copper with riveted seams, but how that, with its furnace and engine, is to be carried in a four-foot boat I don't know, for 40lb. is a high pressure for so small an affair—so small that there is no room for an attendant or "engineer." Please ask another riddle.

B. T. E.

[72940.]—**Motor.**—This querist is quite correct when he says that "a great want would be met if somebody would construct a motor of ¼H.P. at a low figure and fairly efficient"; but does he not see that if such a thing were possible it would already have been done, not by one, but by several competitors for public patronage. If gas is cheap in the vicinity of querist's workshop, I think he would find a gas-engine least expensive and most satisfactory, all things considered. R.

[72941.]—**Zincography.**—"D'Evlyn" does not give the page on which the "paragraph" to which he refers is to be found, and I do not see why anyone should be expected to hunt it up and reply for his benefit. The method of making process blocks has been described many times in back volumes, or if they are wanted, so to speak, in one hand, "D'Evlyn" can find them in a little work on "Photo.-Engraving" by W. T. Wilkinson, Ottley, Yorks. See also indices of back volumes. Process blocks are cheap nowadays. R.

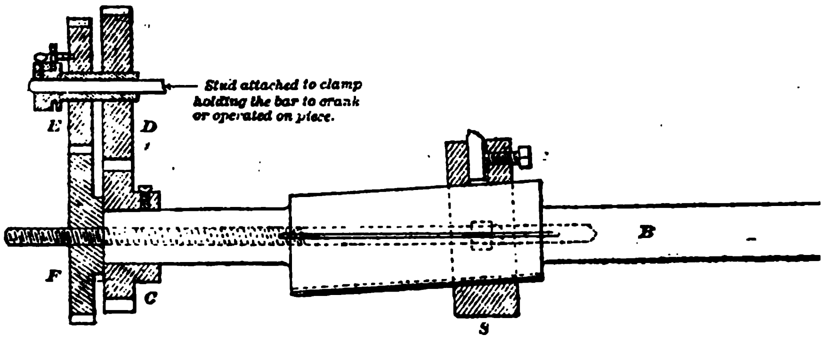
[72943.]—**Dynamo Designing.**—Seeing that the Gramme is a development of the Pacinotti, what does "J." mean? The rules, with examples, have been given some hundreds of times recently—in fact, *ad nauseam*, for there cannot be many who want to design dynamos when so many good patterns are available. T.

[72946.]—**Feeble Hand.**—Should not this sufferer consult a surgeon? I do not understand how anyone (even a surgeon) can give useful advice without examining the patient. T. M.

[72950.]—**Strata under Sahara.**—Do not understand what querist means by a M. S. section of the strata bored through by the French in the Great Desert. Doubt whether anything of the kind has been made. Some borings were made to ascertain the possibility of flooding the Sahara by cutting a sort of canal to the Mediterranean, but nothing has been done towards its accomplishment except what has been recorded in back volumes.

Tripoli.

[72953.]—**Boring Taper Holes.**—Seeing the question about boring taper holes, I send the following, which I found in an American paper. It will interest many, if it does not exactly meet the wants of the querist. It was specially designed for boring taper holes for wrist-pins in cranks. The mounting is not shown, but consists of the ordinary boring-bar clamps, with sleeves adjustable by set-screws. It consists of a (steel) bar, with an enlargement near the middle of its length. This enlargement is set at an angle with the axis of the bar. On this is fitted a sleeve (or several sleeves of different diameters), feathered to slide easily. The cutter is held in a suitable slot by a set-screw, as shown. This sleeve is drawn along the bar by a cross-key, sliding in a slot cut through the enlarged part of bar, the seat in sleeve being slotted, as shown, to allow for side movement of key in sleeve. This key is drawn by a right-hand threaded rod, through which it passes, the rod being moved by the gears shown at the end of bar. The gears C and E have (in this case) each 31 teeth, and D and F each 36 teeth, and the lead of screw is 12in. to 1in.; this gives a feed of about 48 cuts to the inch. If the nut (or gear F) were prevented from revolving, of course the feed would be 12 to the inch; but as the train gives about three-quarters of a revolution to gear F to one revolution of bar, the resultant is a forward movement of one quarter of $\frac{1}{12}$in., or 48 to the inch. The bush, or sleeve, in clamp used in front, was made larger than any wrist we expected to have, and when the hole was brought nearly to size wanted the bar was slipped out and pin tried in; then if, for instance, the pin went to its place within $\frac{3}{16}$in., the bar was put in again, but moved endwise just the $\frac{3}{16}$in., and another cut taken without moving the tool; and it was an absolute certainty then that the hole was the right size. The pins were previously fitted to holes bored with the same bar in templates covenient for handling in the lathe. In this way they could be finished beforehand, with no danger of having a misfit. The bar bored so perfect a hole that if the pin was properly fitted to template, no grinding whatever was necessary. Of course, the boring was done after the crank was on the shaft, and the bar could easily be put in perfect line with shaft. W. C. T.


Stud attached to clamp holding the bar to crank or operated on piece.
E
D
F
C
B
S

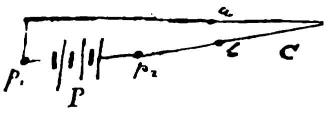
[72957.]—**Electric Clocks.**—If this query refers to clock arrangements which have been really patented, it would be advisable to give more details, which can be obtained easily by those interested. Otherwise, I should recommend the querist to read up his back numbers, in which he will find many ideas for, and practical methods of, working electric clocks. R.

[73057.]—**Condensing Engine.**—If the injection water is constantly being used over again, falling from a height to which it is pumped up by the air-pump, it gradually loses, and remains all but free of air. It should, however, fall into a receptacle somewhat below the bed of the air-pump, in which it can settle down to a state of rest. Many of these kind of coolers are now in use fitted with a kind of propeller fan for driving air up against the falling water, which latter, in falling through a vertical tube or casing of wood, or of sheet iron, fitted with a series of stagings, or steps, secures its subdivision and cooling by the upward air current. On this plan, no additional water, after once providing, or at most a very small quantity, is required, as the condensed steam makes up for loss in vapour escaping with the air at the open top of the cooler. The cooler should be about 22ft. high, and may be of square or circular section. The power required to drive the fan and lift the water is about 3 per cent. of the total engine power. The water circulates in this way every 15 minutes through the air-pump, and a very excellent vacuum (28in.) is obtained. Of course, the hot water from the air-pump is delivered through a rose in the form of spray at the top of cooler. The air-propeller, which is fixed low down—say, on a level with the engine floor—to the side of the cooler, may be driven by a secondary shaft from any suitable part of the engine, or by a small donkey engine. Good ventilation of the engine-room is also secured in this way. The power of non-condensing engine, when water is scarce, might be easily increased by adopting condensation with a cooler on this simple plan. Marienberg.

[73090.]—**Glow-Lamp.**—"Elektron" is not right with the constants of his glow-lamp. He says the lamp requires 0·5 amp. 40 volts,
resistance hot of 30 ohms. The equatio
teaches that we can have the three followin

I.—Supposing right T = 0·5 amp.
and R = 30 ohms
we find E = 30 × 0·5 = 15 volts.
II.—Supposing right T = 0·5 amp.
E = 40 volts
we find R = $\frac{40}{0·5}$ = 80 ohms.
III.—Supposing right E = 40 volts
R = 30 ohms
we find T = $\frac{40}{30}$ = 1·33 amp.

"Elektron" further is wrong when he t
he can glow his lamp with a battery from
E.M.F. just represents the voltage of th
lamps, because the difference of tension
when in use, is much less then at rest, an
the lower the smaller the external resis
respect to the internal resistance. For if w
a battery P with external circuit C, we



that there will be difference of E.M.F. be
separate points $a$ and $b$ of the circuit, and
difference will be proportionate to the res
the circuit $a\,c\,b$, when resistance between
nil—i.e., when $a$ and $b$ have no distance th
be zero. Therefore we can apply the la
in the separate external circuit too—

Intensity in $b\,c\,a = \frac{\text{diff. of E.M.F. betw.}}{\text{res. } b\,a\,c}$

Let $p_1\,c\,p_2$ the external, and $p_2\,p_1$ the int
cuit, this equation becomes: T being the
E, E.M.F. battery, $e$ difference of E.M.F.
when in junction, $r_e$ external, and $r_1$
resistance. $T = \frac{e}{r_e}$, and by the law of
have $T = \frac{E}{r_e + r_1}$. Eliminating T betw
equations, $e = E \times \frac{r_e}{r_e + r_i}$. Apply this eq
the three above cases—

I.—$E = 2p$, $r_1 = 1·5\,p_1$, $e = 15$, $r_e = 30$
is the number of cells used $15 = 2p \times$
$p = 12$ cells.
II.—$E = 2p$, $r_1 = 1·5p$, $e = 40$, $r_e = 80$;
$\times \frac{80}{80 \times 1·5p}$ $p = 32$ cells.
III.—$E = 2p$, $r_i = 1·5p$, $e = 40$, $r_e = 30$;
$\times \frac{30}{30 \times 1·5p}$.

This equation gives 1,200 = 0, and show
with these cells there is no possibility of
the lamp. We shall in this case be o
diminish the resistance of battery by u
equal series in parallel, or to use a partial p
series something like "Elektron's" seco
ing. By using two parallel series
$r_i = \frac{1·5p}{2} = 0·75p$, and the equation
comes $40 = 2p \times \frac{30}{30 \times 0·75p}$ p = 40. "E
wants 80 cells in two parallel series also in
As for the connecting of the battery, "E
will see that this is not the fault except i
case, and, further, the equations will teach
$p$ must become larger when $r_e$ diminishes,
also the number of cells must grow
number of lamps. Du

[73092.]—**Wimshurst Machine.**—Pl
rect erratum, p. 358, in my reply to t
number; last line but three, "control"
"contact." Ca

[73092.]—**Wimshurst Machine.**—"C

ı the rotation of his plates and in the
iddle two plates to the ends of one
ıuld very much question the policy
ɾo end bosses to the spindle; doing
friction of the centre boss, and makes
more difficult. I like to have ready
g the bosses endwise upon the spindle,
drop of oil when necessary. Then,
carriers for the brushes, I prefer to
ixed to its wood seat, and capable of
moved for the renewal or keeping of
order; they may be so fitted as to re-
adjustment to obtain either freedom
or length of spark. The best material
is the fine brass wire used by the
s. The No. 22 gauge is a very good
bought in Little Britain—and is the
e obtained for one shilling per oz.;
orth will last "Calculus" for years.
say, 15 or 20 wires to make a brush.
are in good condition, and all of
d together by metal, the machine
obtain excitement with a half-turn

J. W.

**Tangent Galvanometer.** — My
been so busy, we have been com-
ontinue, for a time, the articles on
ctrical Testing"; but on resuming
e hope to give details for the con-
a tangent galvanometer such as
quires. F. C. ALLSOP.

**bbing Horses.**—An Indian method
this evil is to slip a thin rope, about
d the fetlock of one of the fore-legs,
olding the two ends in one hand. By
the horse is induced to make a step
o forgets his obstinacy. As soon as
one end of the rope is let go and the
wn. The various animals of all sizes
dian Postal Service frequently begin
lying down, when the usual hitting,
hipping are resorted to. A Canadian
not peculiar to that country, is, I
e about a dessert-spoonful of ground
palm of the hand, and then hold it
l's nostrils. This is said to surprise
uch that he proceeds without more
otice the S.P.C.A. would take of this
lo not know. G. G. B.

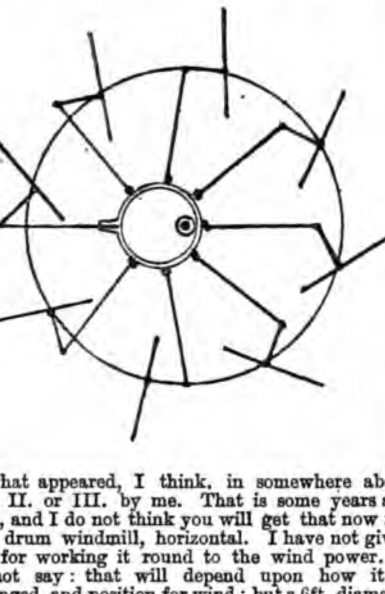
**Mechanical Similitude.** — Thank
nhill, for your courteous and timely
k me to calculate the dimensions of
l for a 20-knot speed. I should say
ame revolutions, and wheel in pro-
a length. But what I want to know
ressure has to be reduced with the
does it come about that 50lb. is not
e model as the ship? According to
aw of "mechanical similitude," if I
n a 48th scale at 50lb., then, to pro-
result in the ship, I should require
s pressure of 2,500lb. to the square
in, a model 6ft. long at 40lb. for a
length to obtain the same result as
ld require a working pressure of 240lb.
hly understand you? I take this
thanking "J. A." for his endeavour

PADDLE-WHEEL.

**Mr. F. C. Allsop.**—The usual re-
Bell receiver is from 70 to 80 ohms
h a microphone and induction coil.
no rule as regards the resistance of
er, as they differ so for each instru-
sistance of the line varies so for each
ents. F. C. ALLSOP.
Victoria Street, E.C.

**ontents of Cylinders.**—In deter-
uantity of liquor contained in a
linder, imagine a section at right-
of cylinder; the area occupied by the
represented by a segment of a circle.
er of the cylinder and the versed
of liquor, are known, the area of
an be found, which, multiplied by
ylinder, gives cubic contents of space
e liquor. To calculate the area of
s a long process; but it is readily
ns of a table of areas of segments
ller" will find at p. 120 of Hurst's
l Surveyor's Handbook" (published
n other similar books of tables. For
linder 10ft. long, 2ft. diameter, with
deep. Find quantity of liquor in
de depth of liquor in inches by
ches, $\frac{10\cdot25}{24} = \cdot427$. Look in first
le for ·427; against it in adjacent
.9959. Multiply this by diameter
24 × ·319959 = 184·296, the area of
uid in square inches. This, multi-
ı of cylinder in inches, 184·296 × 120
quantity of liquor in cubic inches,
l by 277·274, gives gallons. If the
or exceeds half the diameter of
the above process to find area of
pied by liquor, and deduct this from the whole area of cylinder, found by squaring diameter and multiplying by ·7854. The results are approximate, but true enough for practical purposes. SQUIRE.

[73129.]—**Small Windmill.**—The sketch here



is what appeared, I think, in somewhere about Vol. II. or III. by me. That is some years ago now, and I do not think you will get that now; it is a drum windmill, horizontal. I have not given sail for working it round to the wind power. I cannot say: that will depend upon how it is arranged, and position for wind; but a 6ft. diameter should do all you want.

JACK OF ALL TRADES.

[73157.]—**Koumiss.**—The following is taken from the *Scientific American*: "Dissolve 4oz. of white sugar in one gallon of skimmed milk, and place in bottles of the quart size; add 2oz. of baker's yeast to each bottle, cork and tie securely, set in a warm place until fermentation is well under way, then lay down on their sides in a cool place. In three days fermentation will have progressed sufficiently to permit the koumiss to be in good condition."

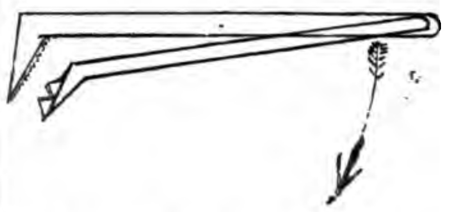
Sheffield. W. H. H.

[73161.] — **High-speed Steamers.** — My boat will run a distance of 1,000yds. in 6min.; maintain the speed for 30min. Return tubular boiler, single engine $1\frac{1}{4}$ bore, $1\frac{1}{2}$ stroke, 700 revolutions per minute; 80lb. pressure of steam, 3-blade propeller. If you will advertise your address, I will assist you.

MARINE MODELLER.

[73161.] — **High-speed Steamers.** — I am aware that I have a good many queer things to answer for; but what can you expect of a Jack-of-all-trades who has always had to feel his way? But I do not think I will plead guilty to that. It is all very well to talk of something definite to work from in these small articles, but where is the data to come from?—only by experiment. A 3ft. boat, 6in. beam, and, we will say, 7in. screw, 8in. pitch, would, I guess, want to run very nearly 1,500 revs. per minute to make nine miles per hour. There is a limit to everything, and I should think, to be effective, from 300 to 500 is the limit of speed for propulsion by water. Of course, I do not know what the electric launches do in that way; but they will soon solve the problem for us. Now, I know of no rule laid down to get at this; but was it my case, I should lay it down thus:—Boat 5ft. long, 8in. beam, trimmed to draw between 8in. and 9in. aft; screw, 7in. dia., 12in. pitch. Now take the displacement—that is to be got by weighing the boat; say 60lb. Now allow another 20lb. for boiler, engines, water, screw-shaft, &c., &c. 80lb. = 8gals. = 277c.in. per gallon. Now treat your screw as if throwing a solid bore of water, area 38·484. Multiply by 63,160in. = 1 mile. Divide by 277 = 8738·8gals. Now divide that by the 8gals. The displacement of vessel = 1092·4. Multiply this by the length of the vessel, and you get 5462·0ft. Now say the screw makes 150 revs. per min. Reduce this 150ft. to inches—1,800. Now, area 38·484, multiplied by 1,800 = 69571·2; this by 60 = 4174272. Divide this by 277; quotient 15069·5. Divide this by 8gals. = 1883·6. Multiply this by length = 9418·0ft. Divide this by 5,462, and you will see your boat has travelled at the rate of a mile and a half in the hour. Now for engines. 38·484 × 1,800 = 69571·2; divided by 277 = 251·9; multiplied by 10lb. = 2,519. Now allow a third of that for friction, and 2519 + 839 = 3358, the power required, $\frac{1}{10}$H.P. about. Now we will say the engines are to be compound; h.p., $1\frac{1}{4}$ dia., area, 1·227: l.p., $1\frac{7}{8}$; dia. area, 2·761. Now, I propose to work with 60lb. per square inch, cut off half-stroke. Now multiply the area h.p. 1·227 by the mean pressure, say, 45lb., and by 50ft.; that is, supposing the stroke to be 2in., and 150 revolutions; this gives us 2760·7ft.lb., and the l.p. area 2·761 by the mean of 30 and 15lb., that is to say, 22·5, and that gives us, when multiplied by 50, 3106·1ft.lb., and 2760·7 + 3106·1 = 5866·8ft.lb., and there are your engines. I shall cry a spell now, and leave you to digest this, that you may see whether it is any use to you. I have put it as plain as I can, and don't think there are many mistakes. You must understand that it is supposition, i.e., an example. JACK OF ALL TRADES.

[73168.]—**Spoke-grip for Cycles.**—I have

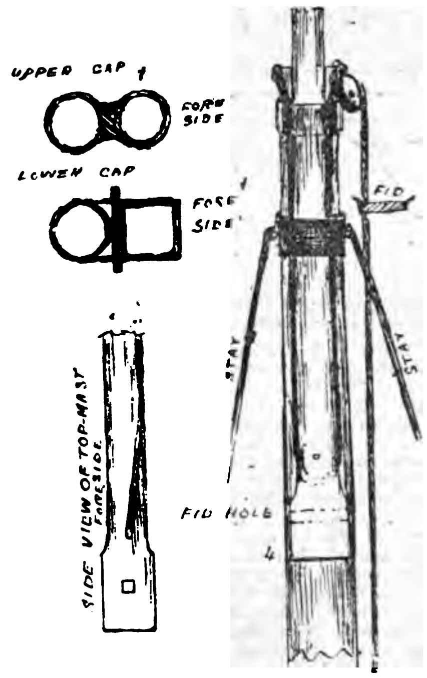


found grip as per sketch most satisfactory for big strains. It will explain itself. F. M.

[73172.] — **Soldering Brass.** — Here is the common method of doing this simple job, which I learned from Indian workmen, and have often performed it myself. Having fitted a disc of stout sheet-brass moderately tight into the tube for the intended bottom, withdraw it; with a feather, dipped in a thick solution of borax (about as thick as cream), smear the edges of the tube inside, and then the edges of the disc; gently but firmly return it to its place in the tube, pressing down on a board to give an even bottom. Cut three or four little bits of silver solder; dip each in the borax paste, and shake off when you remove them, and very carefully insert them in the tube, so that each morsel may adhere to its place on the edge of circumference. Very gently set the tube on any support where it cannot be shaken; put some red embers of charcoal in a metal pan, and on these a handful of very dry charcoal. With a common blowpipe raise this into a clear fire. Fasten a strong wire holder round your tube, and then lift it very steadily to the fire, letting the bottom get sufficiently hot, and no more than is necessary to melt the borax inside. A fizzing noise will tell you of that. Now remove the tube and smear the bottom part, when nearly cool, with a thin paste of clay, and also the lower part of outside, which will protect the metal. Make a firm hollow in the fuel, hold the blowpipe in right hand, and wire-support in the left; blow a good blast, and if you have ever done brazing before, you will know when the alloy has run. A joint properly done can scarcely be seen, after polishing in the lathe, even where the seam is in length. My Indian silver solder used to run like quicksilver in three or four minutes. For most purposes a bottom can be strongly and simply fixed in any cylinder by the soft solder of tinsmiths, provided the disc be of stout metal, which must not be too tight a fit. Smear the inner edges of tube with a little dissolved salammoniac, and also the disc. Put them together; smear the bottom thickly with clay, dry it well over a fire, then drop some bits of soft solder into the tube with a morsel of powdered ammoniac—half a pea in bulk. Having a thick glove on your right hand, apply the bottom end of your tube to a red fire. You will soon smell the acrid fumes and hear a hissing noise. Then give a shake and remove your tube quite upright to cool. Lastly, cleanse the work by washing the interior two or three times with boiling water, and polish the metal in your lathe. This junction will stand everything except fire heat, and may suit your purpose better than the first described. Over three years ago I put a bottom with soft solder into a 1in. piece of brass tube for an instantaneous shaving pot, heated by a spirit-lamp. This appliance is still sound as ever, the water preventing the solder from melting. EOS.

[73176.]—**Induction Coil.**—You do not say what kind of microphone you want the coil for. If you will let me know whether it is of the Gower type or the Blake, I will send sizes and quantities of wire for coil. F. C. ALLSOP.

[73185.]—**Flagstaff.**—If you want a 30ft. flag-pole, you will require a lower-mast, say, 14ft. above ground, and a 16ft. top-mast, and two caps, as shown in sketch, upper (1) and lower (2). Fix the lower cap on the top of the lower-mast, about 2ft., or a little more if you like; then fix the upper cap on about 6in. The after-side of both these caps must go on the lower-mast. Screw two eye-bolts above the top of upper cap, for a 6in. block to hang, and the end of your lift-rope—that will be one each side. You must have a sheave-hole in the top-mast near the square heel, and a fid-pole and fid, if you want to fix it up there. The sheave-hole would be cut not straight up and down the mast, but with a lead into the lower mast. The square hole in the heel is for a fid—a square piece of iron which bears across the top of lower cap when top-mast is right up, and takes the weight of it. The lift-rope should be made fast to the eye-bolt at the top, then passed down through the upper cap through the lower cap and sheave-hole, back up through the caps again, and finally into the block. The lead of the rope will then be down, and the top-mast may then be lowered or raised at pleasure. As for rigging, you will require a stay from the top cap, and one from nearly the top of top-mast. However, you can suit



yourself in that respect from a glance at a cutter-mast. I do not know what you mean by lowering the yard-arm, as a yard-arm is, as its name signifies, the projecting part of a yard beyond the brace hoop. If "Sliev Donard" should require any more information, I should be glad to assist as much as I can. **Mast and Block-maker.**

[73185.]—**Flagstaff.**—Cut head of lower-mast square to depth of 3 or 4in.—this is to receive the

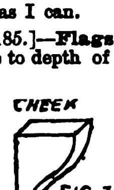


FIG. 1

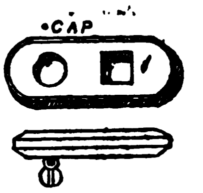


FIG. 3

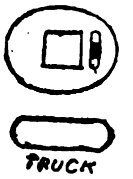


FIG. 5

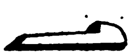


FIG. 4

cap. Screw cheeks, Fig. 1, to mast 3ft. from top, one on either side; make crosstrees, Fig. 2, put this over lower-mast head and fasten to cheeks, now put your stays on and get it up (or stepped); make your stays fast; put on cap, Fig. 3, having eye-bolt on one side of round hole, and small block or sheave

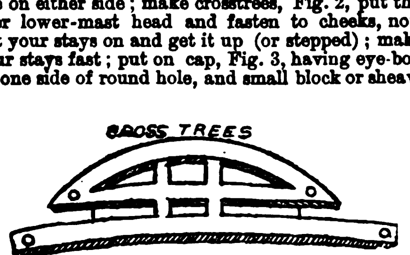
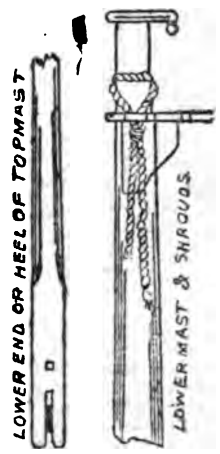


FIG. 2

on the other side. Prepare your top-mast by making sheave at heel or lower end, this lower end should be square to fit crosstree; 6in. above sheave cut square hole clean through to receive fid, Fig. 4. To get top-mast up, make rope fast to eye-bolt under cap, round sheave in heel of top-mast, and up through block under cap, get top-mast head through crosstrees and hoist till head has passed through cap; then put on your truck, Fig. 5, hoist away till top-mast is in position, when your fid-hole should be just above crosstree, belay your rope and put in fid. If you wish to hoist a flag, put sheave in one side of truck, or a simpler plan is to screw a brass eye-bolt in and reeve your halyards through it. If you do not wish to go to the trouble of making crosstrees, a simple batten having a square hole cut in it to receive the heel of top-mast will

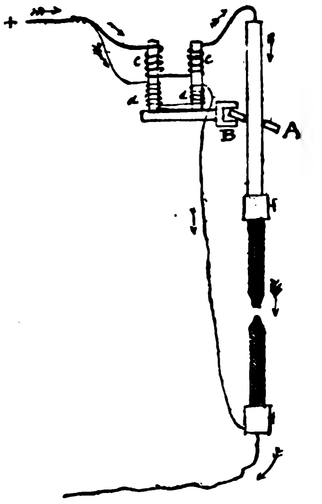


suffice; but the crosstrees will look far better. If you wish to stay top-mast, reduce the top-mast head, say, ½in. all round, splice eye in stays, pass over before cap is put on—these stays to be passed over edge of crosstrees and seized to lower-mast. Of course, after your lower-mast is up you must use a ladder, unless you prefer to put ratlines on your stays or shrouds. If this is done, you can go up and down by them.

New Brompton. G. Howard.

[73186.]—**Benzol and Benzoline.**—I regret that, in my haste, I read this question incorrectly, and I was misled by the spelling, not observing that benzine was meant for benzene. Benzol (not benzole) is a term applied to the volatile products of coal-tar naphtha, and it contains benzene and its homologues, carbon disulphide, thiophene, &c., &c. Benzene is a definite substance consisting of $C_6H_6$. It is crystallisable, and melts at 5·5°C. There is no such substance as benzine, but I believe that formerly the term was used synonymously with bezoline, as a name for the more volatile products of petroleum. Sm.

[73196.]—**Arc Lamp.**—To Mr. Bottone.—I illustrate herewith the working of the Brush arc lamp, as this gives a general idea of the mode in which the carbons are kept at a working distance



by means of shunt and series coils and solenoids. The upper carbon slides in a ring collar, which is pivoted, so that it can be tilted, so as to grip the carbon, as shown in the Fig. at A. This collar is clutched by the notch in the arm of the armature B, which plays in the solenoids *c c* and *d d*. The coils *c c* are of thick wire, and convey the current to the carbons of the lamp. The coils *d d* are of fine wire, and are wound in the opposite direction to the upper coils. When the carbons are too far apart to allow the arc to form, the current passes

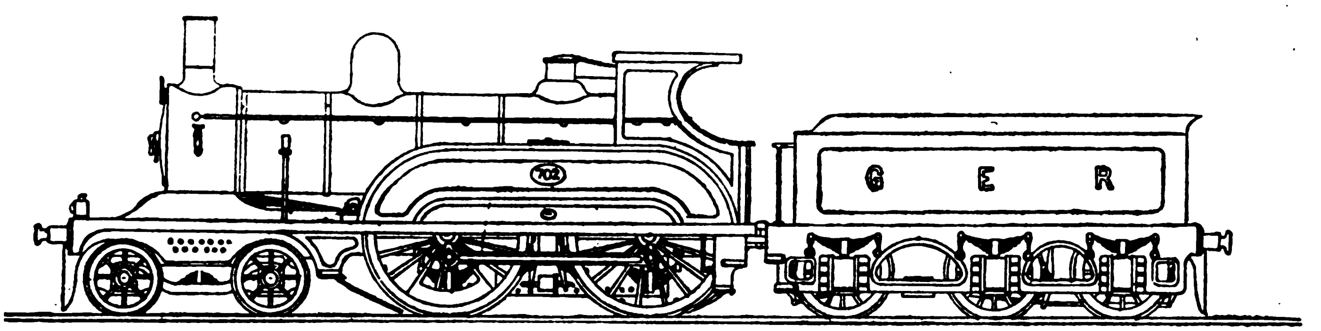
through the fine wire, or high-resistance
core falls, and the collar A takes the h
position, consequently the upper carbon f
touches the lower one, and strikes the ar
since there is very much less resistance i
thick wire coils *c c*, the greater part of the
passes through these, and the core is p
gripping and slightly raising the carbon,
retained in this position until it is so far
that the resistance is so great that the k
can come into action. When this occurs
again drops, and again the circuit is
through the thick or main coils, and so o
as there is any carbon to feed or current
The short ends do very well for m
Leclanché cells. You could charge y
celled accumulator very well if you switc
current from five cells of your large acc
There must be something wrong in
nections if you get the reversal effect you
and no charging when coupled up + to +
S. B

[73201.]—**Magnet.**—It seems to me
want to make a permanent magnet with
but this, of course, you cannot do. Y
hard steel for permanent magnets.
make electro-magnets from your soft
placing it inside your coil, instead of you
iron core. You are bound to get a stron
if you use two batteries instead of one.
netise steel well, you require an elect
which is capable of holding at least ha
pounds. So

[73202.]—**Indian Jugglery.**—I hop
of C. Holt, on the subject of Indian
will be more satisfactory to him tha
years' search for light in that quarter
to me. In 1875 I was lying convalesce
was then Andrez's Hotel, at Alexandria
result of some talk on the subject, a y
of an Indian regiment brought to the in
troupe of Indian jugglers, bossed by a
Sanjatsjee, of whose feats I have since
Anglo-Indians speak. They performed
me—startling tricks, including the baske
growing mangrove, and two or three si
all more or less known to European conj
two that struck me were, first, the rais
jatsjee—a fifteen-stone man—on the p
fingers of four assistants; and second
trick. The former is described in seve
works on spiritualism and conjuring ge
is said to be performable by anyone. I
it scores of times, but always without s
modus is this:—Sanjatsjee crouched o
Indian fashion, on a bit of planking
square, raised about an inch from the
the interposition of stones. The fou
squatted, inserted the forefinger of the
and, all five inhaling a full breath
moment, the board and man were
smoothly raised to the level of the
shoulders, and retained there about t
There appeared to be no room for qu
the facts of this trick. The next was
talked of, but rarely seen, rope trick.
troupe suddenly and without any ap
liminary display, jerked upwards a c
which, to my amazement, remained for
three or four seconds perpendicular in
hand; but no attempt was made to
afterwards examined the rope. It w
some stiff and tough grass, unknown
plaited like a Mexican hair lariat. It
20ft. long. This is my sole personal e
Indian jugglery; but I have spoken
Anglo-Indians, who declare they have
the trick as I describe it and intensifie
climbing up the rope. I am bound to c
ever, that the impression left upon my
cross-examination as to the scientif
of my informants' powers of obser
not satisfactory. Personally, I am
opinion that what testimony we have
alleged marvellous feats is greatly,
intentionally, exaggerated. Ten yea
note-taking and facility for study have
that an accurate observer is one of t
God's creatures. I am myself a bit of
conjurer, and I have constantly brough
attention the rarity of the observing fa
rarely that two spectators agree in desc
took place by way of preliminary to m
the resultant trick is described by diffe
with such variety of detail and fact as
astounding. My notebooks are cro
testimonies to the unreliability of hum
and some day I may give the world th
my observations. I am not indispose
Mr. Holt's suggestion that the witnes
alleged phenomena are the victims
hallucination. Here is an illustratio
fancy, helps out that theory. Six or
ago, as many scientific readers at Br
recollect, I gave a series of private scien
strations of hypnotism there. Among
I produced in one of my subjects wa
that he was covered with caterpillars.

l a gentleman who had been present, when he shed me by inquiring how I got the caterpillars the boy so neatly. I explained that the were but creatures of imagination. He incredulously as he protested, "Why, both fe and daughter saw them distinctly!" And lies persist in their assertion to this day. This to point to some sort of explanation of the miracles. The only weak point about it is aring a pretty extensive experience of hyp-. I have never known a subject recollect, on ing to his normal condition, anything that ired in the hypnotic state. Personally, I my inaccurate-observation theory the sounder two. D. Blackburn.

209.]—**G.E.R. Locos.**—Herewith I send a ng of a Worsdell compound locomotive, No. uilt at Stratford Works, 1885. The principal sions are as follows:—Cylinders, high-ure, 18in. diameter, 24in. stroke; low-pressure, diameter, 24in. stroke; driving and trailing s, 7ft. diameter; bogie wheels, 3ft. 1in. dia-; wheel base: centres of bogie wheels 6ft. 3in.; of trailing bogie wheel to centre of driving, in.; centre of driving to trailing, 8ft. 9in.;



wheel-base, 22ft. 7¼in. Boiler: diameter, in. (outside); length, 11ft. 5¼in.; 201 tubes, diameter; working pressure, 160lb. per square firebox, 6ft. long, 5ft. 6in. high. Heating e: firebox, 117·5sq.ft.; tubes, 1082·5sq.ft.; 1,200sq.ft.; weight, 44¼ tons. The engine is with Joy's valve gear. The tender carries gallons; weight, empty, 16 tons 6cwt. 2qrs.; 2 tons 18cwt. 3qrs.; six wheels, 4ft. diameter; of first to second, 6ft. 6in.; second to third, n.; total length of frame, 18ft. 3in.

J. Vickery.

219.]—**Drilling Watch-Jewels.**—The jewel ened on a diamond mill, and shellaced to a chuck. That side is then turned, and the of the stone caught and drilled half-way gh with a diamond-drill. The cutter for g is a diamond one, and both drill and cutter pt moist with water. The stone is then re-, and the other side turned, drilled, and ed. The cutters and drills are fragments of nd, fixed into brass handles by being forced The lathe is driven at a very high speed. The is polished with brass polishers and diamond and finished with boxwood and diamond dust l. The hole may be made larger, if need be, ng a broach formed of copper wire, with nd dust beaten into it. The hole is polished an ivory broach, used with loose diamond dust l. I have heard that the American watch ies have introduced several improvements into ethods of the drilling and polishing watch-s. C. A. Jones.

233.]—**Electro.**—Should read up the first ples of magnetism. A permanent magnet is of very hard steel and then magnetised by of a dynamo, &c., and does not require any ng. The electro-magnet, on the other hand, le of very soft iron, and wound with silk or -covered copper wire, and is only a magnet g as a current is sent from a battery through ire coils or covering. As to the difference in gth between the two, this will depend on the re sizes, &c., between them, as one can be quite as strong as the other.

shire. H. S. C.

234.]—**Electric Light for Bicycle.**—It is possible for you to light a 2c.p. power glow-for a space of three hours, and the accumu-, if only four volts, can be placed inside your nt lamp. I have for some time now used, and sfully introduced, the electric light for les and tricycles. I can supply customers with ur or six-volt accumulator to light a glow-for five hours continuous. The weight of the lete apparatus does not exceed 3¼lb.

E. A. McLachlan.

Brighton-road, Stoke Newington, N.

234.]—**Electric Light for Bicycle.**—It is ctly possible to fit a small accumulator, mea-g 2in. by 4in. by 6¼in., in a specially-made bicycle-lamp; and such an accumulator, once charged from a battery or suitable dynamo, will give 15 ampère hours, which is much more than you would need for three hours with a 2c.p.-lamp of about four volts. I made a square head lamp, 7in. long, 4¼in. wide, and 3¼in. deep, inclusive of bullseye, and in the back of this fitted the accumulator upright. For convenience of charging without removing from lamp box, I allowed the two terminals to project out of the case above, and connected the lamp, which hung just touching the flat glass of bullseye, by means of two helical wires. I charged the cells from four large chromic-acid cells connected in series. I have also run the lamp direct with one of my 15s. dynamos, the pulley of which rubbed against the driving-wheel of bicycle. This gave a splendid light when riding at a fair rate; but nothing when going slowly.

S. Bottone.

[73235.]—**Charging Accumulator from Siemens Dynamo.**—My experience is, that unless the slit of the commutator be cut very wide, so as to prevent the brushes ever lying on both the two sections at once, the Siemens H form of armature is not adapted to accumulator charging, as the accumulator seems to discharge itself across the brushes (when the slits are narrow) as fast as it receives its charge. Supposing, however, your machine to be shunt-wound, and to have the slits large, a good size for your accumulator cells would be about 6in. by 4in. by 1in., each containing three plates. The mode of making and forming these plates is given fully in my "Electrical Instrument Making." Your dynamo could charge six such cells in series. S. Bottone.

[73236.]—**Boiler.**—Put a little milk of lime into it, perhaps that will stop it. There is no getting at the inside: if so, give it a coat of Brunswick and drop black very thin with plenty of turps, and dispense with your soda. As your water is clean and pure, what do you want with that? And you might lime-wash it with some fresh made hot lime-wash. Jack of All Trades.

[73237.]—**Tremolo Stop for American Organ.**—For one of the best "tremolo" arrangements for American organ, querist should see Nos. for April 5, 1878, and June 7, 1878; but I would advise him to make the fan tremolo I described in No. for April 4, 1879: it is much superior in effect to the tremolo proper, and is generally labelled on the knob "Vox Humana." If numbers cannot be obtained I will re-write instructions if, say, half a dozen readers want them. Organon.

[73239.]—**Electric Lady.**—In front of the electric lady is to be placed a zinc plate, and to this one terminal of the secondary wire of an induction coil is to be connected. The other terminal is connected with the electric lady, who should have a tinfoil-covered glove on, to which this wire is secretly connected. When the coil and battery are working, any person standing on the zinc plate, and shaking hands with the electric lady, will complete the circuit and receive the shock. The coil and battery should be kept out of sight of the audience.

G. E. Newland-Smith.

[73240.]—**White Letters on Glass.**—Either paint, print, or gum paper letters upon the glass, and subject the glass to a sand blast.

Jack of All Trades.

[73241.]—**Dynamo Heating.**—Your dynamo would probably run cooler if the cores were of wrought iron. But the heating probably depends more on the gauge of the wire on the armature than anything else. Of course, the armature is laminated, and you have plenty of air-space (no hub) between the shaft and the armature?

S. Bottone.

[73243.]—**Small Motor.**—To Mr. Bottone.—A motor with armature 1¼in. long by ¾in. diam. is a small affair. Being wound with No. 24, it could not carry safely, without getting very hot, more than 1 ampère of current. Three chromic acid cells are about as much as it would stand. Now these cells would give 2 volts each, hence all three would give 6 volts. Multiplying this number of volts by the permissible number of ampères, viz., 1, we get 6 watts as the theoretic output of the machine. 746 watts are equal to 1 H.P., therefore if there were no loss in conversion of energy, your motor would give $\frac{1}{124}$ of a H.P. But you must allow quite 50 per cent. loss in these little machines, so you could not reckon on more than $\frac{1}{250}$ of a H.P., or $\frac{1}{25}$ of a man power. If connected in shunt and driven against the brushes, it might light a small 4-volt lamp. With a file and an archimedean drill, you could manage to fit up one of the small rough sets of castings. I have done so entirely without a lathe. S. Bottone.

[73244.]—**Artist's Oil Colours.**—Colours ground very fine in water and washed. When dry, grind up with a muller and stone with raw linseed-oil, poppy or walnut oil, and put them up in the metal collapsible tubes, or in, as the old style was, bladders.

Jack of All Trades.

[73245.]—**Motor for Sewing Machine.**—A small motor, with laminated armature, 3in. by 1¼in., wound with about 1¼lb. No. 18, connected as a series machine, will, if supplied with about six ampères, at 12 volts pressure, drive your sewing-machine. This would be the current you would get from six cells chromic-acid battery, of, say, half-gallon capacity. For the reason given in my reply 73235 (which please refer to), you would not be able to charge your accumulators from this motor; the more so, as in your case the machine would be series-wound, and would be, therefore, liable to reversal, even supposing that the commutator-slits were cut wide to enable it to charge.

S. Bottone.

[73246.]—**Electrical.**—If your zincs fiz away at a great rate, it points to one of three things. 1. The zincs are not properly amalgamated. 2. The acid is too strong. Perhaps you take 1 to 10 by measure: it should be by weight. 3. You are taking too heavy a current from your cells. Remember that the consumption of zinc is exactly proportional to the current evolved. You can, to a great extent, prevent creeping by placing a layer of olive oil over the top of each solution. One-sixteenth of an inch is quite sufficient. S. Bottone.

[73247.]—**Winding Electro-Magnet.**—1st. The wider the core, the greater the weight the magnet can be made to sustain; the longer the core, the farther the attractive influence will extend. Since the outer layers, being farther from the iron, have less action on it, the closer the wire can be kept to the rim, the better will be the result. The thickness of the wire makes a vast difference, the right gauge depending partly upon the battery power and current and partly upon the other resistances in circuit. 2nd. Yes; two bars connected by a top yoke (the thicker the better) will form a horseshoe magnet—not so good, however, as when made out of one bar bent, since there is always a little want of magnetic conductivity at the junctions. Read the admirable extracts (eight of which have already appeared in "Ours") of Prof. S. P. Thompson's Cantor Lectures on the Electro-magnet. They will teach you more than I could, if I were to write for a week. 3rd. The make-and-break arrangement is simply a small cam pressing against a flexible spring. S. Bottone.

[73249.]—**Voltmeter.**—Your failures may depend on several causes. 1. The amount of wire you wind on the bobbins or solenoid is too great in proportion to the E.M.F. you are trying the instruments with; thus the form last described will hardly move with less E.M.F. than 10 volts. 2. The tongue does not enter far enough into the solenoid. 3. The insulation is not good. 4. The connections to terminals are wrong or imperfect. 5. The pivoting is not delicate enough. If you could send me one of your instruments I could tell you where the defect lies.

Wallington, Surrey. S. Bottone.

[73250.]—**Dynamo Dimensions.**—To Mr. Bottone or Mr. Allsop.—A, ⅜in.; B, 4in.; C, ⅜in.; D, 4in.; E, 2in.; F. 2in.; G, ⅜in.; H, 1¼in., and should slope outwardly, towards the field-magnet cores above and below, or else a lot of power will be lost by the spreading of the magnetic lines across, where the armature is not; K, ¾in.; J, 4in.; L, 3¼in.; wire on armature 8oz. No. 20; wire on fields, 3¼lb. No. 22, connected in shunt.

S. BOTTONE.

[73254.]—**Electric Railway.**—On p. 468 of Vol. LI. for July 25 of the "E. M.," Mr. Bottone describes an electro-motor for an electric railway. Reckenzaun's reversing gear would be the easiest to adapt; but you will have some difficulty with the gear on a very small loco., and it is really not worth the trouble. Two or three chromic-acid cells will work the loco. alone, and six ought to run the whole train, according to weight. See recent replies to similar queries. F. ASKEW.

[73254.]—**Electric Railway.**—To MR. BOTTONE.—As you do not give dimensions I cannot give a definite answer. If, however, the locomotive is not to be larger than 7in. long by 3in. wide, a little motor on the lines described by me at p. 468, Vol. LI. of ENGLISH MECHANIC for July 25, 1890, will do very well. The tender could be made to carry two small cells, which would be enough to drive it. You will want a Reckenzaun reverser to change the direction of motion. If required for anything larger, you had better consult my book, "Electro-motor: How Made and how Used." If you like to give me dimensions, weight required to be drawn, &c., I can advise you more fully. S. BOTTONE.

[73255.]—**Electro-Magnet.**—To MR. BOTTONE.—Impossible, without knowing what brand of iron you are able to use, and several other circumstances in the case, to give anything more than a very approximate answer. The magnet should be circular in section, about 4in. in diameter, and 3ft. long, bent into horseshoe form, the poles being brought pretty close together. The armature must also be massive. The electro-magnet should be wound equally all over, except at the bend, with about 100lb. No. 16 d.c.c. wire. Ten quart chromic-acid or bichromate cells would give sufficient E.M.F. and current to work this well. In proximity, this magnet would sustain over two tons, and being long, would pull 200lb. through an inch; this is, I believe, what you mean by "overcoming a pressure equal to 200lb.," is it not? Shall be glad to hear of your success. S. BOTTONE.

[73256.]—**Coca Wine.**—This is a French preparation. Its strength is about 1 in 30, and the dose a wineglassful. Coca wine is, roughly speaking, about one-sixth of the strength of the official liquid extract (Extractum Cocæ Liquidum B.P., or Extractum Erythroxyli Fluidum U.S.) To obtain the liquid extract, coca leaves are exhausted by percolation (which differs from either decoction or infusion) with proof spirit. At the termination of the process, the strength should be adjusted so that 1oz. = 1 of leaves. The process of percolation is as follows:—The leaves are placed in a vessel very like an elongated funnel, closed at its base by a porous diaphragm. This funnel fits into a receiver, and a small tube passes up its outer side and enters it near the top, forming a means of communication between the two. Spirit is now poured on the leaves, and the percolator closed. As the percolate filters slowly through into the reservoir, the displaced air passes up the tube, and so maintains an equilibrium in both vessels. The virtue of the coca leaves lies principally in the presence of the alkaloid cocaine. This, in the dried leaves, is supposed to exist as an inert salt, similar to many of the cinchona alkaloids in bark.

J. WEST, L.D.S., R.C.S.E., F.P.S.G.

[73259.]—**Dynamos.**—If the work required to be done is perfectly steady and constant, always having a certain resistance in the external circuit, then a series dynamo should be used. If, on the contrary, the resistance of the external circuit and amount of work is constantly varied, then a shunt dynamo is the best. The above distinction in use for series and shunt dynamos will be found in Bromley Holmes' "Electric Lighting."

G. E. NEWLAND-SMITH.

[73259.]—**Shunt and Series Dynamo.**—To MR. BOTTONE.—Owing to the fact that the whole of the current which serves to excite the field-magnets has to traverse the outer circuit, and that the magnetisation of the field-magnets (and consequently the output of the dynamo) depends on the current of electricity circulating round them, it follows that a series-wound machine is only useful in those cases in which the resistance of the outer circuit remains fairly constant, and is never too high to allow of the due magnetisation of the fields. Hence the series machine is adapted to arc light, to welding, to incandescent lighting with a fixed number of lights. In the shunt machine, on the other hand, the greater the resistance placed in the outer circuit, the more the current driven round the field-magnets. Hence the shunt machine is to a great extent self-regulating, and is, therefore, adapted to incandescent lighting, where the number of lamps, and consequently the resistance, may be varying. Owing also to the fact that any back current traverses the coils in the proper direction to magnetise the field-magnets, the shunt-wound dynamo is the best machine for plating and accumulator charging. S. BOTTONE.

[73262.]—**Lathe Cones.**—To "F. A. M."—I much prefer the round-gut band, and think ¼in. band sufficient. If you want my notions on lathes in general, you can find them in the first 14 numbers of *Work*. If you want to study the whole subject, begin with Vol. X. of the "E.M.," and go through the indices. If you want working drawings, look up "J. H.'s" articles on the "Amateur Workshop." No. XXIV., on page 545 of Vol. XLIII. begins a series of articles with dimensional drawings of a 4in. slide lathe. Take these for your guide; you can easily enlarge a little. Buy a set of castings, make full-size drawings, set to work, and good success attend you! F. A. M.

[73263.]—**Bacteria.**—Yours is a large order, especially as theories on the subject are not founded on fact, but only guesses as to what is the probable action of the attenuated culture. One may guess that the attenuated cultures produce a condition of the blood unfavourable or disgusting to the original bacilli, and that they will not—or at least do not—invade a territory which has been formerly exploited either by themselves or by their attenuated culture. You second query is based apparently on the anonymous recipe in the French paper noticed in this week's "E.M.," and is answered with "No." Dr. Koch says in his statement that his lymph (supposing for a moment that it contains Ptomaines, as the Frenchman thinks) "does not kill the tubercle bacilli, but the tuberculous tissue."

Plymouth. B.Sc.

[73264.]—**Telephones.**—As a transmitter, you could hardly do better than use a Hughes microphone, as shown in my articles. You could connect this directly up to a Bell receiver, connected with flexible cord, and pass round to the audience. I do not know whether this would suit you; but it would be the easiest arrangement to rig up. You might use an Edison loud-speaking receiver, if you could procure one. Lay a watch on the stand of a microphone; this will give the best results. You could have half a dozen receivers connected to the same microphone. F. C. ALLSOP.

[73265.]—**Three-Wire System.**—The system of wiring for electric lights known as Edison's three wire, was fully explained with illustrations in the No. for Sept. 30, 1887 (p. 113), and, I think, also in other numbers. NUN. DOR.

[73267.]—**Drilling Square Holes.**—An illustration of a method of drilling square holes was illustrated on p. 57, Vol. XXVIII. Sept. 27, 1878. It was a patented method by Mr. J. Hall, and was accomplished by means of what may be termed a "wobbling" cutter. That it did cut square holes I know. S. R.

[73271.]—**Lantern Illuminants.**—If your bags supply a blow-through jet for three hours, they ought to last longer for a chamber jet. The etho-oxy light to which I refer is a jet of oxygen blown through burning ether on to a lime. There is a new dodge out now (see last week's "E.M.") I used to find that two cubic feet of oxygen and four of coal-gas would last about two hours, with care—turning down the light when not required, &c.—using a chamber jet, without wire packing, and ½cwt. on coal gas; 1cwt. on oxygen. SM.

[73278.]—**Drilling Fine Holes through Glass.**—You can do it with an archimedean drill-stock and a steel drill with a triangular point. Wet it with turps and camphor.

JACK OF ALL TRADES.

[73279.]—**Crystoleum Painting.**—See that your glass is thoroughly clean. Take some smooth starch solution and anoint the face of photo., using the finger; let it be free from lumps. Place photo. on glass, and squeeze out the starch by rubbing back of photo. with a slip of wood, taking care not to crease the paper. The less starch left the better; the paper should be in contact with the glass. When quite dry, rub away paper with sandpaper until picture shows through back. Warm, and rub with bit of spermaceti. Spots are caused by too much starch being left, or want of proper contact between picture and glass. SM.

[73281.]—**Liquefying $CO_2$.**—I should generate in an apparatus like I have represented, and at great pressure, then construct a small pump with a ⅜ ram, and pump it into a receiver well covered with ice and salt. JACK OF ALL TRADES.

[73285.]—**Coppering Carbon Plates.**—Immerse carbon required depth in a saturated solution of copper sulphate. Provide a Daniell or Grove cell. Lead a wire from zinc to the carbon plate, and from the carbon of battery to a copper plate immersed in the copper-sulphate solution. SM.

[73285.]—**Coppering Carbon Plates.**—Make a saturated solution of sulphate of copper. To this add about $\frac{1}{20}$ of sulphuric acid. Now place this in a wide, flat-bottomed jam jar about 6in. diameter. In the jam jar place a porous cell 6in. high 2in. diameter, nearly full of dilute sulphuric acid, 1 part acid to 12 of water. In this porous cell place a rod of amalgamated zinc, with wire attached, similar to what is used in the Leclanché cells. Now attach your carbon plate tightly by means of fine copper wire to the wire coming from the zinc, and immerse the carbon, as far as you want it coppered, into the sulphate of copper solution: it will immediately become coated. Leave it there until you get a coating at least $\frac{1}{30}$in. thick; then remove, and wash in many waters until it has no coppery taste. Now dry quickly by immersing in boiling-hot water, and rearing up to dry. You will find you can solder easily to this copper deposit. S. BOTTONE.

[73286.]—**Ebonite Plates for Wimshurst.**—When you can get perfectly flat ebonite plates, they act as well as, if not better than, glass, while new: but little by little the surface becomes oxidised, and the plates become more and more conducting. To a certain extent this can be remedied by varnishing. However, ebonite is dearer than glass, and altogether, I think, glass gives the better results.

S. BOTTONE.

[73289.]—**String Shrinking.**—The cause is the same—*both* swell; the fibres of the string swell and thicken, and therefore the length is decreased.

SM.

[73293.]—**Collapsible Tubes for Paint.**—I have never seen these done by any other means than a hand fly-press. Solder is used for some, tin for some, and lead for some, according to what they are wanted for, and the price, I expect, has something to do with it. The ends are nearly closed over by laying something thin and straight, and folding over true to start with. I don't see how you can do several at once unless you have a number of rams. JACK OF ALL TRADES.

[73294.]—**Magneto Machine.**—Certainly, the machine can be made with the armature in three pieces, and it will be just as effective. For general purposes No. 22 will give the most useful results. No. 14 is only useful when a very large current of low tension is required, as in plating, magnetic experiments, and heating wires, &c. S. BOTTONE.

[73295.]—**Electric Light.**—If your lamp is a 6-volt one, you will require three cells of a Bunsen battery charged with chromic-acid solution or nitric acid: but it will require more than one charge in two months. See my reply to "Novice" (73193) in last week's issue. The cells should be quart size, and zincs well amalgamated. You will have to lift zincs after using the battery: 2½c.p. is not much of a light. I intend lighting a room 12ft. square; but I shall not use less than two 16c.p. lamps. The second part of your query puzzles me. You say your magnet is 8in. long, and you want to fit an armature 3ft. long by 1ft. diam. You must surely mean inches, and not feet. If you say what you mean, and whether your magnet is horse-shoe type, perhaps I can help you. See also back numbers. F. ASKEW.

[73295.]—**Electric Light.**—You won't light up a very large room with a 2½c.p. lamp. All batteries are a nuisance for lighting. The best is the chromic acid cell. This will run for about three hours at a stretch, when it must be recharged. You can light a 4 volt 2½c.p. lamp from two pint cells, double carbons, single zincs connected in series. A magneto machine, with armature 3in. by 1in. (not 3ft. by 1ft., as you have it) will light a 4-volt 2½c.p. lamp; but the armature will soon run hot. The proper machine for experimental electric lighting is a small dynamo, which is both cheaper to make and acts better than the unidirection magneto machine. This latter, which takes about 1½oz. No. 24 silk-covered wire on the armature, I describe in my book, "Electrical Instrument Making," not because it is the best form, but because it is theoretically and historically interesting. See my book, "The Dynamo," for full description of mode of making a cheap and effective little dynamo.

S. BOTTONE.

[73296.]—**Creeping in Leclanche.**—To MR. ALLSOP OR MR. BOTTONE.—The zincs being covered with sal-ammoniac points to the solution of sal-ammoniac being too strong, or else that the cell stands in too warm or dry a place. The addition of a few drops of chloride of calcium solution acts, to a certain extent, as a preventive to this. The use of a layer of oil is to prevent creeping. It does not do harm, nor yet very much good. The probable cause of the weaker ringing is the excessive work put upon the battery, which goes on working while the maid is dressing. S. BOTTONE.

[73296.]—**To Mr. Allsop or Mr. Bottone.**—There is no doubt that the bell being left ringing so long exhausts the battery quickly. Housemaids are not, as a rule, apt to be very quick at dressing, and so probably the bell has a merry time of it of a morning. Oil should never be put in the cells. See my book "Practical Electric Bell-Fitting" for information on the Leclanché battery.

F. C. ALLSOP.

165, Queen Victoria-street, E.C.

[73297.]—**Photo. Exposure.**—Nothing but experience will teach you correct exposures. If you rely upon other people instead of yourself, you will ıke a decent negative. You must not open ıphragm beyond the covering power of the 'he lesson learnt by spoiling a few plates is artloads of advice. Sm.

3.]—**Telephones.**—The hissing noise is y due to the battery being too powerful. next article of "Telephones: their Construc- l Fitting," where I have treated of noises in ısmitter. As regards the receivers for use luction coils, these should have permanent ı. This is not absolutely necessary, but etter results are obtained. As regards the Bell receiver, the horseshoe magnet is a ent one, with soft iron polar extensions : the cores of the bobbins. Enlarging the gm and bobbin of the receiver does not ı the results you imagine. I prefer a gm 1⅝in. to 1¾in. in diam. I find these give ılts for all round purposes. With reference liaphragm in "E.M." No. 1335, I presume ər to Fig. 49. This is quite correct, and is for ɔeivers; used also as a transmitter. The *is cut out* during speaking, and is used only ing. Fig. 50 is one for "E.M." telephones equire the battery in circuit while speaking. teries here are carbon to return at one end, .c to return at the other, as you will see ıscription. Go over the diagrams carefully, ıncy you will see where you are wrong.

F. C. Allsop.

Queen Victoria-street, E.C.

# 'ANSWERED QUERIES.

*mbers and titles of queries which remain unan- or five weeks are inserted in this list, and if still ed are repeated four weeks afterwards. We trust rs will look over the list, and send what information for the benefit of their fellow contributors.*

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Locomotive Disabled on the Railway, 175.
German and Italian Locomotives, 175.
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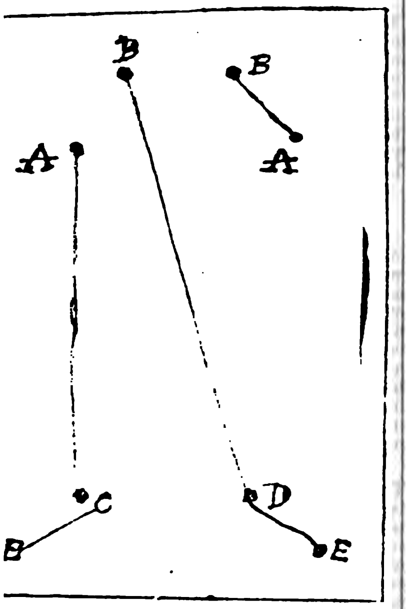
Pidgeon English, 258.
Rapid Determination of S.G., 258.

# QUERIES.

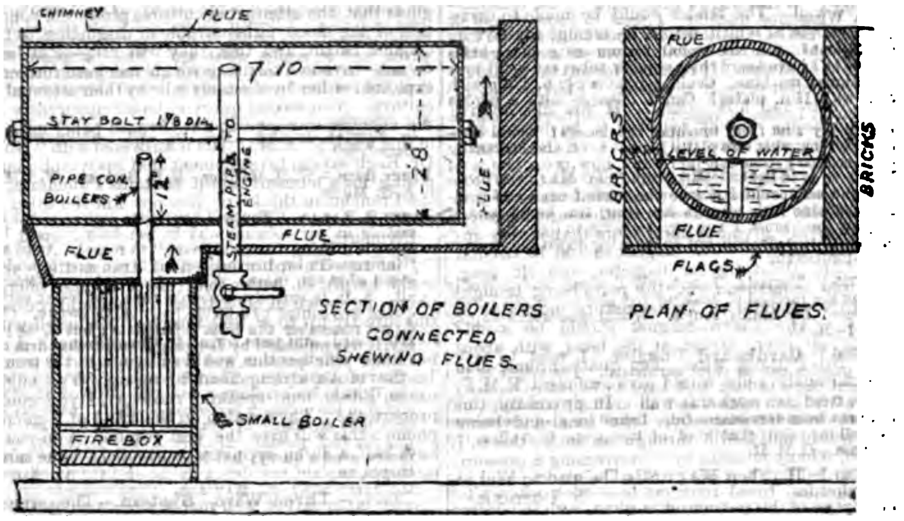
.]—**Rhumkorff Coil.**—Can the electricity d by the Rhumkorff coil be made to produce an ight by means of 5 or 6c.p. incandescent lamps, ɔt, what is the reason? A little information on t will be very gratefully received.—J. A.

.]—**Coil.**—Will Mr. Bottone or some one kindly out of the following difficulty? I have made a



l the inclosed sketch gives the connection of all ; they appear on the bed or base-board when ıp. A A are the ends of wire on the bobbin, one ı is carried to the pillar B, to which the battery is l, and the other is carried on to the pillar C, · the screw of the contact-breaker from the other battery pillar B, a wire is carried on to the pillar D, which carries the vibrating spring of the contact-breaker. C E and D E are the connections from which the shock ought to be produced, but no effects are to be felt, and yet the vibrator works rapidly, and every knob or pillar, connect them in whatever way you will, produces a considerable deflection in the galvanometer—nothing seems to come to the points E E. I have made several coils before, and have two by me now constructed just as I have shown, both of which work well.—J. V.

[73301.]—**Boilers.**—Having got into a serious difficulty with my boilers, I should feel very grateful if "T. C., Bristol," or any other kind friend will help me out of the following difficulty. I have one tubular boiler, 2ft. 8in. diam., 5ft. 6in. high, running a steam-engine, 5in. cylinder, 10in. stroke, which does not make steam enough. So thinking that if I got another boiler and placed it over the top of the other and put the flue underneath up the end and over the top, and connect both boilers together, I should have more steam room, and catch all the waste heat from the bottom boiler. I did so; but I now find that I am in a worse position now than I was before I started. The fire draws well, and we have the top boiler covered up the side with one course of bricks, which forms the flue, as you will see by the sketch. I think it is because there is not enough waste heat to counteract the heat which the top boiler gives out. Would placing a fire in the flue under the top boiler and taking the flue the other way mend matters and be economical working, or would it be best to take the little boiler out, and use the large one only? Please say also what pressure the top boiler will stand. It is 2ft. 8in. diam., 7ft. 10in. long, plates 5-16 thick at thinnest place, ends flat, with 1⅞in. stay-bolts right through the ends.—Ignorance.



SECTION OF BOILERS CONNECTED SHEWING FLUES.

PLAN OF FLUES.

[73302.]—**Waltham Pinions.**—I shall be very glad if "Schloss Schwerin" or some others will let me know how these pinions are so well and quickly pivoted? I am designing a machine for the work.—Pivot.

[73303.]—**Watch Dials.**—How are the latest Swiss enamel dials made to look so well, with what appears to be gold and silver leaves let in and glazed over?—Dial.

[73304.]—**Digitorium.**—Can any of your readers kindly describe a simple method of construction?—C. W.

[73305.]—**Heating Small Room.**—Would it be practicable to heat a small room, 15ft. by 8½ft. by 8½ft. high, by gas, for drying confectionery, a temperature of 100 to 120° at most being required? A few hints as to proceeding would greatly oblige.—F. C.

[73306.]—**Acid Water and Boilers.**—Will any of your readers say whether acid water, when neutralised by lime, can or cannot be used to feed boilers?—"E. M." Reader.

[73307.]—**Engine.**—Will some reader kindly inform me whether I am right in proportions of the following engine? Cylinder 8in. stroke, 4in. bore, port-holes 3-16in. by 1⅜in., to run at 100 revolutions per minute, with 20lb. square inch boiler pressure. What H.P. may I expect to get?—J. C.

[73308.]—**Thinning Oil.**—I have a barrel of very thick dark oil which I want to make thinner, so that I can use it on threshing machinery out-doors. What shall I use, and what quantity? I have about 18gal.—W. W. M.

[73309.]—**Electric Bells.**—I have three bells in a line to ring from one push. The first two ring well, but the third does not. I have six cells (nearly new) between the push and first bell. I put a relay to the third bell, thinking I should get over the difficulty. The third bell does ring, but the other two have stopped altogether. Can any of "ours" help me out of my difficulty? The distance from push to battery is 40yds., to first bell 15, to second 16, to third, 17. Is it proper to put a relay with ordinary bells in the same circuit, or would it have been better to have strengthened my battery instead of putting relay?—J. S. B.

[73310.]—**Telephones.**—To Mr. F. C. Allsop.—Am obliged for your reply to my former query. You say each magnet must be wound to a resistance of 40 ohms. If I put on about ½oz. of No. 38 s.c.c. wire, will that do? How many No. 2 cells shall I require to work instruments about 200yds.?—Amateur Fitter.

[73311.]—**Paint or Enamel.**—I want a paint or something black to stamp a name or figures on glossed or enamelled surface, and to be of a permanent character. Can any reader kindly inform me of a paint or chemical that will produce this result?—Fugitive.

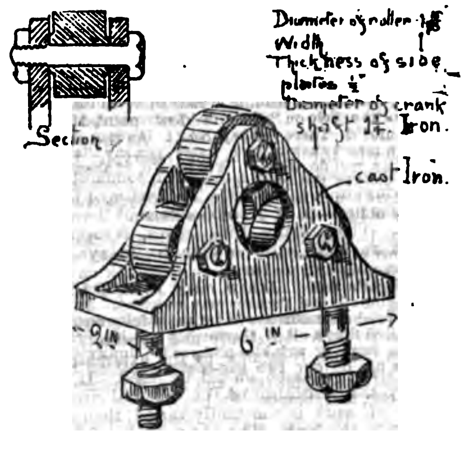
[73312.]—**Slide Valve.**—I have in my charge a steam-roller. Eccentrics are solid. I have them set all right on shaft, and she takes steam all right. My trouble is in the cut-off, which is as follows—viz., Forward gear, out ⅜ stroke, in 1-5 stroke; back gear, out ¼ stroke, in ⅜ stroke. Will some kind reader correct the above?—New Chum.

[73313.]—**Cock-Boring Machine.**—Can any reader give me sketch of a machine for boring the barrels of cocks with the fluted reamers? I find that they clog with swarf in the lathe, and having been told they are made vertical, if some one would give design I would make one. I think it would be also useful to others.—Borer.

[73314.]—**Differential Calculus.**—Will some one explain the meaning of successive differentiation, using, as an example, the case of a line increasing at the rate of a foot a second, giving the increase of the area and the cubic contents of the square when the line becomes 10ft., and in the same case, assuming the line starts from nothing, what is the meaning of the successive differentials when the line becomes one foot? I fail to see the import of (2) and ($6x$, 6) in the final differentiations.—J. C.

[73315.]—**Brass Pipe.**—Will some kind reader tell me the best way to get a dent or bulge out from the middle of a brass pipe about 2ft. long, size of hole 1in., while the pipe is bent little more than half round?—Thomas Weeks.

[73316.]—**Roller Bearings.**—I intend fitting the crank shaft of my lathe (4in. back-gear) with roller



bearings, as sketch, but am ignorant as to what metal to use for rollers and pins. Will some one kindly help me? I have no room for larger rollers.—E. T. P.

[73317.]—**Magnetism.**—Are there any substances known which practically or totally obstruct the passage of the magnetic force through them? What experiments have been made in this direction?—T. D.

[73318.]—**Electro-Gilding Brass.**—I have a polished sheet of brass, 2ft. square, and on it are three circles 6in. diam., which are to be electro-gilt. What composition am I to put round the circles to contain the gold solution that the cyanide of gold will not run over the other part? Must I first deposit a coating of copper on the brass before gilding?—Lux.

[73319.]—**Bunsen Battery Zincs.**—I have somewhere read it is essential for the good working of these cells that the edges of the zinc cylinders should not meet at least by ⅜in. Can anyone refer me to page or volume of the "E. M." or mention name of book where the statement is to be found? At same time oblige by giving opinion as to why they should be so.—M.M.I.Sc.S.

[73320.]—**Steam.**—Suppose there is 50lb. of steam against the throttle valve, will the pressure be on the engine side, or how much? Engine will work at 35lb., running 20 strokes a minute.—Air Compressor.

[73321.]—**Finishing Leather Work.**—Having small articles to cover with skiver and bookbinders' calf, light colour, it often turns black in spots when finished.

The leather must be put on wet to take the shape, and is generally immersed for a few minutes in cold water. Will some kind reader say what course to adopt in order to produce the best finish, and also how could the finish be afterwards improved? What polish or varnish is suitable for light-coloured fancy leathers? Can they be enamelled and how? The title of a good textbook on the subject would oblige.—PELT.

[73322.]—**Banjo.**—I am desirous of making a really first-class banjo, and would be glad of any information as to construction, and as to the main points on which the quality of the tone of the instrument depends.—Jo.

[73323.]—**Electric Bell.**—Will any of our kind readers tell me how to make a strong trembling bell to ring a 5in. gong? I should like to know size and length of iron cores, and size and weight of wire to wind bobbins. What length should spring and hammer be from top of frame to hammer head, and weight of hammer? How many No. 2 cells should I want? Any other instructions will be gratefully received. I should like to know how long the porous pot of a Leclanché cell will remain active before it requires recharging; the outer cell being kept charged.—ELECTRIC.

[73324.]—**Wimshurst Machine.**—I am constructing a Wimshurst machine. I want to know if lead or iron balls can be substituted for brass balls, and are they as efficient? Also are tinfoil sectors as good as brass sectors? I have heard that vacuum tubes can be lit by a Wimshurst machine. Could I light a 2½c.p. lamp with one, with 12in. plates? Can I dispense with a porous tube in the Leclanché agglomerate block-form, as long as I keep my zinc from touching the blocks? Could anybody tell me what size plates I must have, and how many in an ordinary stone salt jar? And how many jars must I have so as to light a 2½c.p. lamp from one to two hours at night, and could I charge the same from a uni-direction machine with magnet 8in. long, 1in. broad, and if so, how long must I run my machine to light it? If a magnet of this size will not do, how big ought the magnet be?—BEGINNER.

[73325.]—**Tennis Court.**—Will some reader kindly tell me the method of making red cinders, which I have seen used for tennis courts. Would gas-works supply them?—H. C.

[73326.]—**Cardboard Puzzles.**—I want to make some puzzles out of stout cardboard. The edges of the different pieces to look well have to be cut quite sharp. I have tried both scissors and an ordinary pen-knife, but have not been very successful. I shall be glad if someone can tell me with what kind of tool I can best effect my purpose.—G. E. H.

[73327.]—**Hughes Magnetic Balance.**—Will any kind electrical friend refer me to a book where a full description of this instrument is given, with full instructions for and mode of using same? There is a slight description in Prof. S. P. Thompson's "Electricity and Magnetism," but not in detail. Any information will be esteemed.—SCISSORS.

[73328.]—**Transmitted Heat.**—I have a revolving cylinder 20ft. long by 42in. diameter, the air inside of which is wanted at a continuous temperature of from 400° to 600° Fahr., for drying purposes. Can this be got by a system of through going steam pipes, or coil of copper pipe? Boiler-pressure is 85lb. per square inch. The dimension of such pipe, or any suggestion to accomplish the same, I shall feel obliged for. The heat meantime is supplied from a stove with fan.—DACONNE.

[73329.]—**Voltmeter.**—To MR. BOTTONE.—I have a Tandstickor match box coiled with No. 35 s.c. wire from end to end. There seem to be about 100 turns, or 40ft. of wire, the box being gummed to keep the wire in place. Could I use this for making a voltmeter, as described by you in the article on "Electrical Instrument Making for Amateurs"? There you say No. 40 German silver wire, but in a recent answer to a query you say that 50ft. of No. 36 s.c. will do as well. Will the No. 35 about 40ft. do? Also what are the glass-capped boxes there mentioned, and where could they be obtained? Any information will greatly oblige.—G. E. NEWLAND-SMITH.

[73330.]—**Gas-Engine Oil.**—Being rather a large consumer of gas-engine oil which is not satisfactory (the oil carbonises and makes the cylinder stick on restarting after night's rest). I know many of "Ours" will use gas-engine oil, and perhaps may assist me. Any mixture of oils to obviate above will be thankfully received. An advertised firm's oil, if thoroughly reliable, will do, but private form or wrinkles preferred.—GUMMY CYLINDER.

[We use on our two gas-engines nothing but Bell's "Special Gas-Engine Oil," and find it better than anything else, and cheaper.—ED.]

[73331.]—**Wooden Battery Box.**—How can I make a wooden battery box with six compartments, ⅛in. thick, outsides ¼ thick, both waterproof (hot) and acid-proof, and at the same time non-conducting?—HOPEFUL.

**French Plums.**—It is asserted by the Kew Gardens authorities that very little is known about the production of those "French plums" which figure so conspicuously in glass jars in the grocers' windows at this season. From a report made by Mr. Colchester-Wemyss, who has devoted a special study to the subject, they are not only essentially a French product, but are peculiar to one rather limited district. Other French provinces send us prunes, and Mr. Colchester-Wemyss himself has produced them at Westbury-on-Severn, though he does not hold out much hope of the cultivation in this country proving profitable. But the true French plum—large, jet-black, soft, and juicy—comes from the shores of the Garonne and its affluent the Lot, and is the fruit of the tree known as the *Prunier d'ente*, or grafted plum. The centre of the "French plum" district is Clairac, a quaint little old-fashioned town built on a steep hill-side overlooking the Lot, and though it is 150 miles from the Pyrenees, almost more Spanish looking than French.

## ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

### HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

**The following are the initials, &c., of letters to hand up to Monday evening, Dec. 22, and unacknowledged elsewhere :—**

PERCY REID.—W. H. Harling.—S. R. Bottone.—F.R.M.S. A. T. Miller.

JAMES E. RATHE. (You will have seen letters about the meteor in our columns and in the daily papers; but there is nothing "extraordinary" to record. As to any "information on the matter," it is not easy to understand what you mean. The meteor was seen—that is all. 2. It is scarcely probable that the Essex earthquake was caused by a bolide.)—J. A. CRAWLEY. (We do not remember the book referred to; but if, as you say, it was published by Longmans, surely that firm can answer your question, and no doubt also the present editor of *Knowledge*. There is much information about the Tides in back volumes, and the received theory is stated in the ordinary textbooks.)—P. K. (Are not the questions answered in the books? Too crowded just now for such queries. If there is any difficulty, by all means send a query; but let the question be definite—that is, explain the defect in the instruction given in the textbooks.)—S. HAYLLOR. (Impossible to explain what is the matter with your sewing-machine without examining it, especially as you do not even describe the make. If a part is broken off, as you say, it is certain that must be replaced, because it would not have been there if it had not been wanted—that is certain. Surely in Brighton there is a sewing-machine maker who can put it right. As to threading "the cotton in the shuttle," how can anyone explain without knowing what sort of shuttle? As a rule, the cotton is simply wound on as regular as possible How came the piece "broken off"? There must have been something wrong for that to happen; but you do not mention the "make," so it would be useless to insert such a query.)—"E. M." READER. (If you cannot refer to back numbers, send for the catalogues of such publishers as Longmans, Macmillans, Crosby Lockwood and Son, Griffin and Co., and so on. We really cannot undertake to recommend books without knowing something of the attainments of the inquirer. In mechanics there cannot be any doubt about Rankine's works.)—OLD SUBSCRIBER. (We really do not know. Why not ask if there is a Japanese design for a screen published already on paper, in the usual way? You do not mention the size, but it would be as well to do so in the advertisement. See "Hints" above.)—WAKEFORD. (Query should be put to a medical man by the patient submitting himself for examination. However, address it to the Medical Editor of the *Weekly Times and Echo*, for symptoms such as dropsy in the legs, palpitation of the heart, inactive liver, indigestion, and tuberculosis of the throat require skilled attention.)—J. T. (See back numbers, and answer last week. The test is a practical one—on the road; the "colour-blind" test is a matter for the company's surgeon, and has been fully explained in back numbers.)—EUXTON. (A dulcimer is merely a strong frame covered with a soundboard of thin wood. The dimensions may be anything you like; but you will find instructions how to make in the numbers for Sept. 29 and Oct. 20, 1882. It is an instrument not worth making, except as a curiosity, or a means of "raising the wind.")—ANGLO-ROMAN. (You will have no doubt seen the description of lithanode given by the inventor on p. 102, this volume; but it is a patented preparation, and is supplied in the form of plates as cheaply as anyone can make it on the small scale, and can be had in Rome by the post. For full details, see the number for Nov. 5, 1886.)—E. E. (Do not understand what you mean by a "reliable telegraph instrument." Is it a needle instrument, a clapper, or a bell that you require? Perhaps you will find what you require on p. 288, May 25, 1888.)—THOUGHT READER. (If you will refer to the indices of Vols. XXXVII. and XXXVIII. you will find that we had a great deal about thought-reading or the transfer of thought, and in those volumes you will learn all there is to be said as to "how it's done.")—JACK OF ALL TRADES. (Thanks for the portrait. Glad to hear the old connection is likely to last; but even if you had gone to Tasmania, we know we should soon have heard from you as usual.)

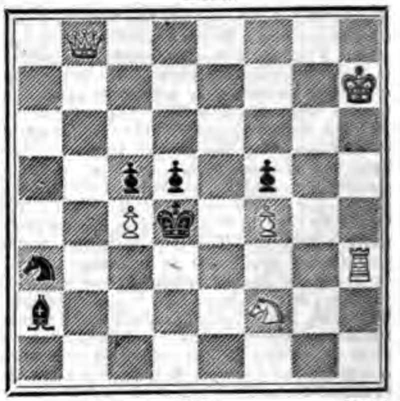
**A Station-Master's Experience.**—Mr. J. B. Carne, the well-known and popular station-master at Clapham Junction (L. B. & S. C. Ry.), writes:—"I have derived very great benefit from wearing Harness' Electropathic Belt. I used to suffer from lumbago and pains in the back, both of which have now ceased. I have already sent you many patients, and they all appear as pleased with your treatment as I am." All in search of health, strength, and vigour should follow Mr. Carne's example, and procure one of these invigorating curative appliances. Book of testimonials, pamphlet, and consultation free, either personally or by letter, on application to the Medical Battery Company, Limited 52, Oxford-street, W.

## CHESS.

ALL communications for this department must b addressed to "J. PIERCE, Knollside, Yawl, Lyme Regis, Dorset."

### PROBLEM MCCXXXIV.

*Black.*



*White.* [6 + 6

**White to play and mate in two moves.**

SOLUTION TO 1231.

| *White.* | *Black.* |
|---|---|
| 1. B-Q 3. | 1. Any. |
| 2. Q, R, B, or Kt mates. | |

SOLUTION TO 1232.

| *White.* | *Black.* |
|---|---|
| 1. Kt-Q B sq. | 1. Any. |
| 2. Q, B, or Kt mates. | |

### NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1232 by White Knight, W. L. Martin, F. W. N. Lambert (not so easy), C. P. P., W. A. Clark, Squire, J. Kistruck, Biene, W. Gleave, and G. W. Middleton; to 1231 by T. H. Billington, W. Gleave, G. W. Middleton, J. Kistruck, D. Mackay, F. W. N. Lambert, W. L. Martin, and White Knight (very good and difficult).

WHITE KNIGHT.—Your second solution of 1232 will not hold, as there is no P to mate with.

J. KISTRUCK.—Thanks for good wishes, which we reciprocate.

OUR correspondent Mr. Gleave has just won the first prize in the *Bristol Mercury* Two-Move Tourney just concluded. The other prize winners are G. Heathcote and R. G. Thomson. Hon. mention: G. L. Fothergill. In the three-move section the order is 1. G. Heathcote; 2. H. Cudmore; 3. J. Rayner. We append Mr. Gleave's two-mover as a Christmas nut to crack:—White: K-Q Kt sq; Q-Q R 8; R's K R 5 and K R 7; B's-Q B 8 and K R 8; Kt's-Q R 4 and Q sq; P's-K Kt 2 and K Kt 4. Black: K-K 5, B-Q Kt 5; Kt's-K 2, K B 4; P's-Q R 4, Q B 3, Q 6, and Q 7. White to play in two moves.

## CHARGES FOR ADVERTISING.

| | s. | d. |
|---|---|---|
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| Every Additional Eight Words .. .. .. .. | 0 | 6 |

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| | s. | d. |
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*** It must be borne in mind that no Displayed Advertisements can appear in the "Sixpenny Sale Column." All Advertisements must be prepaid; no reduction is made on repeated insertions, and in cases where the amount sent exceeds One Shilling, the Publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however, (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

The address is included as part of the Advertisement, and charged for.

Advertisements must reach the Office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

## NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which the subscription is paid will be forwarded to them in a PINK Wrapper, as an intimation that a fresh remittance is necessary if it is desired to continue the subscription.

**Rupture and Truss Torture is Terrible.**—Secure the Sherman method and avoid both. Call on or address J. SHERMAN, Hernial Specialist, 64, Chancery-lane, London. The photographs of extraordinary cases before and after cure to be seen at his offices are marvellous. His book, post free, 7d.—[ADVT.]

**Holloway's Ointment and Pills** exercise priceless power over Lumbago, all pains of the muscles, nerves, and joints, and quickly reduce all swellings caused by accidental injuries, weakness, or hereditary taints. The intelligible instructions enveloping Holloway's medicine give full counsel for using it most advantageously for regaining health, strength, and mobility.

he English Mechanic
D WORLD OF SCIENCE AND ART.
*FRIDAY, JANUARY* 2, 1891.

## LATHE APPLIANCES.—V.

(*Continued from page* 3.)

### The Oval Chuck.

HIS appliance provides the means of turning true ellipses on the ordinary ie, and though usually termed an "oval" ick, it is sometimes, and it would seem h more propriety, called an elliptic chuck. bster's unabridged dictionary gives it as l chuck, and so the term is sanctioned.

n many respects the oval chuck resembles eccentric chuck, which has been illus- ed and described in a previous paper (see 433 *et seq.* Vol. LI.) The principles are, vever, quite different, and so are the uses of se chucks. The work they do also differs irely, the one describing ellipses, the er simply circles eccentric with the normal tre.

he principle on which the oval chuck rks is peculiar, inasmuch as it depends on ixed guide to give it motion at right gles to the axis of the mandrel. This tion causes any point on the face of the rk attached to this chuck to describe an iptic path about the axis of the mandrel. is fixed guide is the peculiar feature in an al chuck. It consists of a circular ring ovided with means of attaching it to the ndrel head. A false nose is fitted to a ding part of the chuck, and this is pro- led with two jaws or rubbers, called llets, that bear against opposite sides of e ring. On rotating the lathe mandrel, th the chuck screwed upon it, these two llets naturally follow the circular ring, d when this ring has its centre concentric th the axis of the mandrel, the pallets ke the circuit of the ring without lateral tion, and then the false nose runs con- ntric with the mandrel. With these con- tions, any point on the surface of work ached to the false nose describes a circular th. On moving the ring, so that it is ec- ntric to the mandrel's axis, and on rotating chuck the pallets must make the circuit before; but they must slide laterally, to commodate the eccentric ring. These cular and lateral motions combined cause y point to describe an elliptic path. The ount of eccentricity given to the ring erns the difference between the major l the minor axes of the ellipse. This cription may make the action of the oval ck intelligible, though a few minutes' eful examination of a chuck in action uld certainly be more likely to do so.

he accompanying drawings, which are de to scale, will show the construction of igh-class oval chuck.

he paper on the eccentric chuck which pears on pages 433-6 in the ENGLISH CHANIC of July 18, should be read in nection with this present paper As eady mentioned, there are certain points resemblance between these eccentric and l chucks, and in some parts their con- ruction is identical. For this reason, some the parts illustrated and described amongst e full-size details on the above-named ges are not again shown here, except in complete chuck. For example, the rm-wheel and tangent screw, and all the rts belonging to them, and shown on the mplete chuck, are precisely the same in ery particular as those illustrated in detail p. 435, Vol. LI.

he first group of drawings show the mplete chuck, front, side, back, bottom- l, section, and top-end being each given, d from these the general construction of oval chuck must be clear to anyone accustomed to similar work, and who understands drawings.

The front view shows the face of the chuck. The main sliding-plate is the foundation to which the other parts are fitted. The side view is the front turned to show its right-hand edge, and the back view is the right-hand side of the side view. The pallets are fixed on the back of the chuck, being screwed to the sliding plate, by screws which pass through the steel V-edged strips. These pallets are made of steel, and are shown on the side and back, and on all the three lower views of the complete chuck. In the group of details eight views of these pallets are given, so that their shape may be readily understood. Further particulars of the complete chuck perhaps will be superfluous, so we pass on to the other drawings which show details of construction.

The illustrations showing the foundation-plate and the sliding-plate of the oval chuck are grouped on one sheet. On the left, the back, side, and section represent the foundation-plate which screws on the mandrel nose, the sectional view showing the female screw which fits the nose. The small circle P on the top left-hand corner of the back view represents a hole made to receive a pin for fixing the sliding-plate whilst this latter is having its boss turned true; these same holes are useful to pin the oval chuck all at centre at any time. On page 435, Vol. LI. a similar hole is shown, also marked P, and its purpose more fully explained. The side view shows the edge of the foundation-plate grooved to receive the V-edged steel strips which are screwed to the sliding-plate. The section shows all dimensions as to thickness and length of this foundation-plate. It is most often made of brass, but sometimes gunmetal is used, and occasionally cast-iron. This last material, though it is the least used is undoubtedly the best. The facts that it is harder to work and not so ornamental in appearance as are the alloys of copper, combine to exclude cast iron from general use in high-class lathe appliances, much to their detriment. As an example may be cited the "brass" pulley fitted on some ornamental lathes, and which is not nearly so good as an iron one; in fact, for such a purpose "brass" does not possess one point of superiority to iron, except being easier to work and being more shiny. Anyone who has ever used "brass" pulleys knows that they have many disadvantages.

On the right the section, side, and front represent the sliding-plate. The front shows, in the centre, a hole for the stalk of the worm-wheel to pass through; the larger dotted circle round it represents the enlargement to receive the head of the screw which holds on the worm-wheel. The section shows this; but it may be seen even more clearly in the sectional view of the complete chuck forming the central figure in the lower part of the first group of illustrations.

Again referring to the sliding-plate front view, the large circle represents the central boss on which the worm-wheel is fitted. The six uniform circles near the edges of the plate represent holes through which the screws pass that fix the V-edged strips.

The four smaller circles, with dotted circles round them, near the corners are the screwed holes which receive the screws that fix the pallets. The large circle, in the lower right-hand part, is the hole in which the tangent screw frame is pivoted by the boss on its bottom. This frame is fully illustrated on p. 435, Vol. LI. The rectangle, just above it, is a hole to receive the end of a steel spring, which throws the tangent-screw out of gear when released by the cam. The hole for the screw on which this cam works is shown by the small double circle in the lower part of this illustration. The sliding-plate is made of brass usually, and this material is suitable for the purpose.

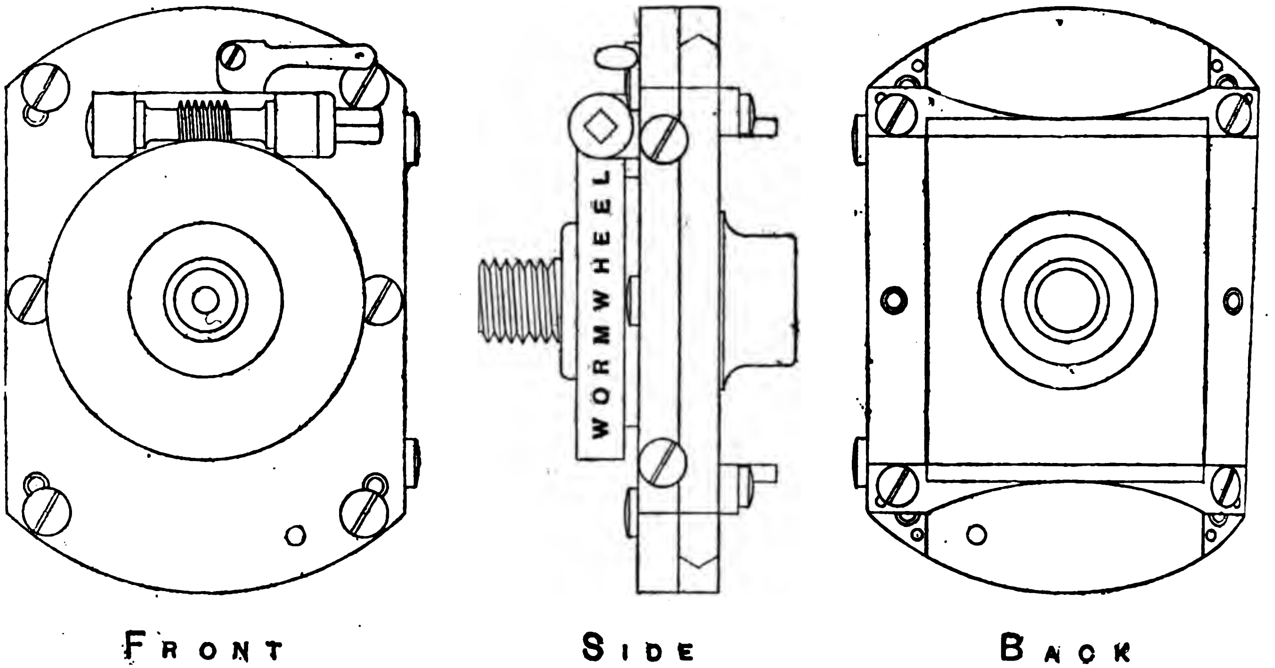
The side view and the section show the thickness of the sliding-plate, and of the boss on which the worm-wheel is fitted; in the former the two small circles on the edge show holes threaded for screws to adjust the V-edged strips into proper contact with the V grooves in the foundation-plate. The amount of projection of the boss and the shape of the round hole through the centre are shown by their side and section views.

The next group of drawings show those parts of the oval chuck which are peculiar to it. The four top figures show the ring and its adjuncts, by which it is fastened to the mandrel headstock; the shape can be seen from these figures, though it may be noted that the contour is not arbitrary. The thumb-screws, by which the ring is adjusted laterally, are removed from the back, side section, and front views of the ring. Below, in the middle, two views of one of these thumb-screws are given, the two screws being alike.

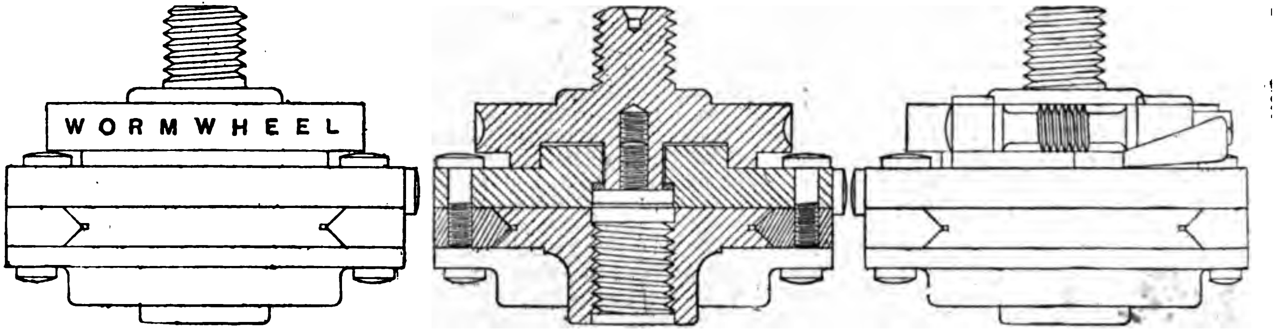
The shape of the ring and its adjuncts having been shown, a few words on the method of fitting will be sufficient. Taking the casting, usually made of brass, it may be first burred up, and the bosses which are to receive the thumb-screws are carefully centred, so that the hole drilled through each will lie in a line parallel to the back and front surfaces. Accuracy in centring these bosses will save lots of after-work. The ends of the bosses are to be filed fairly flat, and the casting is then laid with its flat part on parallel strips of packing, say front downwards first, and with a surface gauge set approximately to the height of the centres a line is scribed across each boss. The casting is then turned over, bringing the front upwards, and the surface gauge re-set and another line scribed across each boss. These lines will be parallel to those first made, and if both bosses have the lines equidistant apart, it will show that the casting is straight and of even thickness. If the scribed lines are not very nearly equidistant, the casting must be examined to ascertain where its form is defective, and then got somewhat nearly to shape.

The bosses may now be centred, each one by its circumference, and the way to test the truth after lightly indenting each end is to spin the casting between the cone points on the lathe. If necessary, draw the original centres till both bosses run fairly true; then punch them deeply, and drill through both with a small drill, one about ⅛in. diameter being suitable. Take a piece of straight steel rod which fits the hole, and pass it through to prove that the holes are straight through each boss, and opposite each other. Probably they will have run out in the drilling, and if so, they will require correcting. Precautions must be taken to insure the holes being exactly in line when enlarged to the size for tapping. Nothing short of absolute straightness will be near enough for this. A long reamer passing through both holes may be used for final correction; but the diameter of the holes must be sufficiently small to allow the reamer to make them straight before it has enlarged them beyond the tapping size. These holes, after enlarging to correct size for tapping, are next carefully countersunk for running on the cone centres and the two bosses are turned to precisely equal diameters, with the ends of the casting from which each boss projects also turned flat.

The casting is now to be chucked on a face-plate, using blocks with V notches to support it by the turned bosses, and the back and front are turned as small as possible. The front can be set so that the ring runs true, and the whole surfaced at one chucking—the flat part outside the ring, the ring itself, and the inner part being all turned true and smooth before the casting is shifted. The elongated hole in the middle of the ring, through which the mandrel nose will pass, is also made. As there are ears



FRONT SIDE BACK



OVAL CHUCK COMPLETE.

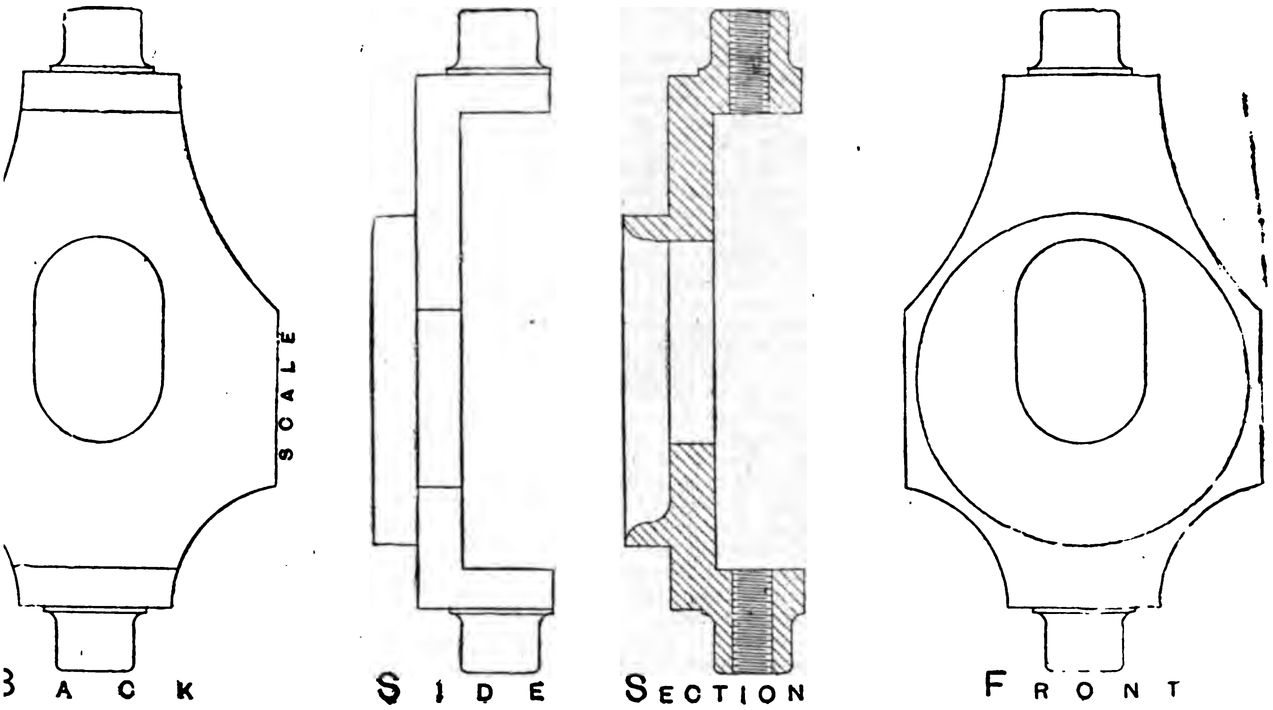
which carry the bosses projecting from the back, it cannot be turned all over; but most of the back surface can be turned, leaving four small spandrel-shaped pieces to be levelled by filing. The inner sides of the ears are also filed flat at the same time. The edges of the casting may be wrought by filing or by turning. That part of the edge which is marked with a scale of divisions should be first made to size, and as this depends on the headstock, it is well to leave the edges till after the ring has been adjusted to its place on the mandrel headstock.

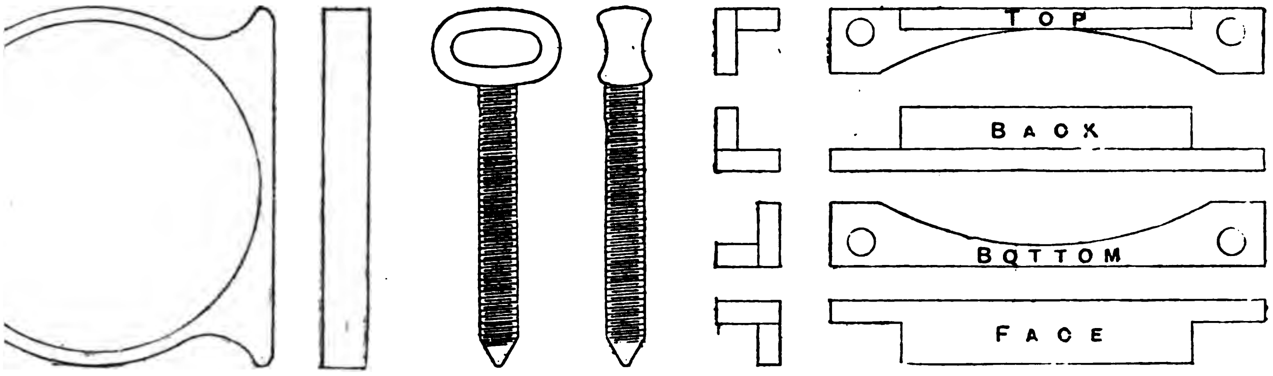
The thumb-screws by which the ring is shifted to and from a position concentric with the mandrel, are made of steel, and their shape is shown by the two views low down in the middle of the drawing. These screws should be easily manipulated with the thumb and finger, and the bow is made sufficiently large for this to be done. The length of these screws is governed by the amount of eccentricity that can be given to the ring, as determined by the lateral movement allowed by the oval hole in the centre of the ring. The thumb-screws should be as long as requisite to allow all possible travel to the ring; but excessive length is not wanted. The ends of these screws have conical points, and these points take their bearings in small holes, countersunk conically, one in the back and one in the front of the front upright of mandrel-headstock, on a level with the mandrel's axis. The ends of the screws are hardened; but only the ends should be so treated. The threads must be cut quite true by self-acting motion, for if the thread is even in the slightest degree drunken, or the screw bent, the action of the oval chuck cannot be depended upon.

The bosses in the casting have to be tapped to receive these thumb-screws, and in this operation all the care previously taken to insure both the screws travelling in one straight line may be annulled. It is almost futile to try to tap the two holes so that the two threads will be in a line, unless a tap is used that is long enough to pass through both the holes at the same time. Such a tap is guided properly, and cannot fail to give a straight lead to the screw. In most cases this means that a special tap must be made for this purpose, which, perhaps, would deter some people from undertaking the work, especially as the tap required would probably be some 8in. or 10in. long, and about ⅜in. in diameter. The making of such a tap is a matter that would require considerable knowledge and skill.

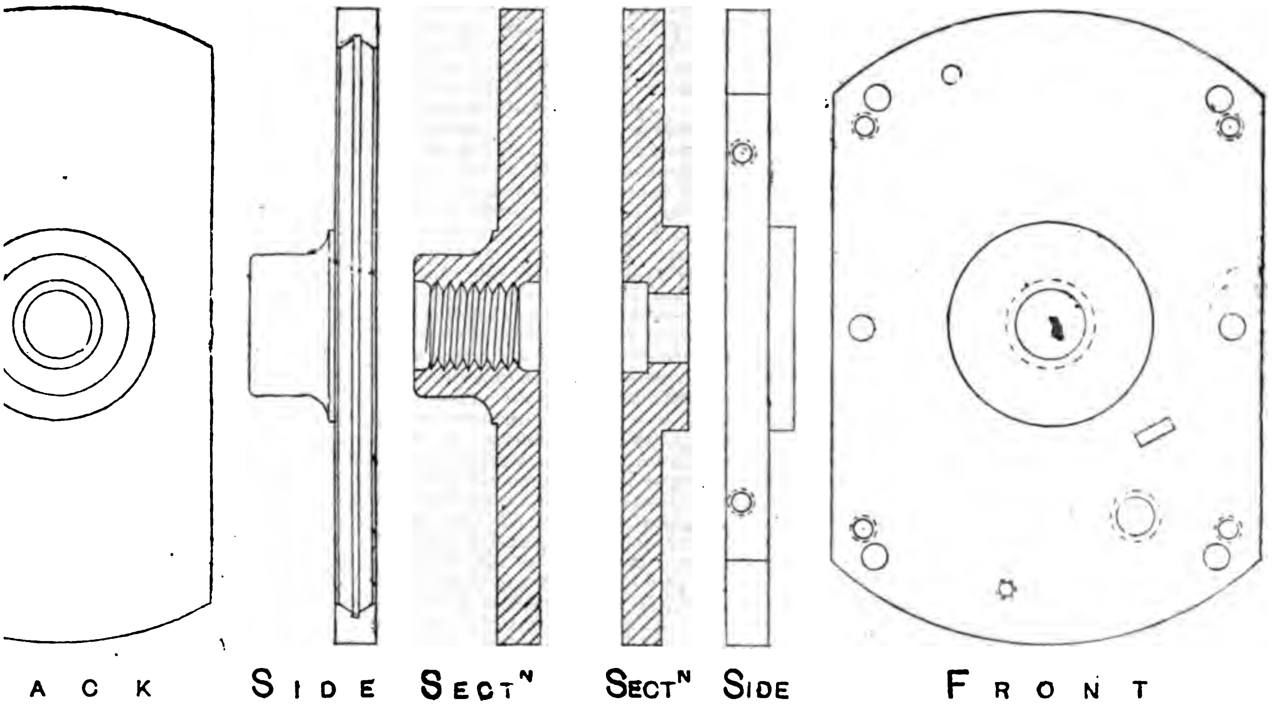
A special tap that answers perfectly can, however, be made quite easily by the following method:—First, select a steel rod some 8in. or 10in. long, and make it fit the holes in the bosses, now made just the size for tapping, which will probably be about $\frac{5}{16}$in. wide. Making the rod fit may be interpreted to suit the reader. The rod may be turned parallel and to size; but if one is selected that is straight and round, and not too small, a little filing will make as good a fit as the circumstances require. It is only necessary that the rod should pass through the two holes, and not shake. Next cut a mortise hole through the rod, commencing at about 1in. from one end and making width of the hole about one-third the diameter of the rod. Now prepare a piece of cast steel, on which to make a thread, like that on the thumb-screws, just over an inch long, and cut the thread upon it. See that this thread is a little less than full size, and taper it as would be done for a tap. File away about one-third of the diameter from each opposi side, and so produce a piece that will be of size to suit the hole mortised through th rod. Fit this piece to the hole, so that may be fixed, with a small wedge at on end, leaving the screwed portion, which i now less than ⅛in. wide, projecting from th mortised-hole on the opposite sides of the ro Harden and temper this piece, which, wh wedged in the rod, will cut famously. Af this special tap has been passed throu both bosses, it is easy to follow with a ordinary working tap, and so regulate th size of each threaded hole, without fear o making it crooked relatively to the oth one. Bearing this in mind, no speci trouble need be taken in sizing the sma screwed piece, provided it is not too larg and even the exact thread-form is n essential to its effective working. Und these conditions the making of this speci tap is neither a long job nor a difficult on The want of a long tap to lead straig through the two holes will, however, resu in a defective oval chuck.

At this stage the ring is ready for fitti on the headstock, the thumb-screws being their places. The ring requires to be la against the face of the headstock, the ri itself being set true with the mandrel's axi This is best done by placing a wood-chu on the mandrel and turning the back pa that is the surface against the shoulder the mandrel, so as to fit the ring and hold firmly against the headstock. The ri being set true with the mandrel's axis, t thumb-screws are adjusted horizontally, that the lateral motion of the ring will be a line level with the mandrel's axis. T leveling of these screws is done by mea suring with a surface-gauge from the top





RING, SLIDING-PIECE, THUMB-SCREWS, AND PALLETS FOR OVAL CHUCK.



FOUNDATION-PLATE AND SLIDING-PLATE OF OVAL CHUCK.

ed. It is better to gauge the
he ring rather than the screws
in levelling. When the screws
ntal and the ring accurately
ese thumb-screws are carefully screwed in to touch the headstock, and each one is brought to a firm bearing, the position of the ring not being shifted during this screwing up. The points of the screws will mark the spots where they touch on the headstock, and thus show the exact positions for drilling the small holes which are afterwards countersunk to receive the coned points of these screws.

The headstock has its front upright prepared on the edges opposite the collar and rendered smooth and flat where the screws will impinge; a decided dot can be made on each side of the headstock by screwing the thumb-screws home firmly, but not enough to spring the ring, and then giving each screw a gentle tap with a heavy mallet. The ring is then removed from the headstock and the latter is taken off the lathe-bed; the dots made by the points of the thumb-screws are enforced with a centre-punch. Driving them slightly back from the face of the headstock will cause the ring to hug the headstock, and it is a wise precaution to make it do so. The amount of draw should be the least possible: it is only desirable to insure the ring lying snug against the headstock, but any excessive draw will tend to bend the ring. The dots in the sides of the headstock are drilled in with a small drill, and then countersunk to the same angle as the screw points, 60° being usual.

Though the ring has been set as truly concentric with the mandrel as it is possible to set it, yet it is necessary to take another cut over the perimeter of ring to make it mechanically true. The ring is fixed by its thumb-screws in position, and a chuck, provided with a cutter to scrape round the outer edge of the ring, is screwed on the mandrel-nose. This cutter has a finely-ground keen edge, and cuts the entire width of the ring at one time. It may be conveniently bolted on the back of a face-plate, or some similar chuck, packing it up to get it in position, and feeding it into cut by tapping with a hammer. If the ring has been set very true, only a bare shaving will be requisite in this final truing.

If the edges of the ring casting have been wrought smooth, and the index edge made to size and graduated, then the scratch by which the index is read may be marked on the headstock when the ring is fixed as finally trued. This will insure the all-at-centre mark reading correctly. This index-scale for reading the amount of eccentricity that is given to the ring can be divided either in decimals or in thirty-seconds of an inch. The amount that the ring is set eccentric is doubled by the motion of the sliding plate of the oval chuck, so that if set ⅛in. out of centre, the ellipse produced would measure ¼in. longer than its width, whatever this latter measurement might be.

Having completed the adjustment of the ring, the pallets are to be fitted to it. It is a general practice to make these pallets touch the ring itself, but this is not satisfactory, consequent upon the small amount of surface contact afforded by the straight face of the pallet against the ring to which it is tangent. From what has been said in explaining the action of the oval chuck, it will be understood that these pallets slide on the ring to-and-fro as the chuck rotates. The amount of sliding motion is but trifling, and all the wear occurs just about the middle of each pallet face. The small area of pallet face that is subjected to wear, and the mere line of ring in contact, are both conducive to rapid deterioration, and an oval chuck so fitted soon ceases to work smoothly and uniformly.

The pallets are shown by the drawings grouped in the lower right-hand corner of the illustration, both being alike. The top, back, bottom, and face views show the shape of the pallets. At the left hand of each is shown the end view. The pallets are made of steel, and require to be hardened at least in the middle, where they are subjected to friction against the ring. The two round holes, one at each end, receive the screws which fix the pallets to the back of the chuck, these screws passing through the steel V-edged strips, and being tapped into the sliding plate. This is shown clearly on the drawings of the complete chuck. It is usual to provide means for adjusting these pallets into due contact with the ring, in the same way that provision is made for adjusting the V-edged strips. This adjustment is a convenience in some cases, and perhaps necessary in others; but when the pallets and the strips have been once properly adjusted, a good steel steady-pin near each end are the best contrivances to maintain the adjustment.

There now remains only the figure in the lower left corner to be explained. This is a piece of metal, somewhat square, having a round hole through its centre, which accurately fits the ring of the oval chuck, and having two opposite edges parallel and made to fit between the pallets. The other two edges of this metal piece may be shaped as drawn, so as to decrease the weight of it; the thickness is about equal to the thickness of the ring, and is shown to the right. This metal piece is to overcome all the trouble mentioned in connection with the inadequate bearing surfaces of pallets and ring. The hole in this metal piece having been accurately fitted on the ring, so that it will rotate freely but without shake, two opposite edges are made true and parallel, and the pallets are fitted to these. Thus in action the surface contact of each pallet face extends over some few inches instead of being only a mere line of contact. This piece is certainly a very great improvement on the older method of fitting the pallets to the ring, and yet it is not a very serious addition to make in respect of labour and material. Cast iron is perfectly suited for the purpose, though steel is employed by some people. The pallets will require to be placed somewhat farther apart if this piece is used; but in all other respects the dimensions may remain the same.

This description must suffice for the accompanying drawings of an oval chuck.

## CAMPBELL'S AMMONIA ENGINES.

THE many defects inherent in the steam engine have from time to time induced inventors to turn their attention to ther means of providing motive power, but although some success has been achieved on the small scale with gas and petroleum engines, all attempts to use such fluids as carbonic acid, ammonia, ether, bisulphide of carbon, &c., have met with no more satisfactory results than did the experiments of Tyndall and Brunel many years ago. Mr. J. H. Campbell, of Wall-street, New York, has, however, taken out a patent for an invention relating to aqua-ammonia engines, wherein ammonia gas for propelling an engine is expelled from aqua-ammonia by heat, and the exhaust vapour is reabsorbed by weak solution withdrawn from the generator wherein such heating takes place, the combined absorbing liquid and exhaust vapour being thereupon forced back into the generator. The purposes of the invention are to provide methods and apparatus for accomplishing the following objects:—1. To obtain proper circulation of steam when it is used as the heating agent for the purpose of expelling the gas from aqua-ammonia in a generator and superheating the gas, and to obtain proper circulation in the generator of the gas so expelled. 2. To so utilise, in operating a compound aqua-ammonia engine, the heat contained in weak solution drawn from the generator for the purpose of absorbing by it the exhaust vapour of the engine, as to increase by it the temperature of the working vapour after its leaving the high-pressure cylinder and before entering the low-pressure cylinder. To utilise the heat of absorption developed upon the union of exhaust vapour and spraying liquid for the purpose of heating the feed liquid. 4. To accomplish absorption of the exhaust vapour by the spraying liquid in an absorber along the exterior surfaces of a series of pipes or tubes arranged in a series of communicating chambers, such pipes or tubes being cooled by the passage through them of cold water or other refrigerating liquid. 5. To prevent the violent agitation of the aqua-ammonia in a well communicating with the atmosphere, or in that part of the well from which the feed pump takes its supply for the generator, and thus avoid a loss of ammonia vapour, whether the agitation is produced by the forcible entry of the combined exhaust vapour and absorbing liquid or by air that has been carried over to the well. 6. To purge the aqua-ammonia in the apparatus of air or incondensible gases, automatically or otherwise. 7. To prevent oil or other foreign substances that have been carried into the well from being forced into the generator by the feed pump.

In the drawings, Fig. 1 is a longitudinal vertical view, partly in section, of an apparatus embodying the various features of the invention, while Fig. 2 represents a vertical cross-section of that part of the apparatus commonly called the absorber, and Fig. 3 a vertical section, on an enlarged scale, of the receiving well. Corresponding letters throughout the various views represent corresponding parts. A is a steam-boiler of ordinary construction; B is a secondary boiler wherein aqua-ammonia is heated by water-steam. Such aqua-ammonia boiler is termed the generator. The same is so arranged that the water-steam generated in boiler A enters it through connection $A_1$ when the gate valve $a_1$ therein is open, and after circulating through its tubes will be drained back into the steam boiler. The generator is provided with tubes above and below the liquid line, and with steam chambers 1, 2, 3, and 4 at its heads, and is so constructed that the steam entering chamber 1 through connection $A_1$, will pass through the tubes $b_1$ $b_1$ to chamber 2, then through tubes $b_2$ $b_2$ to chamber 3, and from there through tubes $b_3$ $b_3$ through chamber 4, where it is drained back through connection $A_2$ into the liquid space of the boiler A. $a_2$ is a check valve in pipe $A_2$ opening downward. The lower tubes of the generator are surrounded by aqua-ammonia; $f_1$ and $f_2$ are horizontal division plates to prevent the conveying of water with the vapour to the engine, and to cause the gas to travel over the heated tubes in the vapour space in a direction opposite to that taken by the steam while passing through the tubes, so that the vapour may become superheated. In most cases the use of only one such plate will be sufficient. Steam having been generated in the boiler A, as the valve $a_1$ is opened and the steam passes through generator B as indicated above, it will be observed that while first going through the tubes in the vapour space, it will readily superheat the vapour in the upper part of the generator, but that in passing finally through the tubes in the lower or liquid space (the requirement of heat there being much greater), a portion of the steam will be condensed and a circulation of steam will be effected in this direction. A difference between the temperature of the vapour in the upper part of the generator and of that of the liquid in its lower part is maintained, and continuous circulation of the steam is produced by the withdrawal of liquid so heated for the purpose of afterwards employing it in a cooled condition in absorbing the exhaust vapour of the engine and returning it so enriched at a temperature lower than that maintained in the generator, by means of a pump.

The gas expelled from the solution is superheated as described, and any liquid carried along with the gas will be vaporised before leaving the generator, for use in the engine cylinder. The check valve $a_2$ in pipe $A_2$ is to prevent the liquid from being forced out of the boiler into the generator when the valve $a_1$ is closed, the pipe $A_2$ reaching into the liquid space of steam boiler A. C is the main vapour valve of the generator, and $C_1$ the throttle-valve of the engine. D is the vapour pipe for supplying vapour to the cylinder of the engine, and in compound engines, as in this case, to the high pressure cylinder E, from which the exhaust vapour is discharged into the reservoir F, whence it passes through the pipe G into the low-pressure cylinder H, and having performed its work there is discharged into pipe L. I is a pipe conveying the absorbing liquid from the generator B to the exhaust pipe of cylinder H, where it discharges the liquid by means of the jet J. $C_2$ is a cock for regulating the discharge through jet J. The pipe I is made to pass through reservoir F in form of a coil. It there imparts heat to the vapour which has just left cylinder E, where such vapour has lost part of its heat owing to its expansion therein. From reservoir F the spray pipe I passes, again in the form of a coil, through reservoir K, where it is further reduced in temperature by cooling water surrounding the coil. Pipe R is used for supplying such water, and $K_2$ for withdrawing it from casing K. The com-

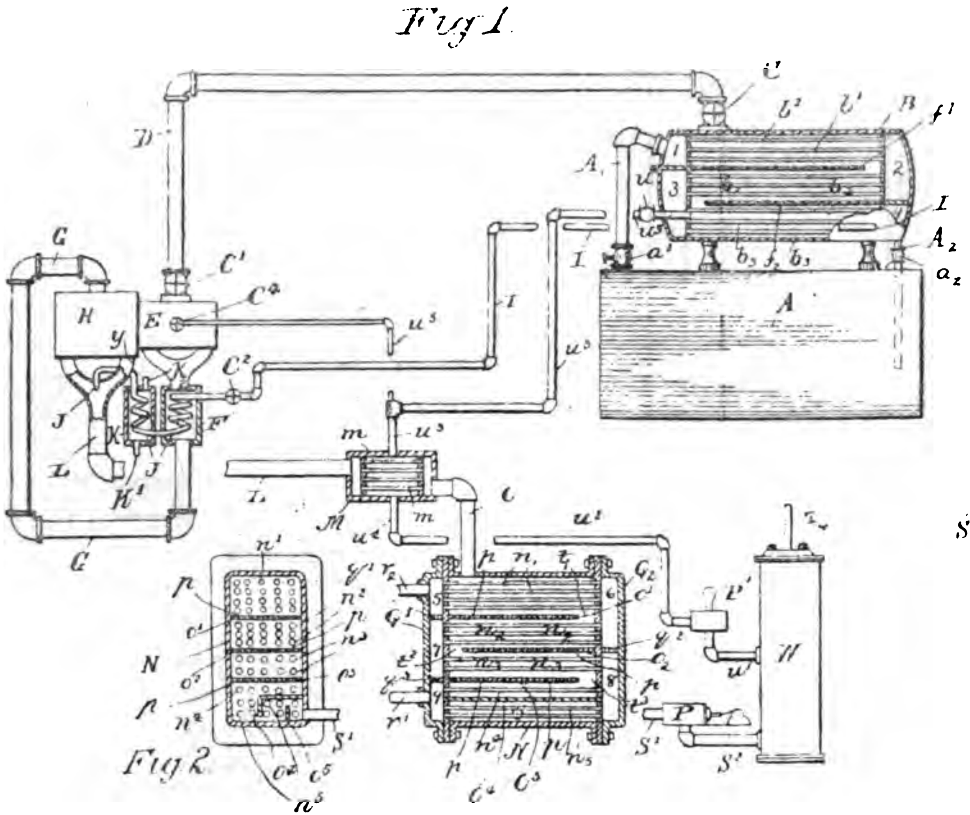


Fig 1.

Fig 2.

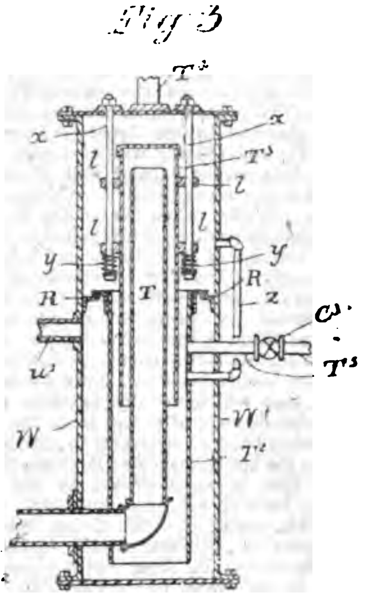


Fig 3

ined spraying liquid and exhaust vapour pass rough exhaust pipe L into chamber M, acting s a heater for the feed liquid, and constructed s a surface condenser. After passing through he tubes *m m* of the heater M, the absorbing quid together with the exhaust vapour enter bsorber N through pipe O. They are withdrawn rom the absorber by vacuum pump P through ipe $S_1$. The absorber has a double head at each nd, formed by bonnets $Q_1$ and $Q_2$ bolted on to he main body. It is furnished throughout with series of longitudinal tubes $n_1 n_1 n_2 n_2 n_3 n_3 n_4 n_4 n_5 n_5$, hich at each end open into the water-ways ormed by the double heads. The space at each nd of the absorber formed by the bonnets $Q_1$ and $Q_2$ is divided into such water-ways , 6, 7, 8, and 9 by partitions $q_1$ $q_2$ and $q_3$, and nd $r_1$ is the pipe through which the cooling water enters the absorber, and $r_2$ is the pipe discharging such water from the absorber. These artitions correspond in location and height with iaphragms or division plates $O_1$ $O_2$ and $O_3$, each f which extends entirely across the interior of he absorber, and lengthwise from one end early to the other end, diaphragms $O_1$ and $O_3$ being attached to the tube-head at the left end here partitions $q_1$ and $q_3$ are located, and iaphragm $O_2$ to the tube-head on the right nd where partition $q_2$ is located. By his arrangement the interior of the upper art of the absorber is divided into four ommunicating chambers, and spaces $t_1$, $t_2$, nd $t_3$ are left at the ends of the diaphragms r the free passage of any liquid or gas which as not found its way from one of the upper hambers to another through the perforations *p* of the diaphragms, which are shown to be rovided in the same. Liquid and vapour combined enter the upper chamber of the absorber or hat portion traversed by the tubes $n_1 n_1$ and are arried downwards, partly owing to the weight f the liquid and the constant reduction in the pace occupied by the free gas in the lower part f the absorber produced by its continued absorption, and partly owing to the vacuum pump P, hich pump through pipe $S_2$ discharges into ell W, the gas being more and more absorbed y the liquid, as they become more intimately ixed and the liquid becomes cooler. A portion the liquid and gas passes through the perforations in the diaphragm $O_1$ and the remainder sses through the space at the end of the diaphragm into the next division, and so on, down the division of the absorber containing tubes $n_4$, and thence the liquid, having become oled, and having absorbed a large proportion the gas, enters the lowest compartment of the absorber, where further absorption takes place. $O_4$ is an ∟-shaped plate, extending entirely from one end of the interior section of the absorber to the other, covering the exit pipe, and so close to the bottom of the vessel that only a narrow space remains between its lower edge and the bottom plate of the absorber. Inside of the space thus inclosed by the ∟-shaped plate is an upright plate $O_5$ attached to the bottom of the absorber, and extending nearly up to, but not quite touching, the lower side of the horizontal part of the ∟-shaped plate $O_4$. This construction is shown clearly in Fig. 2. The effect of this arrangement is that the space inclosed by the ∟-shaped plate ond the upright plate $O_5$ is constantly filled with liquid to the height of the upper edge of the upright plate $O_5$, and as no gas can escape but through the exit pipe $S_1$ (the mouth of which is inclosed by the ∟-shaped plate $O_4$), all free gas attempting to pass out of the absorber must enter the space inclosed by the ∟-shaped and upright plates $O_4$ and $O_5$, and pass through the body of liquid imprisoned therein. A gas trap is thus formed, through which no free gas can escape, and if it accumulates sufficiently to force its way through the water, the quantity is so small that it cannot escape absorption by the liquid if that be sufficiently cool. A practical test of this improvement has demonstrated its efficiency to secure the desired result. The patentee describes the absorber as having tubes and diaphragms; but these are not necessary to the operation of his improvement, but add to its efficiency by tending to secure a more perfect absorption of the gas with the absorbing liquid. Instead of completing absorption of the gas in the body of liquid confined between plates $O_4$ and $O_5$, as described, an independent second absorber might be employed wherein free gas might be made to pass through a body of such liquid, kept cool by cooling water circulating through it by means of proper tubes. $S_2$ is the discharge-pipe of vacuum pump P. Such pipe connects with pipe $T_1$ in well W near its bottom, and projects upward sufficiently so as to discharge its contents in the upper part of the well. $u_1$ is the suction-pipe through which feed-pump $p^1$ withdraws liquid from the well for the purpose of forcing it through pipe $u_2$, heater M, and pipe $u_3$, back into generator B. The well W is cylindrical in form, having within it a cylindrical casing $T_2$, provided at its upper end with a rim extending outward sufficiently so as to rest upon and be attached to a ring R, attached to the inner side of the walls of well W, the ring and the rim forming an airtight joint. The casing $T_2$ is open at its top and bottom, and reaches downward nearly to the bottom of the well W, leaving, however, a space sufficient for the free passage of liquid from the interior of casing $T_2$ to the part of well W surrounding it. $T_3$ is a cylindrical casing closed on top and open at its bottom, pipe $T_1$ passing upward into such casing $T_3$ to within a short distance of the disc which closes its upper end. *x x* are bolts passing through the top of well W. *l l* are lugs rigidly attached to casing $T_3$. The bolts *x x* are made to pass loosely through the lugs as shown, so as to utilise the bolts as guides for casing $T_3$. Y Y are spiral springs surrounding the lower parts of bolts *x x* and resting on the heads of such bolts or on washers supported by the heads. The springs serve to counteract the violent shock which would otherwise be produced by the dropping down of casing $T_3$ after the same had suddenly been elevated by the force of any air or gases discharged against its head by vacuum pump P. $T_4$ is a pipe for the escape of air from the upper part of well W, and $T_5$ is a pipe provided with a suitable cock $C_3$, and extending through the walls of well W and inner casing $T_2$.

In operation, the engine having been started the exhaust ammonia gas, air, and incondensibl gases pass through the absorbers, are withdrawn by the vacuum pump and forced by the same into the well through pipes $S_2$ and T. The ammonia gas having been absorbed by the accompanying liquid before it reaches the outlet of pipe T or at that point, the force of the liquid and the pressure of the air and incondensible gases operate against the top of casing $T_3$, and their force is ordinarily neutralised by the weight of the casing. The liquid discharged from pipe $T_1$ passes down within the body of casing $T_3$ and out of its bottom into that part of casing $T_2$ surrounding the lower part of the casing $T_3$ without violently agitating the liquid in this part of the well. The liquid surrounding the casing $T_3$ is generally higher than the liquid within such casing. This is due to the pressure of the air, and incondensible gases within the casing $T_3$. When the engine remains standing for a considerable time, or the generator or engine has been opened, or if from any cause a large amount of air has been drawn into the apparatus so as to reach the vacuum pump after the engine has been started, this quantity of air will force the casing $T_3$ upward and the liquid in casing $T_3$ downward, and will thus make a free passage for the air to the atmosphere between the casings $T_2$ and $T_3$. Ordinarily the amount of air discharged into the well while the engine is running will not be sufficient to force casting $T_3$ upward, but will force the liquid in casing $T_2$ downward and thus permit the air to escape through the same passage between the casings $T_2$ and $T_3$. Free gas that may be forced through said passage will be absorbed by the liquid between casings $T_2$ and $T_3$, and the air will be forced upward, passing between the walls of well W and casing $T_3$ until it reaches and is discharged through air-pipe $T_4$. While, when the engine is operated with ammonia gas, no oil is required for lubricating the interior of its cylinder and valve-chest, it frequently occurs that oil remaining over in such cylinder since the time when the same was last operated by steam enters the absorbing apparatus through the exhaust pipe. Such oil when in contact with ammonia and subject to very high temperatures will form a combination with it, that will materially interfere with the proper development of vapour from the solution. It therefore becomes necessary to withdraw such oil from the apparatus before it enters the generator. This is accomplished in the well as follows: Such oil will pass downward with the air within casing $T_3$ and, being lighter than aqua-ammonia, will rest on the surface of the liquid in casing $T_2$, from which place it may readily be withdrawn through pipe $T_5$ after cock $C_3$ therein has been opened. The annular space existing in well W around the upper part of casing $T_2$ and above the suction-pipe $u_1$ of the feed-pump furnishes room for the liquid when forced in unusual quantity out of casing $T_2$, and before the same can be taken by the feed-pump. Z is a vertical glass tube, its upper end being connected with the air-space surrounding casing $T_3$ in the well, and its lower end being connected by a suitable pipe with the inner casing $T_2$ at a point slightly lower than that where the drain-pipe $T_5$ communicates with the said casing $T_2$. Thus, whenever oil or similar substances fill the upper part of casing $T_2$, they will enter the glass tube Z from the bottom, and their presence can in this manner be observed, and they may be removed by opening valve $C_3$. It will be seen that, with a slight modification, casings $T_2$ and $T_3$ might be placed on the line of pipe $S_2$ before the same enters the well, and by properly connecting the same with the well would perform the same functions as specified above. They are shown within the well, as this offers a simple and convenient form of construction, and it is also evident that the well could be divided into two parts by a central partition, and one part might be made to receive the incoming liquid and to serve to separate the air from it, while the second part of such well might be made to supply the feed pump, but the construction as shown is preferred, but not essential. As explained before, the feed pump $P^1$ withdraws the liquid from the well and forces it first through pipe $u_2$ into the space surrounding the tubes *m m* in heater M, where the feed liquid takes up heat of absorption developed therein, and afterwards through pipe $u_3$ (having check valve $u_4$ closing towards the generator) back into such generator. $u_5$ is a branch pipe leading out of pipe $u_3$ into the valve chest of engine cylinder E. Such pipe is provided with a cock $C_4$ for admitting the feed liquid so heated in heater M to the valve chest and cylinder at such times as such lubrication seems especially called for. This will occur particularly upon starting the engine. Obtaining such lubricating liquid from pipe $u_3$ offers the advantage that a strong solution can thus always be obtained under a greater pressure than any pressure that will ever occur in the engine cylinder.

## MODEL LOCOMOTIVE-MAKING.—XIII.

WITH the intention of saving labour, I have shown no cleading either on boiler or cylinders. There is, however, no special difficulty, and there is some advantage in putting it on. In the case of the boiler, a sheet of felt can be wrapped round the barrel, and a sheet of thin iron over this, and held with brass bands. The cleading of the firebox, however, should not be attempted, because space is so very contracted there. Sheets of felt can be wrapped round the cylinders, and thin sheet iron or brass lying over these can be screwed to the cylinder flanges with small screws tapped into the edges of the flanges. But I should prefer to leave the cylinder castings exposed to view, because of their good appearance, though the clothing would, of course, lessen the condensation of steam within them.

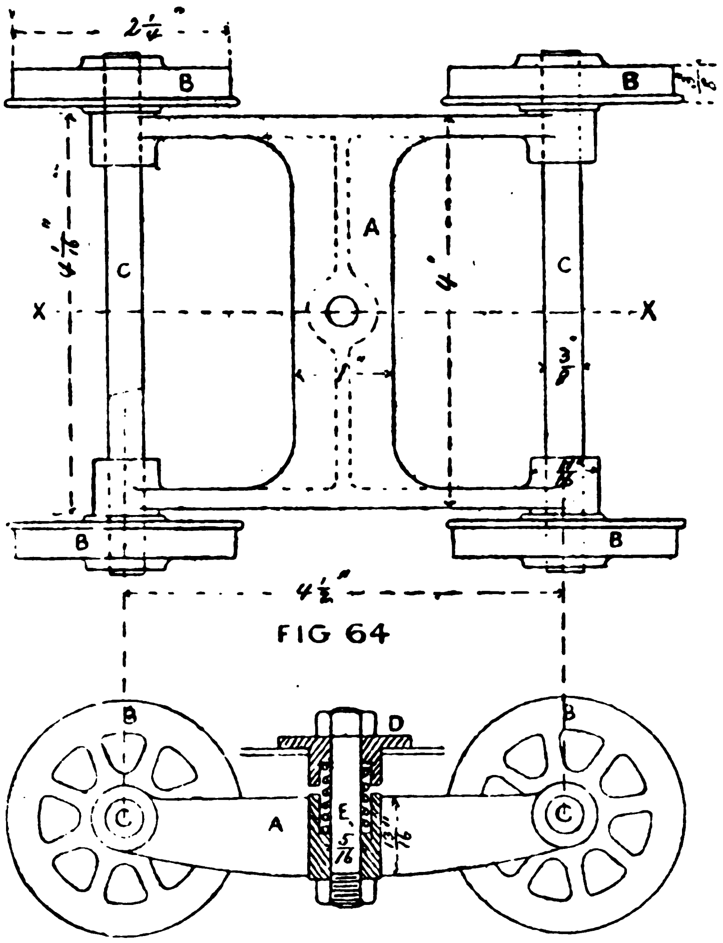


FIG 64

SECTION X-X

For oiling the cylinders and steam-chests, a lubricator may be screwed into the top side of each cylinder, through the foot-plate, or into each steam chest within the smoke-box. Even a little plug, like a tiny mud-plug, having a square head, and screwed either into the cylinder or chest, to be removed for the admission of oil, will answer the purpose. But lubricators are not necessary in a model doing an occasional spell of running only, which is all that it could be made to do in the absence of a pump and tend a short run sufficient lubrication can be g injecting oil into the cylinders through cocks beneath, and oiling the rods ext The steam will not be very dry, and t will assist slightly in lubrication.

FRONT VIEW OF BOGIE

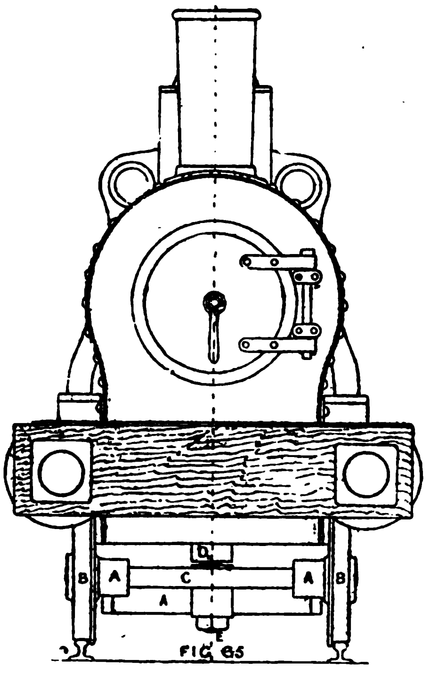


FIG 65

SECTIONS THRO BOGIE

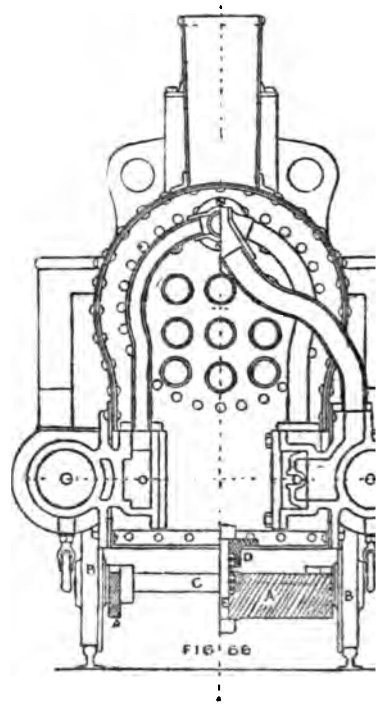


FIG 66

I have been asked to describe a bogie c A proper model of such a carriage coul adapted for this without giving an i amount of trouble. I shall even dis loose axle-bearings that we employ ordinary wheels previously described, a of the eccentric with which the pump must be driven, to $\frac{5}{8}$in., a rather short stroke, and so I have made the pump bore larger than as though the stroke were made equal to the piston stroke. To enable the straps to clear the boiler, the lugs are set diagonally.

The cross-stretcher A, that carries the valve-rod guides, affords a good surface of attachment for the pump-casing B, and as the pump is fixed diagonally, no cutting and weakening of the stretcher is necessary, as would be the case if it were fixed horizontally. A flange, *b*, is cast upon the body to be bolted to the stretcher, and a shoulder on the bottom edge of the flange bears against the bottom edge of the stretcher to keep the casting firm.

The pump is made as simply as possible. Going through the details: B is the body, made by pattern and core box. It is bored to receive the ram C, and faced on the gland-shaped flanges. The inlet valve D is of gunmetal, fitting into its bored seating E, also a casting. The flange F of brazing metal receives the inlet pipe G, of copper, brazed into it. This flange F, the seating E, and the corresponding bottom flange of the casting B are secured together with two bolts passing through the whole. The valve is prevented from rising out of its seating by means of a bit of wire, *d*, driven in and riveted or soldered over at the ends. The top valve H is similar to the bottom one, and is fitted into a seating bored in the pump body B. It is prevented from rising too high by means of a bored shoulder in the casting J, and over this comes the flange K, of brazing metal, carrying the feed-pipe L, going to the check-valve. These three parts are also bolted together similarly to the lower ones.

The feed-pipe L, on leaving the pump, is curved suitably to clear the eccentric rods and the boiler, and then is attached to the check-valve casing M by means of a flange, N. The check-valve O is like the pump-valve, and is contained in a casing designed to give just the necessary lift, and provided with flanges for bolting to the boiler. Of course, it is not like any ordinary check-valve, but is made to fulfil the purposes of the model only.

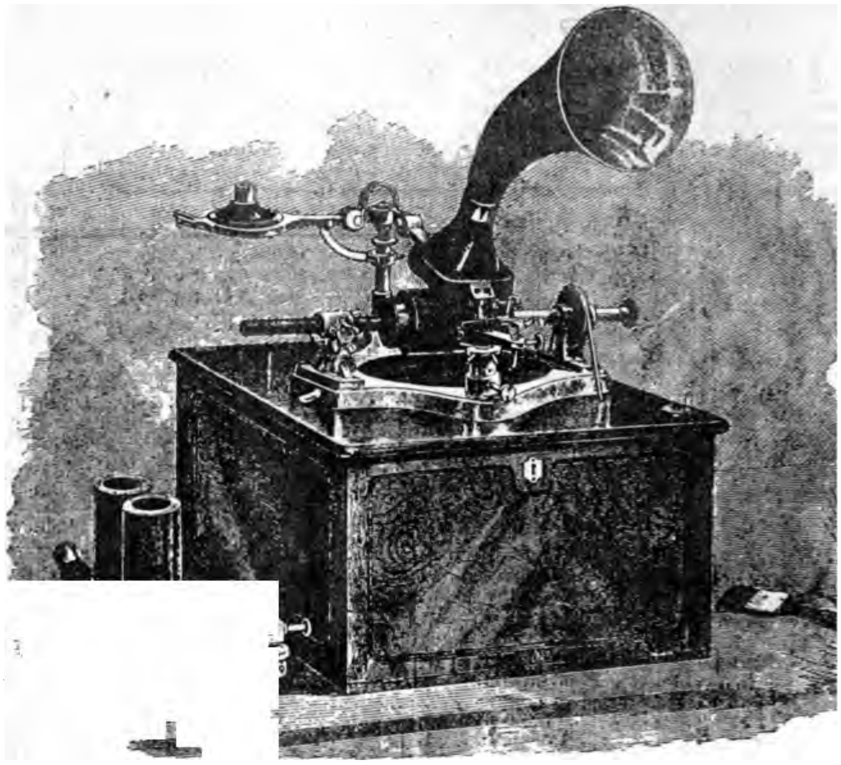
The eccentric sheave P has a radius of $\frac{5}{16}$in., and is fitted on the driving axle. The straps Q and R are checked over the sheave as in ordinary valve eccentrics. The half Q is forked to fit over the ram, to which it is secured with a pin and split pin.

As mentioned in the first article of this series, I now propose to describe one—perhaps two—very simple models, in which there will be no attempt to follow shop practice, even in appearance, but only amateur work. After this, a tender or two will conclude the series. **J. H.**

## THE NEW MICROGRAPHOPHONE.

SINCE the year 1887, when Edison gave to the world that remarkable instrument the phonograph, there has been a great deal of research in the direction suggested by this discovery, and many forms of apparatus have been devised for recording and reproducing sound. One of the most interesting of these inventions is the graphophone, commonly attributed to the genius of Edison, but really worked out by Mr. Sumner Tainter, in conjunction with Prof. Graham Bell and Dr. Chichester Bell. Our readers have always been interested in the development of these speaking machines, hence we call attention to a recent improvement in them, which is due to Gianni Bettini, a lieutenant in the Italian navy.

The various forms of phonograph have been justly considered to possess, at least, two defects, which seriously interfere with their practical application to the requirements of life. In the first place, the quality of the sounds transmitted by them is not of the same order as that of the sounds confided to them. The reproduced sounds are thin; they lack *timbre* and are "punchinello-like";—this defect has been found very difficult to improve away. Again, the amplitude of the sound-waves emitted by phonographic or graphophonic instruments is so feeble that, unless suitable acoustic appliances are attached to the embouchure, it is impossible that the sounds can be distinguished by many listeners. Although strenuous efforts have recently been made in the laboratories of Edison to produce perfectly-acting models, it remains a fact that the former (and, to some extent, the latter) of these general defects still remain.



According to Bettini, the reason for this may be found in the fact that an important acoustic principle has been overlooked. It has not been fully recognised that the sensitive diaphragm, which is an important feature in every variety of phonographic instrument, does not vibrate in a simple manner: it breaks into nodal and ventral segments or areas, and, in fact, behaves in a manner which is comparable to the behaviour of stretched strings, organ-pipes, &c. The vibration of a diaphragm is not a simple oscillation to-and-fro, but a complex movement. Unless, then, due regard be paid to the character of the vibrations produced by the diaphragm, and unless the style which is attached to it be adjusted in the proper way, all sorts of interferences will be set up, partial vibrations will be superimposed upon primary vibrations, and the result will be a deterioration in the quality and in the intensity of the reproduced sound.

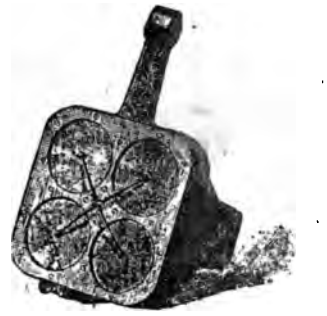


Fig. 1

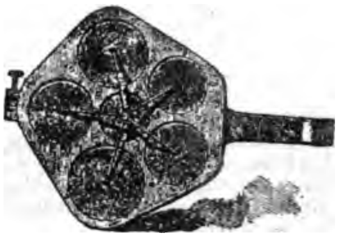


Fig. 2

That a diaphragm (whether it be a thin sheet of metal or a membrane) behaves in a complex manner may be readily demonstrated by strewing its surface, when placed horizontally, with fine
sand, silica, or lycopodium powder, setti
vibration. It will then be observed how t
or powder will be arranged in little heaps or
whilst some areas will be left practically c

Bettini has specially undertaken the
remedying the loss of quality or timbre. 
his new instrument the micrographopho
is the outcome of much patient experi
work, in which attention was chiefly dire
the character of the most suitable form
phragm.

In appearance the micrographophone d
differ much from the ordinary Edisonian
graph, and it is worked upon the same
principle. There is the usual wax-coated
der, capable of a movement which is at
revolution and a translation. A metalli
attached to the diaphragm, which vibrate
sounds, cuts its way into the surface of t

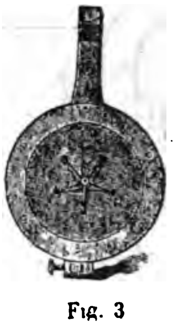


Fig. 3

Fig. 4

and records these sounds. There is noth
in this method of recording and repr
sounds. The essential point of difference
Bettini's instrument and those of prev
ventors exists in the character of the dia
this has been considerably modified.

Bettini has found that when a style is
to the centre of a circular diaphragm, i
the vibration of this central area that it
to. Now, since the whole diaphragm is
by the sound-waves which are received,
reasonable to suppose that it would be
to employ the whole area. But the vib
the diaphragm at different points of it
varies. These are *loci* where the vibrati
maximum; others where it is at a m
hence it would appear desirable to ascert
*loci*, and to attach the style in such a
it may be set in motion by the most
able parts of the diaphragm.

After a great deal of labour Bettini
ceeded in devising certain forms of di

culiar form of style in which the prin- ich we have just been describing has rked up.

is a complex diaphragm in which there ral small membranes of equal area suit- anged. To the centre of each of these embranes is attached an end of a branch- e, the character of which can be best od, without further description, by a t Fig. 1. By this artifice many of the rence effects" are avoided, and the and intensity of the reproduced sound is tter than if a simple membrane with a y-adjusted style were employed.

her improvement now suggested itself ventor. Instead of having the membranes omplex diaphragm of equal area, they de of different sizes, so that each would to some special characteristic in the ceived. These were then connected as y a branching style, and the result was a ter success. This form of diaphragm is a Fig. 2.

ght be thought that such a complex nent as that of a branching style attached ing membranes of equal or unequal area, fect the proper registration of sound; fear is not realised—the registration is t as in the simple case of a single mem- th a centrally-attached style.

d other modifications of the original idea n worked out by Bettini with, it is said, access. He has manufactured simple ms, and estimated the exact *loci* upon which the vibrations are most intense. *loci* the ends of the branching style are . In Fig. 3 the arms of the style are to those arms in the diaphragm at e vibrations are of the greatest ampli-

. 4 the so-called "neutral zones," sepa- the alternate "nodal zones," have been s *loci* of attachment for the ends of the the style.

neral view of the whole apparatus is a Fig. 5 A noticeable feature in this s the acoustic embouchure. The dia- which are shown in Figs. 1, 2, 3, and ; by any means represent all the possible . which the acoustic principle may be l; they are merely given as types. arrangements appear to be best adapted in particular kinds of sound. Thus, more suitable for registering and re- g the sound of the human voice; others for dealing with instrumental music, a. Bettini proposes, when he has com- s researches to his own satisfaction, to t of diaphragms with each instrument. ill be labelled for particular purposes, be capable of easy adjustment even inexperienced hands.

**J. T. N.**

## MENTING GLASS, WOOD, &c.

following method of ornamenting glass, od, and other solid substances forms the f a patent granted to Messrs. J. and S. of Ramsbottom, Lancaster, the object produce a new ornamental material is applicable for windows, screens, . and other blinds, panels, and other urposes. According to the invention the print upon one side, or preferably upon es, of the glass, wood, or other material designs in one or more colours by the ; means:—For printing identical pat- on both sides of the glass or other solid they mount upon a frame, suitably ed, two ordinary copper rollers (prefer- he same plane, but some distance apart), llers, if the material is transparent, as or example, are specially engraved for printing. In contact with these rollers they mount two cylinders which ed with a soft and elastic substance such rubber, or a composition of glue and , or other similar substance. These revolve in contact with the two en- rollers; they work together touching er, or nearly so, in the centre, and the other transparent material or substance rinted upon, passes between them in with both. The engraved copper rollers ied with colour and cleaned in the ordi- nner, and all the rollers are adjustable ed together as usual, in such a manner ir surfaces run together with absolute accuracy. The composition, or "transfer" cylinders running in contact with the engraved copper rollers receive the colour therefrom, and this impression is transferred from their surfaces to both sides of the glass or other material at the same time (and exactly at the same places) as it passes between them. If the material or substance to be printed upon is not transparent, then there is no necessity for engraving the same pattern upon both rollers; but they may be of different patterns, and if the pattern is required upon one side only, then only one engraved roller will be necessary. Suitable arrangements are made for washing and drying the composition or "transfer" rollers after they have given their impression, so as to present a clean surface to the engraved copper rollers at each revolution.

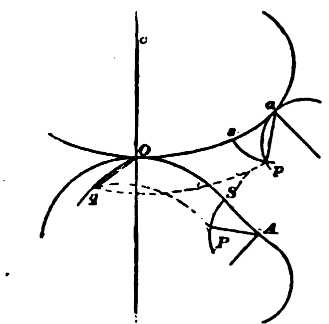
## ODONTICS, OR THE THEORY AND PRACTICE OF THE TEETH OF GEARS.—XIII.*

### Non-Circular Pitch Lines.

THE consideration of pitch lines that are not circular, and of the teeth that are fitted for them, is an interesting but not particularly important branch of odontics. Such pitch lines are largely used for producing variations of speed and power, but have no other practical applications.

### The Irregular Pitch Line.

The most general case is that of two indefinite irregular curves rolling together (Fig. 107), the only condition being that they shall be so shaped that they will roll together continuously.



'rregular pitch lines

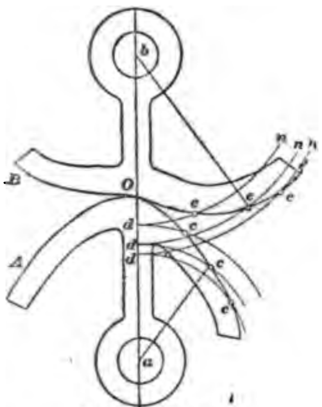
*Fig. 107.*

As the practical importance of the free pitch line is very small, we shall not examine it in detail.

### Pitch Lines on Fixed Centres.

When we attach the condition that the two pitch lines shall revolve in rolling contact on fixed centres, we have a definite problem of more interest and importance than that of the free pitch line.

If, as in Fig. 108, we have a pitch line, A, revolving upon a fixed centre, *a*, we can construct a pitch line, B, that will roll with it, and revolve on the given fixed centre *b*, by the following process.



Fixed centers

*Fig. 108.*

From any pitch point, O, step off equal arcs O*c*, *cc*, *cc*; draw circular arcs *cd* from the centre *a*; draw circular arcs *dn* from the centre *b*; step off the same equal arcs O*e*, *ee*, *ce*, then O*eee* will be the required mating pitch line.

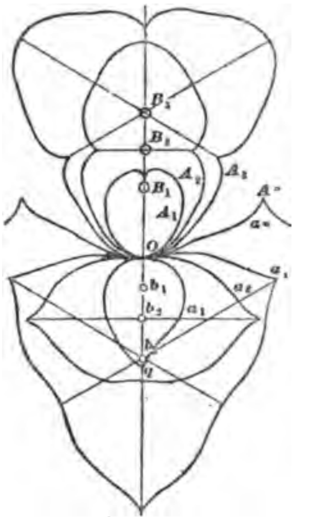
These curves will always be in rolling contact at a point on the line of centres *ab*, the pitch point and the angle of the curves with the lines of centres continually changing.

The velocity ratio of the curves will be variable, and always equal to the inverse proportion of any two mating radiants, *ac* and *bc*.

### Closed Pitch Lines.

When one of the curves of Fig. 108 is a closed curve, the other will in general not be closed, but by trying different centres, a curve can be found that will be closed.

If the closed curve $a_1$, Fig. 109, is taken, the mating curve $A_1$ will be closed when the centre is chosen at a certain point $B_1$, that can be found by repeated trials.



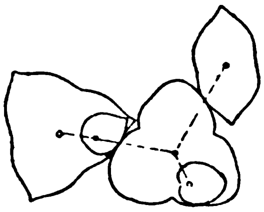
Set of Multilobes

*Fig. 109.*

The mating closed curves thus constructed will seldom be alike, but will always have points of similarity. A salient point, *q*, on one will be paired with a reversed point or notch on the other, and lobes on one will be represented by depressions on the other. Half a revolution of one of the curves from any position will turn the other through half a revolution.

### Multilobes.

If, after finding the centre $B_1$, Fig. 109, for the closed mating curve, other centres are tried, second, third, and succeeding centres, $B_2$, $B_3$, $B_4$, will be found, about which the mating curves will also be closed.



Train of multilobes

*Fig. 110.*

These closed curves, called multilobes, will be each divided into like lobes, the second curve, or bilobe, into two lobes; the third, or trilobe, into three lobes, and so on.

If the centre is placed at infinity, the rack lobe $A_\infty$ will be formed.

If the centre be taken negatively, on the same side as the original centre $b_1$, at $b_2$, $b_3$, $b_4$, &c., negative multilobes $a_2$, $a_3$, $a_4$, &c., will be formed about the original curve $a_1$.

All these multilobes, positive and negative, will roll together collectively about their fixed centres, in rolling contact at a common and shifting pitch point O.

Any two, of the same sign, will roll in internal contact, and any two of opposite signs will roll in external contact, so that they can be formed in train, Fig. 110.

When it so happens, as it does with the ellipse revolving on its focus, or the logarithmic spiral revolving on its pole, is taken, that the first derived pair of curves, or unilobes, are exactly alike, all the multilobes will be alike; the positive trilobe like the negative trilobe, and so on, so that any two curves of such a set will work together in either internal or external contact, Fig. 111.

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* By Geo. B. Grant, in *American Machinist.*

### Conic Section Pitch Lines.

If two like conic sections are mounted upon their foci, they will roll together.

Their free foci will revolve at a fixed distance from each other, and may be connected by a link. The line of the free foci will intersect the line of the fixed foci at the point of contact of the pitch lines.

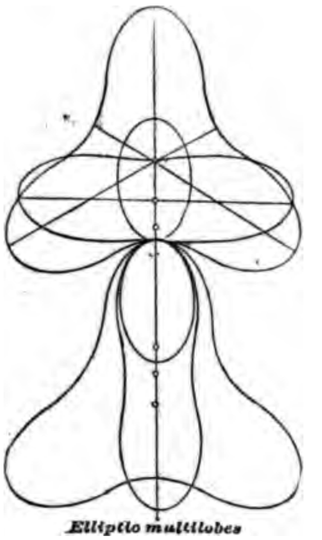
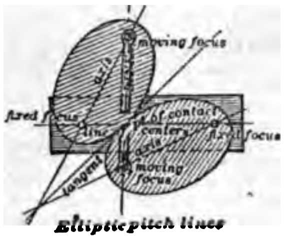

Elliptic multilobes
*Fig. 111.*

Fig. 112 shows a pair of ellipses, Fig. 113 a pair of parabolas, and Fig. 114 a pair of hyperbolas.

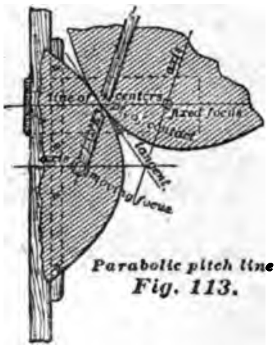


Elliptic pitch lines
*Fig 112.*

The elliptic pitch line is the only one known that will revolve with its equal, and make a practical and complete revolution.

### The Logarithmic Spiral.

If the radiants *a*, *b*, *c*, *d*, *e*, Fig. 115, make equal angles with each other, and each one is equal to the adjacent one multiplied by a constant number, their extremities will determine a logarithmic spiral.



Parabolic pitch lines
*Fig. 113.*

If the first radiant *a* is given, with the constant multiplier *n*, the second radiant will be *na*, the third will be $n^2 a$, the fourth will be $n^3 a$, and so on.

If the first and last radiants, *a* and *e* are given, and there are *p* equal angles between them, the constant is

$$n = \sqrt[p]{\frac{e}{a}}$$

so that it is a simple matter to construct a logarithmic spiral to connect any two given radiants at any given angle with each other.

The curve possesses the singular property that all tangents, A or E, make the same angle with the radiants at their points of contact. The curves are always inclined to the line of centres at the constant angle.

The curve continually approaches the centre M, or "pole," making an infinite number of turns about it, but never reaching it.

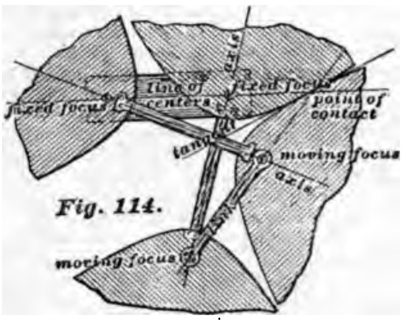


*Fig. 114.*
Hyperbolic pitch lines

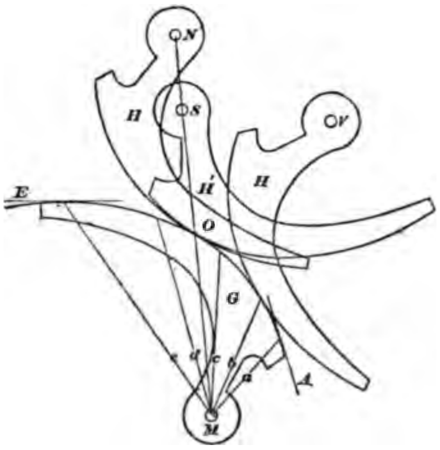
It has also the entirely useless property that the pole will trace an involute of the base circle if it is rolled upon the pitch circle (75).

It possesses the property not possessed by any other curve, that it will roll with an equal mate on fixed centres that can be varied in position. The curve H will roll with the curve C, whether its pole is at N, or at S, or at V.

Fig. 116 shows a pair of logarithmic spirals in internal contact.

### Composite Pitch Lines

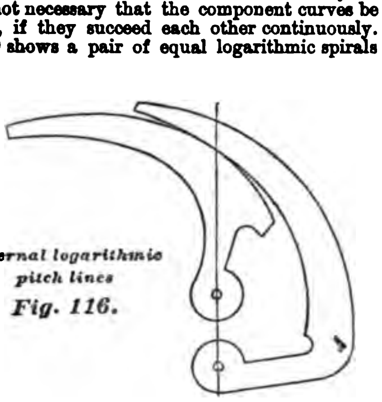
Instead of drawing a curve at random, and finding the mate to run with it, Fig. 108, the complete pitch line may be built up of a number of curves, of which the properties are known.



Logarithmic pitch lines
*Fig. 115.*

Thus, Fig. 117 shows composite gears, consisting of circular parts A and *a*, and an elliptic trilobe B, working with an elliptic bilobe *b*. Fig. 118 shows a combination of a pair of logarithmic spiral arcs A and *a*, a pair of elliptic bilobal arcs B and *b*, a pair of logarithmic spiral arcs D and *d*, and a pair of elliptic quadrilobal arcs E and *e*. An endless variety of combinations can be made in this way.

It is not necessary that the component curves be tangent, if they succeed each other continuously. Fig. 119 shows a pair of equal logarithmic spirals with a break at *ab*, the action at *b* commencing just as it ends at *a*.

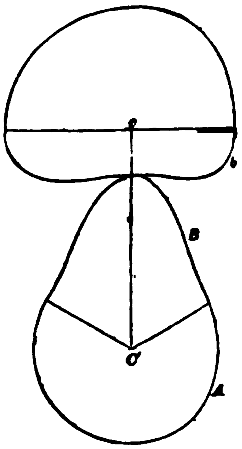

Internal logarithmic pitch lines
*Fig. 116.*

Care should be taken to avoid salient points, breaks, and interruptions of the continuity of the curve, for there must be defective tooth action at such points. The curves should run
each other with gradual changes of cur

### Teeth of Non-Circular Pitch

The action of the teeth of non-ci
lines does not, at first sight, appear to
laws pertaining to circular lines; but th
very little difference.

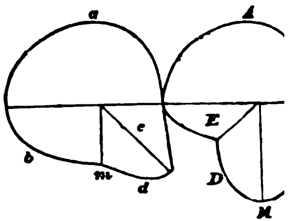
If we consider the two pitch lines to b



Composite pitch lines
*Fig. 117.*

to be so moved while they roll togeth
pitch point O, Fig. 107, is fixed, and
fixed line *c* C is always at right ang
curves at their common point O, the
tooth action will be almost precisely
laid down for the circular pitch line. F
be easily applied, as illustrated by Fig.

When the centres are fixed, the same



Composite pitch lines
*Fig. 118.*

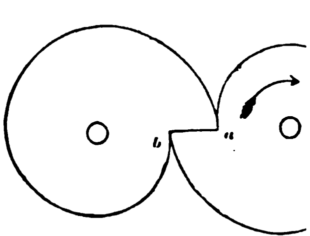
takes place, but the line of action a
point continually change their positions

The teeth of non-circular pitch lin
fore be formed either by conjugati
odontoid, or by the rolled curve theory

By all means the most practicable m
the circumstances will permit, is to
curve by joining approximating circu
to provide each circular arc with
ordinary way. See this process as ap
elliptic pitch line [to follow].

### Teeth at Salient Points and

When there is a salient point, or oth
tion of the continuity of the action, as a



Broken pitch lines
*Fig. 119.*

or at *Mm*, Fig. 118, there must be an
in the arrangement of the normals
curve, and a consequent failure of the

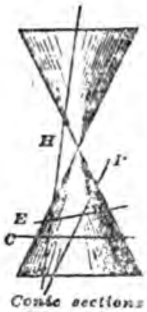
Fig. 120 shows a cycloidal tooth c
corner or salient point S, between two
arcs. There is a circular arc A on
made while the describing circle is t
the point S, and that arc can have r
tooth action. Therefore the tooth ac
unless the next tooth curve N spri
salient point.

springs from the salient point, the tooth ›e correct, but mechanically imperfect, ' action of two teeth cannot lap over each ›w for practical defects. And then, as ırves cannot spring from the same pitch ›osite directions, such gears can run in ›ction, and are not reversible. ›re is a break, as at *ab*, Fig. 119, the be so cut off that they will separate at *a* engage at *b*, for there is a sudden change ity ratio. Such combinations are prac- in every way undesirable.

### The Elliptic Gear.

cipal, and almost the only use of the ear, is to produce a variation of speed tain given limits, without conditions as tions of speed and details of the motion limits. When that is the only object, ›itch line is the only one that is required, ›sen because it is the only known con- ›ed curve that will work in rolling con- ı equal mate, and because it is, next to

alient point
ig. 120.



Conic sections
Fig. 121.

ıe simplest known curve. Of the elliptic the unilobe, or simple ellipse, revolving s foci as a centre, is the only one used to iable extent, and therefore is the only quires examination in detail. ›f the elliptic gear is practically confined g a simple variation of speed between its, and to producing a "quick return r planers, shapers, slotters, and similar s, as well as for pumps, shears, punches, hines, and others where the work is done ng one-half of the stroke of a recipro- :. The work of a planer tool or of the ı single acting pump, is all done during of the tool, or of the plunger in one ınd the only object on the return is to e ready for the next useful operation in t possible time. ample, the bobbin of a spinning machine und in a conical form, the thread being ough a moving guide, and the necessary otion of the guide, fast at the point of ıd slow at its base, is best given to it by liptic gears. For another example, the he platen of a printing-press should be the press is open, and slow and power- he impression is being taken, and the be reached best by a pair of elliptic gears ıe platen. tical uses of the elliptic gear are endless, d be in greater use and favour if it were fact that its production, by the means n use for that purpose, is as difficult and e resulting gear is unsatisfactory.

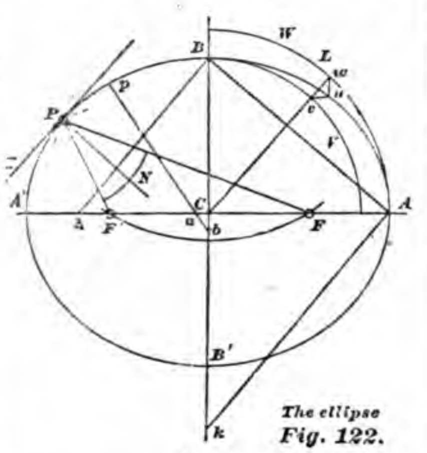
### The Ellipse.

ughly understand the construction and f the ellipse, it is necessary to learn but many properties. ıanical definition of the ellipse is that it e "conic sections." If the cone, Fig. by a plane C at right angles with its tline of the section will be a circle; if cuts the cone at an angle, the section ellipse; if the plane P is parallel with he cone, the section is a parabola, and H is at such an angle that it cuts both ıe cone, the section is a hyperbola. All s will roll together when fixed on centres oints called foci, but the ellipse, and its , the circle, are the only ones that are ontinuous motion. ipse, Fig. 122, the point C is the centre, diameter, AA′, is the major axis, the meter, BB′, is the minor axis; A and A′ or apices, and B and B′ are the minor

be drawn from the minor apex, with a l to the major semi-axis, it will cut the ıt points F and F, called the foci, and ust be chosen as the centre, about which to revolve if used as the pitch line of a

›perty of the curve that the sum of the distances, PF and PF′, from any point to the foci is equal to the major axis, AA′, and this feature is used as a means of constructing the curve by points. Draw any arc at random from one focus with radius FP. Draw an arc from the other focus with a radius equal to AA′—FP, and it will cut the first arc at a point of the ellipse. When the point P is near either major apex, the arcs intersect at such a sharp angle that the method is nearly useless.

Another, and much the best known method for constructing the ellipse by points, is to draw any radial line L, and also circular arcs W and V, from the centre through the apices. From the intersections, *w* and *v*, of the radial line and the circles, draw lines parallel to the axes, and they will intersect, always at right angles, at a point *u* on the curve. This method is very accurate, and has no failing position.



The ellipse
Fig. 122.

Another valuable property of the ellipse is that if the line *pab* be so drawn that the distance *pa* is equal to BC, and *pb* to AC, the point *p* will be upon the curve if the points *a* and *b* are upon the axes.

The curvature of the ellipse is an important feature in connection with its use as a gear pitch line. It is sharpest at the major axis A, and flattest at the minor apex B, elsewhere varying between the two limits.

The radius of curvature at either apex—that is, the radius of the circle that most nearly coincides with the curve, is found by drawing the lines B*h* and A*k* at right angles with the chord AB. The distance C*h* is the radius of curvature at the major apex A, and the distance C*k* is the radius at the minor apex B.

The normal PN to the curve at any point P bisects the angle FPF′ between the focal lines, and the tangent PT is at right angles to the normal.

## THE ELECTRO-MAGNET.—IX.*

### Pole-Pieces on Horseshoe Magnets.

ANOTHER of Du Moncel's researches relates to the effect of polar projections or shoes—movable pole-pieces, if you like—upon a horseshoe electromagnet. The core of this magnet was of round iron 4 centimètres in diameter, and the parallel limbs were 10 centimètres long and 6 centimètres apart. The shoes consisted of two flat pieces of iron slotted out at one end, so that they could be slid along over the poles and brought nearer together. The attraction exerted on a flat armature across air gaps 2 millimètres thick was measured by counterpoising. Exciting this electro-magnet with a certain battery, it was found that the attraction was greatest when the shoes were pushed to about 15 millimètres, or about ¼ of the inter-polar distance, apart. The numbers were as follows:—

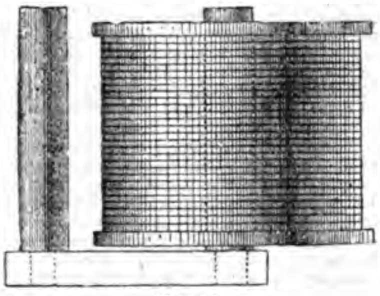


FIG. 24.

| Distance between shoes. Millimètres. | Attraction, in grammes. |
|---|---|
| 2 | 900 |
| 10 | 1,012 |
| 15 | 1,025 |
| 25 | 965 |
| 40 | 890 |
| 60 | 550 |

With a stronger battery the magnet without shoes had an attraction of 885 grammes, but with the shoes 15 millimètres apart, 1,195 grammes, When one pole only was employed, the attraction, which was 88 grammes without a shoe, was *diminished* by adding a shoe to 39 grammes!

### Contrast between Electro-magnets and Permanent Magnets.

Now, I want particularly to ask you to guard against the idea that all these results obtained from electro-magnets are equally applicable to permanent magnets of steel; they are not, for this simple reason. With an electro-magnet; when you put the armature near, and make the magnetic circuit better, you not only get more magnetic lines going through that armature, but you get more magnetic lines going through the whole of the iron. You get more magnetic lines round the bend when you put an armature on to the poles, because you have a magnetic circuit of less reluctance, with the same external magnetising power in the coils acting around it. Therefore, in that case, you will have a greater magnetic flux all the way round. The data obtained with the electro-magnet with the exploring coil C on the bend of the core, when the armature was in contact, and when it was removed, are most significant. When the armature was present it multiplied the total magnetic flow tenfold for weak currents, and nearly threefold for strong currents. But with a steel horseshoe, magnetised once for all, the magnetic lines that flow around the bend of the steel are a fixed quantity, and however much you diminish the reluctance of the magnetic circuit, you do not create or evoke any more. When the armature is away the magnetic lines arch across, not at the ends of the horseshoe only, but from its flanks; the whole of the magnetic lines leaking somehow across the space. When you have put the armature on these lines, instead of arching out into space as freely as they did, pass for the most part along the steel limbs and through the iron armature. You may still have a considerable amount of leakage, but you have not made one line more go through the bent part. You have absolutely the same number going

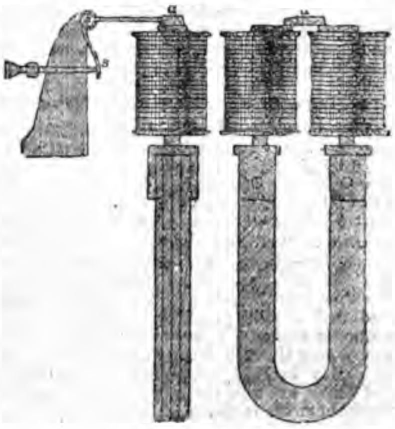


FIG. 25.

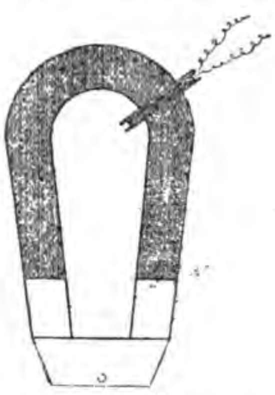


FIG. 26.

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* Extracted from the Cantor Lectures delivered by Prof. SILVANUS P. THOMPSON, B.Sc., before the Society of Arts.

through the bend with the armature off as with the armature on. You do not add to the total number by reducing the magnetic reluctance, because you are not working under the influence of a constantly impressed magnetising force. By putting the armature on to a steel horseshoe magnet you only *collect* the magnetic lines, you do not *multiply* them. This is not a matter of conjecture. A group of my students have been making experiments in the following way. They took this large steel horseshoe magnet (Fig. 26), the length of which from end to end through the steel is 42½in. A light narrow frame was constructed so that it could be slipped on over the magnet, and on it were wound 30 turns of fine wire, to serve as an exploring coil. The ends of this coil were carried to a distant part of the laboratory, and connected to a sensitive ballistic galvanometer. The mode of experimenting is as follows:—The coil is slipped on over the magnet (or over the armature) to any desired position. The armature of the magnet is placed gently upon the poles, and time enough is allowed to elapse for the galvanometer needle to settle to zero. The armature is then suddenly detached. The first swing measures the change, due to removing the armature, in the number of magnetic lines that pass through the coil in the particular position.

### Electro-Magnets for Maximum Tractions.

These have already been dealt with in the preceding lecture; the characteristic feature of all the forms suitable for traction being the compact magnetic circuit. Several times it has been proposed to increase the power of electro-magnets by constructing them with intermediate masses of iron between the central core and the outside, between the layers of windings. All these constructions are founded on fallacies. Such iron is far better placed either right inside the coils or right outside them, so that it may properly constitute a part of the magnetic circuit. The construction known as Camacho's and Cance's, and one patented by Mr. S. A. Varley in 1877, belonging to this delusive order of ideas, are now entirely obsolete. Another construction which is periodically brought forward as a novelty is the use of iron windings of wire or strip in place of copper winding. The lower electric conductivity of iron, as compared with copper makes such a construction wasteful of exciting power. To apply equal magnetising power by means of an iron coil implies the expenditure of about six times as many watts as need be expended if the coil is of copper.

### Electro-Magnets for Maximum Range of Attraction.

We have already laid down the principle which will enable us to design electromagnets to act at a distance. We want our magnet to project, as it were, its force across the greatest length of air-gap. Clearly, then, such a magnet must have a very large magnetising power, with many ampère-rurns upon it, to be able to make the required number of magnetic lines pass across the air resistance. Also it is clear that the poles must not be too close together for its work; otherwise the magnetic lines at one pole will be likely to curl round and take short cuts to the other pole. There must be a wider width between the poles than is desirable in electro-magnets for traction.

### Electro-Magnets of Minimum Weight.

In designing an apparatus to put on board a boat or a balloon, where weight is a consideration of primary importance, there is again a difference. There are three things that come into play—iron, copper, and electric current. The current weighs nothing, therefore if you are going to sacrifice everything else to weight, you may have comparatively little iron, but you must have enough copper to be able to carry the electric current; and under such circumstances you must not mind heating your wires nearly red hot to pass the biggest possible current. Provide as little copper as you conveniently can, sacrificing economy in that case to the attainment of your object; but of course you must use fireproof material, such as asbestos, for insulating, instead of cotton or silk.

### A Useful Guiding Principle.

In all cases of design there is one leading principle which will be found of great assistance—namely, that a magnet always tends so to act as though it tried to diminish the length of its magnetic circuit. It tries to grow more compact. This is the reverse of that which holds good with an electric current. The electric circuit always tries to enlarge itself, so as to inclose as much space as possible, but the magnetic circuit always tries to make itself as compact as possible. Armatures are drawn in as near as can be, to close up the magnetic circuit. Many two-pole electro-magnets show a tendency to bend together when the current is turned on. One form in particular, which was devised by Ruhmkorff for the purpose of repeating Faraday's celebrated experiment on the magnetic rotation of polarised light, is liable to this defect. Indeed, this form of electro-magnet is often designed very badly, the yoke being too thin, both mechanically and magnetically, for the purpose which it has to fulfil.

Here is a small electric bell, constructed by Wagener of Wiesbaden, the construction of which illustrates this principle. The electro-magnet, a horseshoe, lies horizontally; its poles are provided with protruding curved pins of brass. Through the armature are drilled two holes, so that it can be hung upon the two brass pins; and when so hung up it touches the ends of the iron cores just at one edge, being held from more perfect contact by a spring. There is no complete gap, therefore, in the magnetic circuit. When the current comes and applies a magnetising power, it finds the magnetic circuit already complete in the sense that there are no absolute gaps. But the circuit can be bettered by tilting the armature to bring it flat against the polar ends, that being indeed the mode of motion. This is a most reliable and sensitive pattern of bell.

*Electro-magnet Popgun.*—Here is another curious illustration of the tendency to complete the magnetic circuit. Here is a tubular electro-magnet (Fig. 27), consisting of a small bobbin, the core of which is an iron tube about 2in. long. There is nothing very unusual about it; it will stick on, as you see, to pieces of iron when the current is turned on. It clearly is an ordinary electro-magnet in that respect. Now suppose I take a little round rod of iron, about 1in. long, and put it into the end of the tube, what will happen when I turn on my current? In this apparatus as it stands, the magnetic circuit consists of a short length of iron, and then all the rest is air. Tne magnetic circuit will try to repeat itself, not by shortening the iron, but by lengthening it—by pushing the piece of iron out so as to afford more surface for leakage. That is exactly what happens; for when I turn on the current the little piece of iron shoots out and drops down. That little piece of iron shoots out with considerable force. It becomes a sort of magnetic popgun.

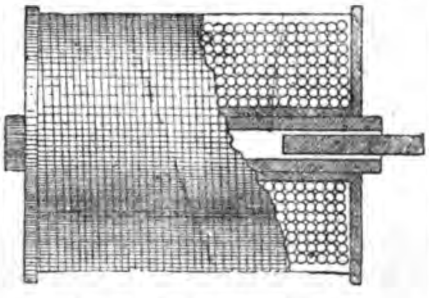


FIG. 27—Electro-magnet Popgun.

### Electro-Magnets for Use with Alternating Currents.

When you are designing electro-magnets for use with alternating currents, it is necessary to make a change in one respect—namely, you must so laminate the iron that internal eddy-currents shall not occur; indeed, for all rapid-acting electro-magnetic apparatus it is a good rule that the iron must be solid. It is not usual with telegraphic instruments to laminate them by making up the core of bundles of iron plates or wires, but they are often made with tubular cores, that is to say, the cylindrical iron core is drilled with a hole down the middle, and the tube so formed is slit with a saw-cut to prevent the circulation of currents in the substance of the tube. Now, when electro-magnets are to be employed with rapidly alternating currents, such as are used for electric lighting, the frequency of the alternations being usually about 100 periods per second, slitting the cores is insufficient to guard against eddy-currents; nothing short of completely laminating the cores is a satisfactory remedy. I have here, thanks to the Brush Electric Engineering Company, an electro-magnet of the special form that is used in the Brush arc lamp when required for the purpose of working in an alternating-current circuit. It has two bobbins that are screwed up against the top of an iron box at the head of the lamp. The iron slab serves as a kind of yoke to carry the magnetism across the top. There are no fixed cores in the bobbins, which are entered by the ends of a pair of yoked plungers. Now, in the ordinary Brush lamp for use witn a steady current, the plungers are simply two round pieces of iron tapped into a common yoke; but for alternate-current working this construction must not be used, and instead a U-shaped double plunger is used, made up of laminated iron, riveted together. Of course it is no novelty to use a laminated core; that device, first used by Joule, and then by Cowper, has been re-patented rather too often during the past fifty years to be considered as a recent invention.

The alternate rapid reversals of the magnetism in the magnetic field of an electro-magnet, when excited by alternating electric currents, sets up eddy-currents in every piece of undivided metal within range. All frames, bobbin tubes, bobbin ends, and the like, must be most carefully slit; otherwise they will overheat. If a domestic flat-iron is placed on the top of the poles of a properly laminated electro-magnet, supplied with alternating currents, the flat-iron is speedily heated up by the eddy-currents that are generated internally within it. The eddy-currents set up by induction in neighbouring masses of metal, especially in good conducting metals, such as copper, give rise to many curious phenomena. For example, a copper disc or copper ring placed over the pole of a straight electro-magnet so excited is violently repelled. These remarkable phenomena have been recently investigated by Prof. Elihu Thomson. He rightly attributes many of the repulsion phenomena to the lag in phase of the alternating currents thus induced in the conducting metal. The electro-magnetic inertia, or self-inductive property of the electric circuit, causes the currents to rise and fall later in time than the electro-motive forces by which they are occasioned. In all such cases the impedance which the circuit offers is made up of two things—resistance and inductance. Both these causes tend to diminish the amount of current that flows, and the inductance also tends to delay the flow.

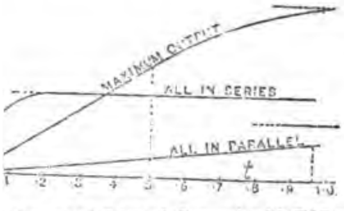
### Connecting Coils for Quickest Action.

Take the case of an electro-magnet forming some part of the receiving apparatus of a telegraph system, in which it is desired to secure very rapid working. Suppose the two coils that are wound upon the horseshoe core are connected together in series. The co-efficient of self-induction for these two is four times as great as that of either separately; co-efficients of self-induction being proportional to the square of the number of turns of wire that surround a given core. Now if the two coils, instead of being put in series, are put in parallel, the co-efficient of self-induction will be reduced to the same value as if there were only one coil, because half the line current (which is practically unaltered) will go through each coil. Hence the time constant of the circuit when the coils are in parallel will be a quarter of that which it is when the coils are in series; on the other hand, for a given line-current, the final magnetising power of the two coils in parallel is only half what it would be with the coil in series. The two lower curves in Fig. 54 illustrate this, from which it is at once plain that the magnetising power for very brief currents is greater when the two coils are put in parallel with one another than when they are joined in series.

Now this circumstance has been known for some time to telegraph engineers. It has been patented several times over. It has formed the theme of scientific papers, which have been read both in France and in England. The explanation generally given of the advantage of uniting the coils in parallel is, I think, fallacious; namely, that the "extra currents" (i.e., currents due to self-induction), set up in the two coils are induced in such directions as tend to help one another when the coils are in series, and to neuralise one another when they are in parallel. It is a fallacy, because in neither case do they neutralise one another. Whichever way the current flows to make the magnetism, it is opposed in the coils while the current is rising, and helped in the coils while the current is falling, by the so-called extra currents. If the current is rising in both coils at the same moment, then whether the coils or in series are in parallel, the effect of self-induction is to retard the rise of the current. The advantage of parallel grouping is simply that it reduces the time-constant.

### Battery Grouping for Quickest Action.

One may consider the question of grouping the battery cells from the same point of view. How does the need for rapid working, and the question of time-constant, affect the best mode of grouping the battery cells? The amateur's rule, which tells you to so arrange your battery that its internal resistance should be equal to the external resistance, gives you a result wholly wrong for rapid working. The supposed best arrangement will not give you (at the expense even of economy) the best result that might be got out of the given number of cells. Let us take an example and calculate it out, and place the results graphically before our eyes in the form of curves. Suppose the line and electro-magnet have together a resistance of 6 ohms, and that we have 24 small Daniell cells, each of electromotive-force, say, 1 volt, and of internal resistance, 4 ohms. Also let the coefficient of self-induction of the electro-magnet and circuit be 6 quadrants. When all the cells are in series the resistance of the battery will be 96 ohms, the total resistance of the circuit 102 ohms, and the full value of the current 0·235 ampère. When all the cells are in parallel the resistance of the battery will be 0·133 ohm, the total resistance 6·133 ohms, and the full value of the current 0·162 ampère. According to the amateur rule of grouping cells so that internal resistance equals external, we must arrange the cells in 4 parallels, each having 6 cells so that the internal resistance of the rill be 6 ohms, total resistance of circuit full value of current 0·5 ampère. Now sponding time-constants of the circuit in cases (calculated by dividing the co- of self-induction by the total resistance) spectively—in series, 0·06sec.; in parallel, grouped for maximum steady current, From these data we may now draw the ves, as in Fig. 28, wherein the abscissæ are



-Curves of Rise of Current with Different Groupings of Battery.

s of time in seconds, and the ordinates the The faint vertical dotted lines mark the stants in the three cases. It will be seen n rapid working is required the magnetising will rise, during short intervals of time, idly if all the cells are put in series, than if the cells are grouped according to the rule.

they are all put in series, so that the as a much greater resistance than the rest cuit, the current rises much more rapidly, of the smallness of the time-constant, it never attains the same ultimate maxi- when grouped in the other way. That is there is self-induction as well as resistance cuit, the amateur does not tell you the best rranging the battery. There is another regarding the matter which is helpful. ction, while the current is growing, acts as were a sort of spurious addition to the of the circuit; and while the current is ay it acts, of course, in the other way, as were a substraction from the resistance. you ought to arrange the battery so that the resistance is equal to the real resistance of it, plus the spurious resistance during that ut how much is the spurious resistance at time? It is a resistance proportional to that has elapsed since the current was 1. So then it comes to a question of the f time for which you want to work it. action of a second do you require your be given in? What is the rate of the of your electric bell? Suppose you have at point, and that the short time during current is required to rise is called *t*; apparent resistance at time *t* after the turned on is given by the formula:—

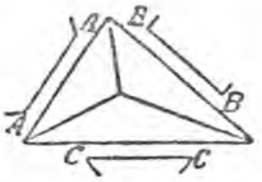
$$R_t = R \times e^{\frac{R}{L}t} \div \left( e^{\frac{R}{L}t} - 1 \right).$$

### Short Cores v. Long Cores.

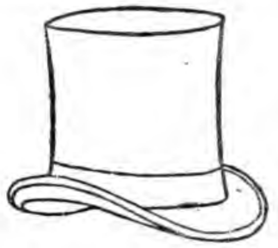
sidering the forms that are best for rapid ought to be mentioned that the effects of s in retarding changes in the magnetisation ores are much more noticeable in the case -closed magnetic circuits than in short Electro-magnets with iron armatures in across their poles will retain, after the as been cut off, a very large part of their m, even if the cores be of the softest of ut so soon as the armature is wrenched off etism disappears. An air-gap in a mag- uit always tends to hasten demagnetising. tic circuit composed of a long air-path and iron-path demagnetises itself much more han one composed of a short air-path and on-path. In long pieces of iron the mutual the various parts tends to keep in them netisation that they may possess; hence less readily demagnetised. In short pieces, ese mutual actions are feeble, or almost he magnetisation is less stable, and dis- almost instantly on the cessation of the ing force. Short bits and small spheres of e no "magnetic memory." Hence the the commonly received opinion amongst engineers that for rapid work electro- must have short cores. As we have seen, reason for employing long cores is to afford site length for winding the wire, which is for carrying the needful circulation of o force the magnetism across the air-gaps. e sake of rapidity of action, length has to ced, then the coils must be heaped up more n the short cores. The electro-magnets ican patterns of telegraphic apparatus ave shorter cores, and a relatively greater of winding upon them, than those of patterns.

## TWO PUZZLES FOR THE EYES.

IN the annexed engravings are two puzzles, which are calculated to test the ability of the eyes to measure lengths with approximate accuracy. The



first has straight lines only, and the puzzle is to guess, by eye-measurement only, which is the longest and which is the shortest of the three lines marked AA, BB, CC. In the other are curves for confusing the measurer. The puzzle is to look at the cut and, without measuring, say which is the greater distance—across the top of the hat, or



from top to bottom. Then put your own hat on the table, about a yard in front of you, and carefully reconsider the problem. When you have made up your mind, take a foot rule and measure your hat both ways.

## PROPORTIONS OF WEARING SURFACES.

SOME remarks on the best proportions of wearing surfaces having appeared in the *American Machinist*, Prof. John E. Sweet made some comments, in which he says that Mr. Wilfred Lewis' able treatment of the question of the proportions of wearing surfaces gives a width of the V to equal a flat, that is new to me, as I have no doubt it will be to many. In this connection, as a matter of interest, I wish to call attention to an unsatisfactory result that must have been noticed by all careful observers, and to suggest a remedy. In Fig. 1 is shown the lower point of a planer V, made in the usual way, and the same as shown by Mr. Lewis. Fig. 2 shows about how this point will appear when excessively worn, which, when it becomes necessary to refit, is objectionable. Fig. 3 shows a form that, assuming the material to be the same in each piece, will pretty effectually remedy it, I believe, no matter what the diverging angles may be, so that the vertical distances (*a* and *b*) be equal.

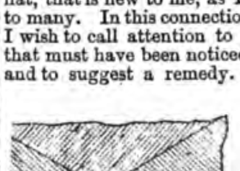


*Fig. 1.*

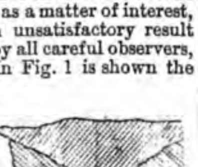


*Fig. 2.*

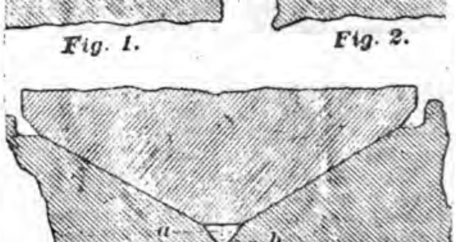


*Fig 3.*

In reply, Mr. T. A. Pandie wrote:—There is one point in relation to the question of the proportion of bearing surface to wear, which, I believe, has not been touched upon yet, and which, it seems to me, greatly complicates the problem of securing the proper proportions for any given case, by cutting away a portion of the surface as proposed by Prof. Sweet. How is it to be determined just where the most wear will take place in any given machine unless it is known just what it is to be used for?

It is very true that most lathe shears, for instance, are worn most near the head-stock, but there are exceptions to this rule. I have known lathes to be used mainly for turning short lengths at the end of long lengths of shafting, bringing the wear mostly near the other end of the bed. In another shop in which I worked, at one time there were some lathes which, so far as I know, were used exclusively for turning shafts of somewhat complicated form, that were always supported at the middle by the steady-rest, so that the shears were never used next the head-stock, except when centres were to be turned or something of that kind. The length of bed and the length of the shafts happened in this case to be so proportioned to each other that the wear was confined almost entirely to the middle of the bed.

I have known planers in which much the same thing happened, both with regard to the wear on the cross-rail and that on the platen slides. There are men who use the universal milling machine with the spiral head always in one position—*i.e.*, at the end of the platen, and where the machine is used in this way the wear of the slide, and of the screw by which the feeding is done, is confined mainly to a length of about 12in. from one end. But then there are other men who, having observed this tendency to wear in one place, correct it by using the head in different parts of the platen, and so distribute the wear as to greatly increase the length of time the machine can be run without overhauling. How can the builder of a tool tell how it is to be used, or for what purpose, and if he cannot tell this, how is he to proportion the bearing surface to wear, the proportions of which he does not know? Now, Prof. Sweet set up his traversing machine, and used it for a while, and by that means determined just where most wear would come on that machine when doing his work, and could then proportion the bearing surfaces accordingly; but could he proportion them on the same machine for some other man's work? He probably could for the majority of other men, but how about the minority, who would be worse off than if nothing had been done in that line, because the chances would be that the bearing surface would be cut away most just where they wanted to use them most? This would seem to indicate that while cutting away might be all right for the man to do who was to use the machine, and knew just how he was going to use it until it was worn out, it would hardly do for the manufacturer of the machine.

## USEFUL AND SCIENTIFIC NOTES.

A TABLE has been compiled showing what some American cities are paying the various companies for their electric lighting. Philadelphia and Boston pay the most, the former having paid the electric light companies in 1889 the sum of 164,780dols., or about £33,000. This was at the rate of 177dols. per light. New York pays at the rate of 90dols. per light, and in the same year paid 122,130dols., or £24,400. On the other hand, Lafayette, in Indiana, pays only 50dols. per light yearly, and Yonkers, New York State, pays 60dols. a year.

**Cost of Transmitting Power.**—The following comparisons of the cost of transmitting power by various methods appeared in the *Revue Universelle des Mines*: 1. Comparative cost on 10 E.H.P. transmitted 1,093 yards: By cables, 1·77; by electricity, 2·21; by hydraulics, 2·90; by compressed air, 2·98. 2. Comparative cost on 50H.P. transmitted 1,093 yards: By cables, 1·35; by hydraulics, 1·87; by electricity, 2·07; by compressed air, 2·29. 3. Comparative cost on 10 effective H.P. transmitted 5,465 yards: By electricity, 2·64; by compressed air, 4·66; by cables, 4·69; by hydraulics, 5·29. 4. Comparative cost on 50 effective H.P. transmitted 5,465 yards: By electricity, 2·37; by cables, 2·65; by compressed air, 2·99; by hydraulics, 3·02. Steam was the prime mover used in each of the above instances, and it appears that for long distances electricity takes the lead in economy over all other systems. It has also a great advantage in the facility with which the power may be subdivided.

**Rubber Emulsion.**—An American paper states that recent experiments show the interesting fact that Indiarubber may not only be kept emulsified by a borax solution, but may actually be dissolved in the same from the raw solid gum. If only an emulsion be desired, a solution of rubber in benzine or other hydrocarbon, to which a small portion of alcohol has been added, is mixed by vigorous agitation with a two-fifths saturated solution of borax, previously heated to from 120° to 140° Fahr., the agitation to be continued until the mixture has cooled down to the temperature of the air, or nearly so. It is found that not more than about 3·5 to 4·5 per cent. of rubber should be present in the fluid when finished, as any higher strength, if attempted, quickly separates, and in such cases sometimes the entire quantity coagulates when the separation once begins. It appears from these experiments that Ceara or Madagascar rubbers are the best for use in connection with borax solutions; even Para does not answer so well.

# SCIENTIFIC NEWS.

IT appears from a telegram to the editor of *Astronomische Nachrichten* that the authorities of Cape Town Observatory know nothing at all of the comet alleged to have been observed by Mr. Eddie, F.R.A.S., of Grahamstown, nor does it appear to have been seen by anyone else. Probably some error was made in the original message.

Dr. Berberich's ephemeris of Zona's comet for Berlin midnight on Jan. 6 reads R.A. 1h. 54m. 36s., N. Dec. 28° 32·8′. The brightness is only a third of that at time of discovery.

Prof. E. C. Pickering sends a communication to *Ast. Nach.* No. 3008 which may interest those who make a study of star spectra. The Rev. T. E. Espin announced the probable variability of D.M. + 33·470° in Wolsingham Circular No. 27, and Prof. Pickering says the spectrum is of III. type, bright hydrogen lines.

In the *Sidereal Messenger* for December, Mr. S. W. Burnham has a note on the place of Tychô Brahe's star, or what is known in the newspapers (as he puts it) as the "Star of Bethlehem." He has been examining, with the 36in. Lick telescope, the region about the point assigned by D'Arrest as the most probable place of the star, and he found one of the nearest Argelander stars —D.M. (63°) 48—to be a close double. The mean of three nights' measures gives P 31·9°; D 0·52″; mags. 9·2, 9·3, 1890·74. That is 2m. *f.* and 18′ north of the assigned place of the Tycho Brahe star. Another star differing but little in declination from D'Arrest's place, but farther following in R.A., was found with the 12in. (at the Lick Observatory) to be an unequal double, and measures on three nights with the 36in. give P 90·2°; D 1·66″; mags. 8·4, 11·3, 1890·74. That is D.M. (63°) 52, rated by Argelander as 8 mag. Mr. Burnham says that in future these stars may prove to be of some interest.

The news of the sad death of Prof. W. Lant Carpenter will have been read with regret by all who have listened to his lectures or benefited by his teaching. He will be missed by many.

The death is announced of Edward Sang, LL.D., a well-known mathematician, in his 86th year. The deceased gentleman, who was a native of Fife, studied at Edinburgh University under the late Prof. Leslie, whose assistant in the Natural Philosophy class he was for some time. Afterwards he held the appoinment of Professor of Mechanical Philosophy at Constantinople. He returned to Edinburgh on the outbreak of the Crimean War, and has resided there ever since, engaging in work of a literary and scientific nature. Mr. Sang was for many years secretary of the Royal Scottish Society of Arts, and to it and to the Royal Society of Edinburgh, and to other scientific bodies, he made many mathematical contributions.

Mr. Nathaniel Clayton, one of the original members of the firm of Clayton and Shuttleworth, Lincoln, died suddenly in his 79th year.

The death is announced of Mr. William John, the well-known naval architect, at the early age of 45 years. One of the first students of the Royal School of Naval Architecture, he entered the Construction Department of the Admiralty, and made the calculation for the first curves of stability. Afterwards he joined Lloyd's Register, and acted as scientific assistant to the chief surveyor. His treatise on "The Masting of Vessels," first brought out in the form of a report to the Committee of Lloyd's, is reckoned the standard authority on the subject, and has been officially translated into the languages of the leading maritime nations, and one of his most recent successes was the carrying off, in a competition open to the naval architects of the world, of the prize of 25,000dols. offered by the United States Government for a design for the war ship *Texas*, now building at Norfolk, Virginia. In 1881, Mr. John became general manager of the Barrow Shipbuilding and Engineering Company, and designed, amongst many others, those fine vessels the *City of Rome* and *La Normandie*.

The death of Gottlieb Stuber, the honorary president of the Swiss Alpine Club, will be noted with regret by more than the members of the Alpine clubs, for he had an almost complete topographical knowledge of Switzerland, and being as ready with pencil as with pen, his "Panorama von Bern" and his "Ueber Eis und Schnee" are consulted as standard works on the Swiss mountains and their climbers. Stuber was in his 87th year.

A captain of industry is dead in the person of Herr Auguste Klein, of Vienna, who did so much to promote, if he did not actually found, the manufacture of fancy articles in leather and bronze.

Mr. G. J. Symons, F.R.S., writing on Christmas-day from Camden-square, says: We are not at the end of the frost yet, so that it is too soon to write its history; but my impression is that we must go very far back for a period of equally long and intense cold; although, as regards actual intensity at any one moment, our lowest here has only been 14·9° on the 22nd, whereas on Christmas-day, 1860, it fell to 6·7°, and the same low point was reached on January 4, 1867.

The President of the Board of Trade has appointed a committee, consisting of Lord Rayleigh, F.R.S., and Sir W. Thomson, F.R.S., representing the Royal Society; Prof. G. Carey Foster, F.R.S., and Mr. R. T. Glazebrook, F.R.S., representing the British Association for the Advancement of Science; Dr. John Hopkinson, F.R.S., and Prof. W. E. Ayrton, F.R.S., representing the Institution of Electrical Engineers; Mr. E. Graves and Mr. W. H. Preece, F.R.S., representing the General Post-Office; Mr. Courtenay Boyle, C.B., and Major P. Cardew, R.E., representing the Board of Trade, to consider whether any, and if so, what, steps should be taken for the provision of electrical standards. The first meeting of the committee will be held at the Board of Trade on Thursday, January 15. Sir Thomas Blomefield, Bart., of the Board of Trade, will act as secretary to the committee.

Dr. C. Le Neve Foster has been appointed Professor of Mining in the Royal College of Science, London.

Prof. T. E. Thorpe, F.R.S., will deliver, at the Museum of Practical Geology, Jermyn-street, a course of six lectures (commencing Jan. 5) to working men, "On Water." It would be of benefit to working men if earlier announcements of these courses of lectures could be given and the tickets be obtainable through the post, as the fee for the course being only sixpence many would avail themselves of the opportunity.

At the Royal Victoria Hall, Waterloo Bridge-road, Dr. Fleming will deliver a lecture on "The Moon" (Jan. 6); Prof. A. H. Green will lecture on "Glaciers" (Jan. 13); Dr. P. H. Carpenter on "Our Bodies" (Jan. 20); and Dr. Collins on "All About Spectacles" (Jan. 27).

The report of Col. Rich on the Newton Fitzwarren "accident" is not altogether satisfactory, but his recommendations may be urged now as they have been urged before on the attention of the companies. The practically reckless way in which trains are now shunted or crossed over the "main" when expresses are nearly due, should be stopped by imperative orders, and as Col. Rich says, all stations where there is much shunting, or where stopping trains are liable to be set aside for fast trains to pass, should be provided with refuge sidings at the proper side of the railway; and, in addition to the present rules lifting bars should be used to lock the signals of the line on which the trains have to wait for "Line clear," as collisions, consequent on the signalman forgetting that he has a train standing at his home or advance signals, are not uncommon. Many signalmen, says Col. Rich, put one of their flag sticks in the spring catch of the signal levers of the line that is blocked to prevent their forgetting that a train is waiting to proceed and pulling off the signals of the line that is occupied, and he suggests that a slide bar, a loop, a wedge, or some other mechanical contrivance, marked "Train waiting," should be fixed to the levers in the cabin to do this, and prevent the levers being pulled by mistake. Surely it is as easy for a signalman to forget that precaution as to forget that an engine is standing where it ought not to be. Why not prevent the levers being pulled until the line is properly clear?

Major Marindin, reporting on the Primrose tunnel "accident" on November 13, says the collision was due to a failure of the "block," and takes the opportunity to reassure the public as to the result of a signalman falling asleep or being overtaken with illness. The result, as experts know, would be a dead lock, and nothing could be done until the unacting signal-box had been visited. Major Marindin thinks that a booking boy is of assistance; but except in large boxes he considers a second signalman to be a source of danger rather than of safety.

A very long telepherage line has been constructed in South America, and is nearly completed. The line will be 186 miles long, and will connect Buenos Ayres with Monte Video. Its object is to allow of travelling letter-boxes being despatched every two hours between the two cities. The line will cross the La Plata estuary where it is 19 miles wide. The two wires will be supported on each side of the river by towers nearly 270ft. high.

The cable forming the submarine connection between the London and Paris ends of the telephone line connecting those cities has been completed, and the land work being already well advanced, it is possible that the telephone line may be opened early in the New Year. There are two lines, with going and return wires, so that two persons will be able to use the telephone between the respective Exchanges (the Royal Exchange and the Paris Bourse) at the same time; but how the arrangement will work in practice remains to be seen.

A method of taking photographs by means of electro-magnetism is reported from Vienna by the correspondents of some newspapers, but details are missing. Meantime, the following may be of interest:—A new method of photography is described in the *Photographische Archiven*. It is based on the fact that yellow phosphorus, dissolved in carbon bisulphide, is converted by the action of light into red allotropic phosphorus, which is insoluble in that liquid. A solution of the yellow variety is poured over a glass plate or a lithographic stone and allowed to dry in the dark. It is then exposed to the light under a negative photograph for half an hour, when a feeble red image is produced. Any unchanged phosphorus is now washed away with carbon bisulphide. Copper or silver images can be obtained from the red picture by immersing the plate in a solution of copper sulphate or silver nitrate to let the phosphorus reduce the salt. Paper moistened with these solutions takes a print of the picture when pressed upon the plate. That does not seem to be a very attractive process to the average amateur.

Sir Thomas Elder's offer to furnish all the expenses for an exploration of the Australian interior on the sole condition that the route and nature of the scheme shall be first submitted for his approval has been received with satisfaction, and it is stated to be "certain that volunteers for the task of exploration will be found in abundance among the brave, hardy, and experienced bushmen of the land under the Southern Cross."

THE total sheep stock of Great Britain, 27,272,[illegible], is now greater than in any year since 1879.

THE cost of warships is stated to be per ton:—England, £30 5s.; France, £46 9s.; Russia, £67 [illegible]. The price per indicated horse-power is:—England, £30 4s.; France, £56; and the United States, £67 2s.

**Prophylaxis of Lead Poisoning.**—M. Lavrand states, in the *Journal des Sciences Médicales de Lille*, that he has found the administration of the iodide of iron pills of the French Codex, either alone or associated with phosphide of zinc, efficacious in arresting the progress of saturnism in workers in white lead. All the patients presented the earthy complexion characteristic of the initial stages of saturnism. The author found that under this treatment, even though the patients continued to ply their trade, the general health improved and the amount of hæmoglobin increased.

**Meserole Dry Battery.**—The mixture for filling the dry cells prepared by M. A. V. Meserole is said to consist of the following solid ingredients in the form of powder:—Charcoal, 3 parts; mineral carbon or graphite, 1 part; peroxide of manganese, 3 parts; lime hydrate, 1 part; white arsenic (oxide), 1 part; and a mixture of glue and dextrine or starch, 1 part; all by weight. These are intimately mixed dry, and then worked into a paste of proper consistency with a fluid solution composed of equal parts of a saturated solution of chloride of ammonium and chloride of sodium in water, to which is added one-tenth volume of a solution of bichloride mercury and an equal volume of hydrochloric acid. The fluid is added gradually, and the mass well worked up.

# ERS TO THE EDITOR.

*ot hold ourselves responsible for the opinions of*
*idents. The Editor respectfully requests that all*
*ms should be drawn up as briefly as possible.]*

*inications should be addressed to the* EDITOR *of*
MECHANIC, 332, *Strand, W.C.*

*s and Post-office Orders to be made payable to*
*s* EDWARDS.

*der to facilitate reference, Correspondents, when*
*any letter previously inserted, will oblige by*
*he number of the Letter, as well as the page on*
*ears.*

have everyone write what he knows, and as
e knows, but no more; and that not in this
a all other subjects: For such a person may
particular knowledge and experience of the
uch a person or such a fountain, that as to
, knows no more than what everybody does,
keep a clutter with this little pittance of his,
ke to write the whole body of physicks, a vice
e great inconveniences derive their original."
*'s Essays.*

## WATER ON THE MOON.

—SOME of the considerations put forward
orrespondent "Ja. Ha." also occurred to
think they deserve less weight than he
them. In the first place, it may be true
vacuum, ice (even when at a very low
re) will evaporate; but it will do so only
on that the vacuum is maintained—that
mething to draw off the vapour as fast as
d. But there is nothing of this kind on
and the vapour would apparently go on
ntil it attained the requisite density, when
ration would cease. There ought, no
be vapour of this density on the moon;
rtain that there is not? The moon prob-
n atmosphere, though a very rare one,
mperature of the lunar ice may be very

re consider the effects of the lunar day
however, the phenomena would not be
hat I have supposed. During the long
dark part, which has little or no atmo-
ould be intensely chilled, and a natural
would thus, in fact, be provided for the
nerated by the sun's rays on the bright
e vapour would distil over to the dark
be there condensed, and the loss by
n during the (lunar) day, would be made
ondensation, whether as hoar frost or as
now during the night. "Ja. Ha." may
this process was going on, we should see
rhaps so; but clouds do not seem to form
rare atmosphere, or during seasons of
ld. I think it more probable that the
uld be precipitated as hoar frost or very
, without having previously existed in
te of suspension as to form visible cloud,
clouds were formed, they would probably
over the dark part of the moon.
a for lunar ice. Even as to lunar water-
oes not seem to me clear. Water wholly
f air behaves in many ways like a solid,
not boil until raised much above the
boiling-point. This is probably its con-
he moon, but there is a new element of
y introduced by other lunar conditions.
ct has the reduction of gravity to one-
susceptible a substance as water? Has
or instance, any effect similar to that of
which alters both the freezing-point and the
int of water? And of course there is
question whether lunar water is not im-
with other substances which affect its
If the quantity of water on the earth
iently reduced, it might all be as salt as
Sea.
ct that a considerable time must elapse
shall have anything on the subject except
.

**W. H. S. Monck.**

## LUNAR GLACIATION.

—I HAVE read with much interest the
mmunications in your columns as to the
he moon's surface, and in your number for
notice a further exemplification of the
of its glaciation, while at the same time
an account of the proceedings at the
A.A., where Mr. Grensted is clearly of
at glaciation is an impossible condition.
tful to me to hear and read of all sorts
, but I have up to now thought that it
epted theory that there existed no water,
or atmosphere on or over the moon's
Is there, then, any astronomical doubt on
? or is this a curious individual theory like
ne months ago in reference to the theory
where Helmholtz and Tyndall were going
led over by some American scientific
May I venture to ask a few ques-
d state a few probabilities—*re* the
urface. During the fourteen - days
moon the sun's heat must be very try-
minds me of the old story of the magnificent beginning of the prize poem: "The Sol's perpendicular ray hath illumined the depths of the sea." Underneath which the wag wrote: "The fish are beginning to sweat: lor, hang it, how hot we shall be." This quite upset the prize poem. Recent research has tended to indicate that the heat of the sun is greater, and not less, than it has been hitherto supposed to be, and if, as was supposed, the heat of the sun at the moon's surface would melt lead at mid-lunar day, there must be an enormous melting of the ice and evaporation of the water.

Now, this stupendous mass of aqueous vapour in the shape of a cylinder with one end on the moon and the other towards the sun, must, at its edges, come in contact with the intensely cold temperature of space, and must be converted into cloud and snow, and fall on the whole of the moon's surface gradually as the evening and night of 14 days' duration supervenes. Then, if so, we on the earth should see the mist or cloud at every new moon, and also the smooth, white surface of the freshly-fallen snow. Am I not right? I wait for a reply.

Now, Sir, the non-existence of water on the moon requires explanation. If the moon was "wobbled off" the earth, which it probably was, it is made up of the same sort of matter as the earth is made of, and if there is no water or ice there must be plenty of oxygen and hydrogen in some other combinations or water in some combination. But may there not be ice or water in the interior of our satellite? Since water on our earth enters the fissures in its crust and meets the molten masses of the interior, which eject it again by volcanic action, would not a time have arisen when the lunar water flowing down the fissures of its crust and not finding heat enough to vaporise it, would there remain and soon become ice? This is my view of what may have become of the lunar water; but it cannot be on the surface now.

Stroud, Dec. 19. **W. J. S.**

[31920.]—IN reply to "Ja. Ha.'s" letter (31895, Dec. 26, 1890), proving "that neither water nor ice can exist in a sufficiently capacious vacuum," I should like him to consider the case when there is a force present to keep it there, such as gravity, in the case of the moon and earth. Further, I should like to hear whether he has a reason to show why the air surrounding the earth does not behave in a similar manner in the boundless vacuum which surrounds it also. **H. J. Dixon.**

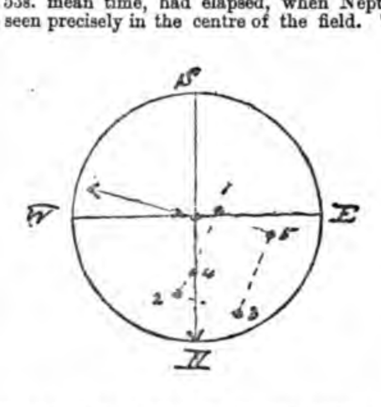
Shanklin, I.W., Dec. 28, 1890.

## PATH OF NEPTUNE.

[31921.]—WITH all due respect to "H. S.," I have found his chart on too large a scale to be of any service in finding this distant planet. The diagram of Mr. Waugh's is much more serviceable; but this is faulty in that it shows the planet's path to be due east.

I found the planet on the night of the 18th as follows:—Ascertaining the star $\omega^1$ Tauri to be in apparent R.A. 4h. 2m. 49s. and Dec. 19° 19′ 15″ North, and the R.A. and Dec. of Neptune from *N.A.*, page 269, to be 4h. 12m. 44s. and Dec. 19° 28′ 27″, I took the differences (9m. 55s. in R.A. and 9′ 12″ in Dec.) and made use of them as follows:—

Orienting my micrometer eyepiece, I brought $\omega^1$ Tauri 9′ 12″ to the southwards of the centre of the Reticule, and allowing the telescope to remain at rest, waited until 9m. 55s. sidereal time, or 9m. 53s. mean time, had elapsed, when Neptune was seen precisely in the centre of the field. The relative positions of the accompanying stars were then as shown herewith.



If our readers will turn to the ENGLISH MECHANIC Oct. 22, 1890, page 187, they may readily, by the aid of the diagram there given, make an accurate chart of the configuration for themselves.

Neptune being in the centre of the field, we proceed as follows:—From centre count easterly along scale line 2½ divisions, and set off at right angles ¾ths of a division to the southward. This marks the place of a star of about the same brightness as the planet, say 8½ magnitude. From centre count due north along north line two divisions, and set off to the eastward 9 divisions. This marks the place of a 9½ magnitude star. From centre count northwards 12 divisions, and set off easterly 5 divisions. This star is 8½ mag. From centre count northwards 9¼ divisions, and set off westerly 2½ divisions. This shows the place of an 8½ mag. star. From centre count 6½ divisions to the north, and set off to the west half a division, and you have the last star (9½ mag.) And, lastly, from centre count half a division south and set off 2½ divisions west, and you have the position of Neptune on Dec. 20 at 9 p.m. A line drawn through the two places of the planet will give its approximate path, and bearing in mind that each division represents 63″ of arc, you have the scale of the configuration. The sketch now sent shows this as seen in an inverting telescope, the stars marked 1, 2, and 3 being of the same brightness as the planet, and those marked 4 and 5 a magnitude or so fainter.

Hull, Dec. 22. **H. P. Slade, F.R.A.S.**

[31922.]—I MUST protest against the figure on page 353 of the ENGLISH MECHANIC of December 19 being accepted as a chart prepared by me to assist in finding the planet Neptune.

At the beginning of this month I sent Mr. Waugh a chart of the leading stars near the planet, drawn on the squared forms in use here for our ordinary variable-star charts, and was greatly surprised to receive from him a note, dated 8th Dec., in which he says, "I have taken the liberty of sending a copy of your chart to the 'E. M.'" The diagram which illustrates his letter, No. 31879, is but a *very rude* copy of the original.

The very excellent chart by Mr. Sadler in the "E. M." of Nov. 15, 1889, and the additional information he has so kindly given in letter No. 31842 in the "E. M." of Dec. 5, render any further remarks unnecessary.

**Chas. Grover, Assistant Observer.**
Rousdon Observatory, Lyme Regis, Dorset,
Dec. 22, 1890.

## THE METEOR OF DEC. 14th.

[31923.]—IN reply to your correspondent Mr. Wm. London, I beg to say that I am well aware of the difference in the rate of speed at which sound and light travel; at the same time, he is fully justified in drawing my attention to the fact if he imagines that I meant to infer that any sound accompanying, or even immediately following its appearance, could be heard from all the points at which its flight was witnessed. My own impression was that, although commencing silently, a rushing sound was audible just before its disappearance; but, as I said in my original communication, I may have been mistaken. If, however, it actually fell, as asserted by Mr. Morgan, whose letter I inclose, on a spot only a few hundred yards distant from that whence I myself beheld it, then, of course, there is nothing surprising in the fact of its having been accompanied by sound. The point of the heavens, W.S.W., in which Mr. London witnessed this phenomena, and the period, "eight minutes," at the end of which the sound—if really that of its flight—reached his ear, correspond very fairly with the locality, Woodbridge, Suffolk, at which he witnessed it, supposing the bolide to have fallen in a northern suburb of London. Two facts seem to me to await verification. Did it really fall, as stated by Mr. Morgan, who goes so far as to declare that he picked up some of its fragments, and was its fall accompanied by any sound?

Dec. 29th. **A. E. Spencer.**

[31924.]—THE London evening paper, the *Echo*, deserves the thanks of all interested in celestial physics, for the liberal way in which it opened its columns to the statements of different observers of the above phenomenon in various localities. Two facts, of no small importance, have thereby been established. Firstly, that the meteor in question was visible over an area extending from Folkestone to Oxford, and from Brighton to Hitchin. Secondly, that it was undoubtedly accompanied by a roaring or rushing sound. The opinion, however, expressed in the *Echo* of Saturday evening, that several meteors must have fallen simultaneously, is a conclusion from which I utterly dissent, and feel sure that all the descriptions refer to one and the same phenomenon. The writer is evidently unaware of the height above our earth at which such bodies frequently travel. **A. E. Spencer.**

## IODINE.

[31925.]—DURING a pleasant sojourn of a few weeks in the Hebrides last autumn I visited some "kelp-works," where the burning of the bulky seaweed, locally termed "tangles," is carried out on a large scale. "Iodine," that important element, was accidentally discovered by the French chemist M. Courtois so recently as 1812. It exists in most marine vegetation, in many marine animals, and has been detected in the mineral kingdom, combined with silver. The ashes from the furnaces form an impure kind of carbonate of soda (kelp), known at the works as "dust." This is repeatedly boiled to extract the chlorides and other superfluous compounds. The residue is treated scientifically with oxygen, which, uniting with sodium, drives off the iodine in purple vapours, condensing in the form of iron-grey crystals. This final operation is performed at Glasgow, to which port cargoes of this valuable "dust" are regularly shipped. There was a pier attached to the yard of the works, at which a line of steam-boats frequently calls. The collection and cartage of the seaweed is a crofter industry, requiring time and labour, which seemed to me remunerative, boats sometimes being found more convenient than wheeled carriages, according to the locality. Some beautiful experiments can be illustrated with iodine. I will only mention one. *Ter. Iodide of Nitrogen.*—Mix a strong alcoholic solution of iodine with liquor ammoniæ; add some distilled water; a black powder subsides, which is to be separated by filtration. When the powder is dry, the slightest touch or increase of temperature will cause it to explode with a sharp report. No use has ever been made of this preparation,—it is only an amusing curiosity. I found iodine ointment, bestowed on the Gaitrous tribes of the Upper Brahmapootra, a wonderful conciliatory present, even more so than rum—their women and children asking for it. **Eos.**

## OUT-OF-THE-WAY TURNING.

[31926.]—I LEFT India so many years ago that I am not in a position to describe the bizarre achievements of native workmen, as asked in letter 31863. For some time past I think their turnery (like other Indian arts) has deteriorated, and it is chiefly confined to those multiple boxes and spherical toys in inferior woods, covered with gaudy lacquers. Ivory is no longer cheap and abundant, which may be one reason, and the demand for high-class work has greatly diminished. China has always surpassed India in articles of this choice material and intricate design. Sixty years ago turning was a favourite recreation among the highly-paid English officials of India with ample leisure to pursue the interesting occupation. They all were good customers of the great Holtzapffel. One of these individuals expended hundreds of pounds on lathes and appliances, and became a perfect master of the art. I have seen some of his splendid attainments—ivory vases, copied from a large book of Etruscan relics; the ram's-head handles of these vessels he carved in ebony, fixed by invisible screws to the sides. The effect of these black adjuncts to the white surfaces was very imposing. I possess one of his specimens—a beautiful circular ivory box, 5in. diameter and 2¼in. deep (including lid), artistically ornamented in every part with fluting and curved patterns, like the cases of high-class watches. The box is very heavy, for the tusks of those days were enormous. This amateur used frequently to send a lovely gold ring of plaited wire, inclosed in a tiny box of ivory no larger than a pill receptacle, to his many female relatives in England, as he never returned to his native land. Sandal-wood also was a favourite material with him, of which he made many tasteful keepsakes. Each ivory vase was mounted on a solid stand of ivory.

**Eos.**

## ORGANETTE.

[31927.]—FROM time to time inquiries appear as to the construction of these instruments, and I remember, some years ago, Mr. G. Fryer promised to send particulars, but never did so. If the recent querist will give an idea of his requirements, I will, with the Editor's permission, send some sketches and descriptions of the various constructions.

Meantime, as they range in size from the little 13-note toys recently advertised in the "E. M." up to 10-stop American organs, at, say, 130 guineas (so far as automatic action is implied in the term "organette"), it is evident some limit as to size and intended cost must be fixed by those asking for information. **A. S. L.**

[Kindly send all you can. Never mind the individual querist's requirements.—ED.]

## THE DEEPEST MINE IN LANCASHIRE.

[31928.]—IN your issue of Dec. 19th you state Ashton Moss as the deepest mine, 1,040 yards. There is some error here, as in Pendleton we have been getting coal 1,105 yards from the surface for some years. **J. P. G.**

## CONTINUOUS BRAKES—TO MR. STRETTON.

[31929.]—I WAS under the impression that the Midland had adopted the ball-valve vacuum in place of the Clayton "two-minute"; but I see in the Continuous Brake Returns, ending June 30, 1890, that the brake at present in use will not work in unison with those of the G.N., M.S. and L., and Caledonian. Will you kindly explain this? I fully understand the Gresham auto. vac. brake as used on the L. and S.W.R. I should also be glad of explanations to the following:—

(1) The instructions to guards on page 104; (2) that the L. and N.W.R. auto. vac. brake will not work with other companies; (3) that the large ejectors must be shut gradually; and (4) the statement on page 114, by the Caledonian, "the vacuum on all vehicles which are fitted with a hand-brake must be destroyed by the ball-valve wire only, and not by the lever of the five-way cock."

**Meteor.**

## LOCOMOTIVES AND LOCOMOTIVE RUNNING.

[31930.]—WE have had a good many diagrams of modern locomotives, and no end of paragraphs about their names and numbers; but few seem to take any interest in their construction—for instance, on p. 383 we have an illustration of a Great-Eastern compound, with dimensions—interesting as far as they go, but no criticism of the design (a four-coupled compo.) as compared with that (p. 95, Vol. LI.) single compo. on the N.E. line. Is it not one of the advantages of compounding that the coupling-rod can be dispensed with, as the high and low pressure cylinders can be separately connected to a pair of driving wheels—thus obtaining as much adhesion and dispensing with the coupling-rod, which has proved itself rather dangerous—notably in the Penistone accident and elsewhere. It is not the rod which is always the first to go; but does not the tieing together of the wheels have something to do with the breaking of crank-axles? I note that there is a decided tendency on the part of loco. designers to return to single drivers for use in express work, and I think it wise, especially when the steam sand-dropper is fixed and the rails are of sufficient strength to carry the weight. I believe it is seventeen tons on the wheels of the new Midland singles. For goods work the six-coupled seems necessary, and probably it might be better to use the eight-coupled, or "Consolidation" type (American), where the traffic and gradients are both heavy. Surely there are some drivers who could give useful notes, and also designers who can explain the reasons for this and that. Alteration of detail is not always an improvement. Then, again, I should like to know why so many drivers (the majority, I think), run with the fire-door open. What is the object? If it is necessary, it would seem to point to some fault in design, for a "furnace" should surely be so designed as to conserve all the heat (energy) possible. Here is another question. What is the system of fog-signalling in most general use? Should there be two detonators for a stop and one for all right, or would it do to have only one for a stop, and the absence of one as an all-right signal. Detonators are, I suppose, now made perfectly trustworthy—not liable to fail. I should welcome some notes on these points, instead of the interminable numbers and diagrams (*sic*) of engines.

**Nun. Dor.**

## A VERY VAGUE CLAIM.

[31931.]—IN letter 31870, pages 335 and 336, a writer claims the first proposal of the "spiral slot and differential screw adjustment" in virtue of the "date of the original drawing being March, 1870." Imagining he meant the "E. M.," I turned up that date, but found no *original* drawing of the kind he describes, figured, or even mentioned, in any of the numbers of that month. I can hardly fancy him founding his claim on the fact of that date *being simply on his own drawing.* At all events, until the gentleman shows that his design was published in some journal—and it is not in the "E. M." at all, so far as I know—I believe anyone having occasion to name the "spiral slot and differential screw adjustment" will designate them as heretofore, and will value such *post factum* claims as have been made in "Ours" at their proper worth, and those who make them.

**J. A. C.**

## REMEDIES FOR IN-GROWING TOE-NAIL.

[31932.]—THE note quoted from Dr. Richardson's *Asclepiad* (p. 352) will, no doubt, be suggestive to many of your readers, and the remedy prescribed is doubtless efficient, when carried out by the surgeon; but the question is, How can people get relief by their own actions? Various causes are assigned for this at times painful "disarrangement," but the most difficult to deal with is the case in which the first nail, having been injured, is replaced by new growth, the old one being shed. It is sometimes said that the in-growth of the toe-nail is caused by wearing boots with pointed toes; but I think that boots too short are far more likely to cause it. But whatever the cause, the remedy is "the thing that concerns the sufferers." Many years ago a retired army surgeon told me that the best way to cure it was to cut a V-slit from the tip down to the lunette, or matrix, and, if my memory does not play me false, Dr. Edmunds suggested practically the same treatment. Scraping the crown of the nail as thin
as possible has also been recommended, a
putting pledgets of wool under the side
grow in, running tinfoil under the edge,
ing the flesh (whence the pain springs)
perchloride of iron, mercuric oxide (whic
soften the nail), or tannic acid—the obje
render the flesh hard. I think mysel
remedy is to encourage the nail to grow
much as possible, but let it grow, even ha
beyond the flesh of the toe, rounding it
and keeping the skin pushed back as
possible to show the "half-moon."
personally interested, I should like to hea
as an in-growing toe-nail is, to say th
nuisance. **Nu**

## BOOKBINDING.

[31933.]—I HAD intended writing in re
your letter 31854 when it appeared; bu
hurry away from home at the time, an
prevented. I think your tool described
31917 for cutting will be most useful to
whose greatest obstacle in following this
the cutting of edges. I would suggest that
binders who have thought out dodges of
and found them useful, should submit the
readers. I am sure the Editor would stri
room for them. I have tried to include al
in my articles; but we practical men, w
every necessary tool at hand, not ha
necessity for inventing dodges, know less
things than those you have to devise a
overcoming every difficulty as it arises.

I am exceedingly pleased that you hav
my articles of service to you, and the expr
your thanks has given me more pleasure
best Christmas-box I have received.

Dec. 25. **Practical Bookb**

## DRY BATTERIES.

[31934.]—MR. A. CAPLATZI (letter 31816
is quite right when he says that in the
moist) cell the oxide of zinc remains wh
formed, and shields the zinc from further
not that it is true with every dry cell; but
with the Gassner and most others. But in
this does not matter much, because these
such a *large zinc surface* that, with ordinary
as bell-work, it takes *years* before the zinc
completely oxidised and chemical action p
Mr. Caplatzi speaks of dry cells six years ag
fair to judge cells of the present date by
Let him take a Gassner, made since M
and, if properly made, he will find that, i
ringing a bell on and off for five or six
will have to wait more like five or six ye
the cell is exhausted. On August 2 of th
made up a small Gassner of the improved
gave it eight or nine hours' bell-ringing
it made a total of over 120 hours. I re
by battery, and again submitted to the
when it gave nearly 100 hours, which
prove that it was not capable of thorough
tion. I recharged it again by battery,
then (Sept. 4th) it has, with another
ringing a bell once every hour night
besides ringing other bells on and off. H
Mr. Caplatzi's common porous-cell Lecla
the 120 hours' bell-ringing at eight or
per day? Would it ring a bell nine hour
ously? How often would he have to
zinc? Would the ammonia chloride di
zinc oxide as fast as it would be form
not the modern Gassner compare favou
the Leclanché as regards heavy and
work? I do not say that the Gassner
fection, as there is plenty of room fo
ment; but, nevertheless, we get good r
the present cell, notwithstanding that
against it. Has Mr. Caplatzi tried the "
Dry Cell"? I have had one for a fe
that seems to perform very well. Its E.
volts, and its I.R. is higher than most
roughly speaking, about the same as
porous-pot Leclanché. One notable thi
is that its I.R. is *decreased*, instead of in
being short-circuited for a while. I ta
owing to the formation of H.O during ac
**Alf.**

## MOUNTING GRINDSTON

[31935.]—WHAT is the most approved
mounting and running grindstones in t
your side of the water? Here the pra
most suitable is that described by M
some little time ago in the *American Ma*
if any improvement can be suggested,
like to know what it is.

In running high-speed stones, says M
following points should be well attend
is, the face of stone should be turned c
the purpose of diffusing water over its
comes from the pipes arranged at the
stone, the centrifugal force carrying to
point on the same. To get the best re
stone, its face should be hacked with a

' stone. Impressions should be made two
nches apart, and about ¼in. deep. The
hould supply just sufficient water to keep
grit from washing off the face of stone,
e free grit that keeps the stone sharp. In
speed, I have run stone, when the work
that the lives of the workmen were not in
high as 6,000ft. per minute; but I would

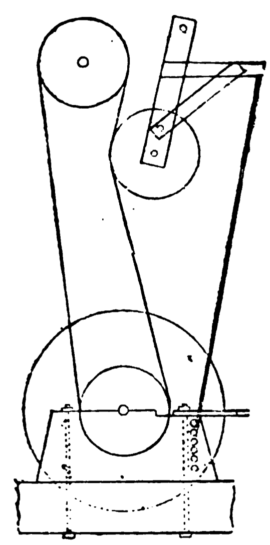


Fig. 1.

ite that speed, for the stone frequently
it I do regard 4,000ft. per minute a
safe speed. Stones with red seams in them
avoided, for they show the presence of iron
n indication of weakness and soft spots.
r in sketch is for the purpose of slowing
of stone; when it is to be turned off a
od will be found to be the best thing for
ose. For machine-shop use the stone
cased in, with the exception of an aperture
to grind through. To attempt to grind

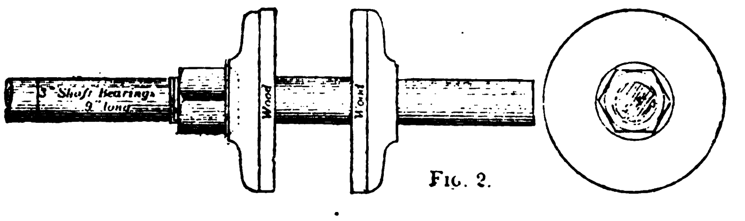


Fig. 2.

; on a stone at that speed would probably
he loss of an arm, or even a life.
a skeleton diagram showing Mr. Pratt's
nts of pulleys and tighteners. The
le represents the grindstone, which is
n timbers over a pit, and supplied with
a pipes which pass along each side of the
llel with its sides, and have holes drilled
r throwing the water in small jets against
of the stone, instead of on its face, as is
g. 2 is the shaft and collars for a 6ft.
is of steel, 3in diam. with journals 9in.
e flanges are 12in. diam., and there is 1in.
of wood on each side of the stone. The
r has a spherical recess in it, and under
a washer, one side of which fits this
ecess, and allows things to adjust them-
out any cramping.
eed do British workers prefer?

er, Mass. **E. T. D.**

### ENERGY AND SPACE.

—The fact that energy and matter agree
he common property of indestructibility
frequently remarked; but the fact that
the common property of extension or
space has not received the same recogni-
t matter occupies space is an obvious
that energy occupies space may require
idation. The fact in question can be
with greatest clearness in the form of a
"If the quantity of energy in any given
space is divided by the cubical capacity
ace within which it is contained, the
never exceeds a certain limit, which,
ying with the form of energy, *is always*
is proposition is equally true if "matter"
ted for "energy." Let us take a few
f the application of this law.
miliar form of energy is that of a heavy
ing on its axis, as, for instance, the fly-
engine. Let us see how much energy can be stored in such a revolving ring. The kinetic energy is equal to half the product of the mass of the ring, and the square of its circumferential velocity. The centrifugal force of the rotating ring produces a tensional stress, and if this tensional stress exceed the tenacity of the substance of the ring, it will fly asunder. Now, the tension due to the centrifugal force depends on the square of the linear velocity and the heaviness of the matter of the ring, but is independent of its diameter. Hence it follows that the maximum linear velocity a ring of any given material can acquire without rupture is independent of its dimensions, and consequently there is a maximum to the amount of rotative energy that a given mass of the material can acquire when formed into one or more rings. Further, the energy of rotation is greater in a ring for a given circumferential velocity than for any other geometrical form; hence there is an absolute limit to the amount of energy that can be stored by rotation on a given quantity of a given substance. This limit can be easily calculated. For iron it is about 2,500 foot-pounds per cubic inch. That is to say, if the quantity of rotational energy, expressed in foot-pounds, in a mass of iron is divided by its contents in cubic inches, the quotient never exceeds 2,500.

(2) If the law is universally true, there must be a limit to the rectilinear velocity that can be communicated to a mass of matter. Since we can in imagination give a mass of matter any velocity we please, it seems at first sight that no such limit can exist. But I consider that the limiting velocity cannot be found, not because there is no such limit, but merely because the problem is indeterminate. If the conditions under which the body is to acquire the velocity are specified, the limit can be calculated. Suppose, for instance, the body is to acquire its velocity by falling to the surface of the earth; then the greater the height from which it falls the greater will be the velocity. But this does not increase definitely. It never exceeds seven miles per second, even though the body were to fall from an infinite height.

(3) Now, suppose, instead of storing energy in a mass of iron by putting it in motion, we store energy in it by making it hot. The amount of energy stored will increase with the temperature, but not indefinitely, for sooner or later the mass of iron will vaporise, and consequently occupy a greater space.

The objection that adding heat to water at certain temperatures causes its bulk to diminish is not relevant. It would be an objection against the position that matter and energy exclude each other from the same space. But this is not asserted. What is asserted, is that energy always occupies *some* space; it cannot be eliminated from space of three dimensions.

Now let us examine the bearing of the above theorem on the theory of electrical action; and, first, with respect to electrostatics, let us suppose the common theory of an electrostatic charge is substantially correct. Then the electric energy is stored on the surface of an electrified conductor, being contained in the space occupied by the electricity. Then the depth of the electricity must be a finite quantity, for otherwise the cubical capacity of the space it occupies would be nil, and the quotient obtained by dividing the energy of the charge thereby would become infinite, which is impossible.

We can also apply the principle in a similar manner to current electricity. Let us suppose we have a cell connected by a wire of large resistance. Call E the energy developed by the cell per second, and $a$ the quotient obtained by dividing the external by the total resistance. Then the energy transmitted from the battery to the wire will be $a$E. Now, suppose we couple $n$ such cells in series, and at the same time increase the length of the wire $n$ times. The result is, that the energy transmitted to the wire becomes $n\,a$E, while the current remains the same as before. If this energy is transmitted by the wire, we must suppose that a certain proportion leaves by each terminal—say one-half; and that there is a definite velocity of transmission—say $v$ feet per second. On the above suppositions, the quantity of energy contained in a foot of the wire next the terminal at any given instant of time is $\frac{n\,a\,E}{2\,v}$. Whence, if $n$ is increased indefinitely, either the energy contained by the foot of wire increases without limit, or $v$ is infinite; neither of which suppositions is admissible, consistently with what we know of energy in general. If the energy of a battery is transmitted along the wire, there is no limit to the amount of energy that may be transmitted along a wire of a given size. This is about as reasonable as to suppose that there is no limit to the quantity of matter that may be condensed into a space of given dimensions. **G. J. B.**

### ETHER AND ELECTRICITY.—VI.

[31937.]—If "G. J. B." (31891, p. 355) proposes to deal with the objections I have raised to the ether theory of electricity I hope he will attack the fundamental ones, not mere incidental side issues of no moment, but only thrown out casually. However, I will point out that the defence he raises, though ingenious in its way, can be upset in an instant. His illustration of an inclosed hot ball losing no heat if inclosed in an equally hot sphere, in no way applies, unless he proposes to upset all the recognised laws of radiant energy. The accepted (in fact proved) law is that all bodies radiate irrespective of their surroundings, but receive radiations from them. The inclosed ball should lose heat freely, but it would be replaced by an equal heat received from the inclosing sphere.

The argument of "G. J. B." really means that two equal lights, at the opposite end of a tube, would give out no light into the tube, because each would oppose the vibrations of the other. Now this does really occur in electricity, as two equal E.M.F.'s opposed, prevent any action. The mathematicians often treat this case as though each acted freely, and equal opposite currents both traversed the conductor; but then mathematicians assume anything which enables them to work out their ideas: facts show that no action occurs, any more than with equal opposed mechanical forces, except some stress upon the connecting medium. But the argument of "G. J. B." illustrates one of the most fundamental differences between light and electricity; one is unial, the other dual, in directive forces. In light, energy is emitted regardless of where it goes; in electricity, energy is emitted only if a proper path is ready. The conditions of "G. J. B.'s" spheres never exist where a current exists, and my argument was related to actual currents. To use the technical phrase, in an electric current energy is always moved from a place of higher potential to one of lower potential: in other words, the inner ball is of necessity of a higher temperature than the outer, and the illustration does not meet my question why the ether should need a sink for energy when the only thing we really know of it is that it transmits energy without loss.

As to the second argument about transparency of dielectrics, I altogether decline to argue about imaginary facts. As a simple fact some of the best dielectrics are opaque, if opaque has any sensible meaning, and very good conductors are transparent. No amount of humming and hawing or talk about the causes of transparency and opacity will alter the facts or justify anyone in converting Clerk Maxwell's mere suggestion into a truth, or treating it as one of the operating causes of nature's facts. "G. J. B." can do better than say, "it is only reasonable to suppose"—when the whole subject which I am attacking is a mere bundle of suppositions treated as facts, but which I am demanding facts to justify.

Since writing this letter the further one of "G. J. B." (31915, p. 378) has appeared, dealing with the imaginary ether transmission of current. As a rule I shall not discuss general matters until I come to them in the course of my own argument, as it is better to show how thoroughly consistent Nature is with herself than to treat incidental subjects here and there. But I will insert here some criticism of "G. J. B.'s" argument. His first par. is a clear non-sequitur. Why should it "follow almost as a necessity" that the ether transmits the energy of an electric current because he has endeavoured to show that the energy of a charge is contained in the ether? I contend that the endeavour is a failure; but had he proved the point, it would not be even a step to proving the case of the currents, where conditions are utterly different.

He has a long stage to go through. When he has demonstrated that in an air condenser the charge is in the ether, he must next show (and by showing I mean make intelligible) why so much greater a charge is taken up by many liquids and solids, and to be consistent with his own particular line of argument, he must show why a thin stratum of ether can store so much more energy than a thick one. But having done this, he will not be one step on the road to proving the known essential—the conductor—is not the path by which electric energy travels, though we find it all there, fairly expended and accounted for in doing work essential to electric transmission.

I must now point out that, just as in the case of charge, every argument which "G. J. B." brings against the transmission of energy by the wire applies, in exactly the same degree, and with equal force, to transmission in space outside the wire. In this, just as in the wire, the energy must be greater close to the source than at the middle of the circuit.

Why, then, demand results in one case and not in the other? But, as a matter of known fact, the space affords no evidence whatever of any action at all when a steady current is passing and *the wire does.* The argument, par. 6, commencing, "Now let us compare," is wholly fallacious and inconsistent with facts. The case of the electric wire is exactly correspondent with that of a pipe full of water under hydraulic pressure; in this, as in the wire, there is the same difference of energy contained and transmitted at different parts; in both alike, the energy transformed is equivalent to the resistance in each portion of the circuit; but, moreover, in both there is a result, proportional not to the transmitted or transformed energy at the point examined, but to the *total contained energy.* This is *pressure*, measured in pounds per square inch in the water, and in volts in electricity. Now, this is perfectly intelligible when we recognise that the energy is *in* the circuit; it is not intelligible at all if, in the case of electricity, we treat it as outside the conductor; for, if the conductor is only a transformer of energy, in order to dissipate it uselessly (in itself rather out of Nature's usual economy of working), the energy entering the conductor at any part ought to be proportional to its power of dissipation—i.e., to its facility of cooling, and therefore less in a small wire than in a large one. *Exactly the opposite occurs.* Then, the pressure in the space towards the wire should be proportional to the transformation: it should be the result of lines of energy entering the wire. *Exactly the opposite occurs.* The lines of pressure are, as I said above, proportional to the energy not transformed, but still retained in the circuit.

But the last two paragraphs involve an absolute absurdity. If the transmission occurs in the space surrounding the conductor, we can have no explanation of the fact cited that the magnetic field varies as the square of the distance from the wire. That fact is exactly what should occur if the wire itself is the centre of action; that is, the ratio of space occupied by circular fields of force surrounding the wire. But if the energy is transmitted in space parallel to the wire, we can conceive of nothing to limit the space occupied, except the fictitious necessity for the sink, or waste-pipe, of energy. Common sense shows that the space around the wire is equally able to transmit at any distance, and the field ought to be nearly uniform at all distances. But more still: if the energy transmitting were the measure of the magnetic field produced, that field ought to be strongest where the energy is greatest. As a matter of fact, the magnetic field has no relation whatever to the energy, either being transmitted or transformed at each part of the circuit, but is exactly the same close to the battery, where energy is maximum, and at the middle of the circuit, where energy is neither transformed nor transmitted; it is evident that the magnetism is a result of something *in the wire* or other conductor, and as the magnetic field, once formed, takes up no energy, it is evident that the field itself is not a kinetic fact, but a *static phenomenon;* it expends and transforms no energy, except that absorbed at first in setting up the magnetic stress, and that in lines or circles dependent on, and attached to, the conductor, and not the space around; also it is clear that its source is not related directly to energy at all, but to something evenly spread along the whole circuit; this something is the thing or action described of old, as a "quantity of electricity" which is past conception, but it is quite intelligible as a reaction of the structure of matter.

I will now return to my own argument, and after so much discursive matter let me once more put distinctly the real essential point of all this discussion—viz., Which is true science? To examine facts, deduce from them their relations, if possible, and, if not, wait for further real knowledge; or to imagine for ourselves something which might explain facts, and then treat that imagination as itself a fact? Should we not rather study what really happens in *matter*, instead of inventing happenings in a something we cannot examine, and about which we really know, and can know, scarcely anything? I contend, for instance, that the work of Shelford Bidwell, Villari, and those who are testing the changes which magnetism produces in matter are *true* scientific labours, which will vastly advance knowledge, while Sir W. Thomson and Dr. Lodge, in their ethereal vaticinations, are merely spinning moonshine and weaving make-believe knowledge, which by-and-by will prove an obstacle to students, and necessitate the painful process of unlearning.

Let us, then, first clear up our notions about matter itself. We are often told that we do not know what matter is; in fact, that we have no right to object to the ether notions on the ground that we do not know what ether is, because we are in the same position of ignorance as to matter itself. Now this is pure cant: it is mere juggling with words. We do not know what matter is, but we do know what we mean by the word; we do know a great deal about the functions and properties of the thing we mean by the word matter, and we can examine and test those properties. Nothing of this is to be said of the ether: we know of it only one thing, that light or energy is transmitted across space, and we can conceive this only by imagining there is something which transmits it. In absolute ignorance really of the properties of this something which we can in no way examine, we infer that it must have some qualities, mainly negative, viz., that it is frictionless, gravitationless, devoid of momentum; that is to say, that whatever ether may be, it is not at all possessed of those properties which are involved in all our knowledge of matter. Then begins the process, not of inferring, but of imagining properties from certain facts of which we are cognisant only in the presence of matter. Some of these facts being at present not clearly explainable, some of our philosophers, rather than wait and patiently trace out the yet unknown powers of the matter in which they occur, take it on themselves to fancy that the ether they know nothing about can be made to explain them, and they impute to it properties they have no possibility of examining, and endow it with properties possible only if it possessed the very qualities of matter which we know it does not possess. They give it structure and organisation. Now these are conceivable only as results of friction or adhesion among the parts; and they make it do work — possibly only to something possessing momentum. When challenged, they use their ignorance as their protection, and practically say that, as we know nothing about it, for all we know it may possess any properties whatever. True enough, perhaps, in the abstract; but that is metaphysics—not science. In science we cannot build upon imaginary may-be; we must, when we explore the unknown, operate from a basis in the known, and keep up the line of communication.

Now the statement that we do not know what matter is belongs to metaphysics solely. In science we do know what matter is most clearly: it is that which our consciousness perceives as existing, independently of ourselves, as a *thing*, while it recognises as clearly the true existence of energy, not as a thing, but as an *action* or a *condition* manifested in the real thing—matter. And equally our consciousness does not perceive the thing itself, but only its actions. In that sense we do not know what matter *is*, but only the properties it possesses—the action which it and energy together produce.

I may conclude by just clearing this point. The writers of the Westminster Confession chose to state, as a fact, what they had no possible means of knowing anything at all about, just as the modern etherialists do: they asserted that "it pleased God to create, or make *out of nothing*, all things." St. Paul, or whoever wrote the Epistle to the Hebrews, only said that "things which are seen were not made of things which do appear"; while the ancient Hindoo Scriptures state that God created all things by thought (i.e., will) "out of his own divine substance." Now it is of this "nothing," or "divine substance,"—that is to say, the ultimate *essence* of matter—that it is truly to be said that we know nothing. Just so; as one of the Hindoo writers says, "No vision can approach them, no language can describe them, no intellectual power can compass or determine them." Why should we know anything of it? Our business is with the things which do appear, not with those which do not. Let us study the properties: the "essence" is not in our range.

**Sigma.**

# REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[72493.]—**Dynamo-Designing.**—I beg to thank "T." for his reply, and will try to make my query clearer. Assume two armatures of the same size and number of turns, one having teeth—would not the latter (at same speed) give a higher E.M.F. or require less wire on field for an E.M.F. equal to the Gramme? What I am in doubt about is whether the magnetic resistance of the circuit is diminished (owing to the teeth) at the air space, or by adding to the cross section of the core. I should be obliged if "T." would refer me to the numbers in which the rules came out, or assist me in the way of measurements.

J.

[72652.]—**Problem.**—Suppose the students are A, B, and C, B to sit between A and C. To satisfy this condition, B may sit on either of the 12 inside seats numbered 2, 3, 4, 5 on benches $\alpha$, $\beta$, $\gamma$.

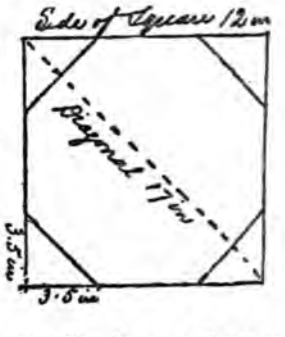
1 2 3 4 5 6
$\alpha$ O—O—O—O—O—O
$\beta$ O—O—O—O—O—O
$\gamma$ O—O—O—O—O—O

The chance of this is $\frac{12}{18}$. A has to sit on one side of B; therefore there are two seats he can take out of the 17 vacant ones. The chance of this is $\frac{2}{17}$. C has to sit on *the other* side of B; therefore there is only one seat he can take out of the 16 vacant ones. The chance of this is $\frac{1}{16}$; therefore the probability of the compound event is $\frac{12}{18} \times \frac{2}{17} \times \frac{1}{16} = \frac{1}{204}$; therefore the odds against the occurrence are 203 to 1. Or the following method:—B may take any one of the 12 inside seats. To each of these positions there are two permutations, such that he should sit between A and C thus: A—B—C, or C—B—A. Therefore there are 24 possible permutations. But the whole number of permutations of 18 things taken 3 together is 18, 17, 16; therefore the probability that B sits between A and C is

$$\frac{24}{18,\ 17,\ 16} = \frac{1}{204}.$$

D. S. B.

[72659.]—**Slide-Rule.**—I do not possess one of the rules referred to by "Apprentice," but the lines of figures are probably the following:—(1) A double line of squares and diagonals; ratio 12:17.



(2) Eight-square line, for converting a square into an octagon; made use of by carpenters for converting a square log into an octagonal one; ratio 12 : 3·5. For example: A log 12in. square—Measure 3½in. from each edge, and strike lines to show edges of octagon. The annexed sketch represents the end of squared log. (3) The figures on the extreme edge of rule are probably inches expressed in decimals of a foot: ratio 12:10.

H. K. L.

[72668.]—**Armourer (U.Q.)**—There has been started what is called the Corps of Artificers, and as I believe this corps was started through the introduction of the breechloading gun, I think the new corps will mean for the Army and the Navy alike. You start with 4s. 6d. per day, and rise to, I think, 9s. I have seen one of the circulars which have been given out, but it is a few years ago, and I can't be too sure of what I say. One thing I do remember: you may be married, and, of course, you have a rank. You have to have a mechanical knowledge before you are accepted as a candidate—I mean such as a fitter, &c. You are kept twelve months at Woolwich on 4s. 6d.; as soon as you leave, your wages are increased. For information, write to the superintendent of the Royal Carriage Dept., Woolwich. You will most likely get a paper giving you all information. In any case, you will get a reply. Sorry I can't give you more.

ARMOURER.

[72685.]—**Yew.**—The contradictory statements made about the character and properties of the wood of the yew (Taxus baccata) are decidedly interesting, and I appeal for further information from readers of the ENGLISH MECHANIC who may have actually used the wood for turning, cabinet-work, &c. All the books that I have been able to consult most decidedly state that the wood is hard, durable, capable of taking a high polish—much used for making snuff-boxes, and so on—while there is the historical (or is it only legendary?) belief in the good English yew bow. Are the yews at Fountains Abbey, Yorks, still in existence; and is it true that in Switzerland the yew is called "William's tree" because the bow of the famous (perhaps fictitious) archer was supposed to have been made of that wood? Here is, then, a nut to crack, and I do not think it can be more easily cracked than by readers of the ENGLISH MECHANIC, seeing that in that list are numbered the most expert turners in the world. Is it probable that some mistake has been made as to the tree—that something else has been mistaken for Taxus? Questions such as this are worth settling, if it can be done.

NUN. DOR.

[72882.]—**Re-Spoking Bicycle.**—With the method you describe, the spokes would be still more liable to break. Your spokes are probably too thin, which would account for their breaking. I recommend you to rebuild your wheel with spokes one or two gauges thicker; or you might use butted spokes, which perhaps would be better, as then you need not re-tap the pipe-nuts.

Materniestr. 3, Dresden. A. F. SHAKESPEAR.

[72915.]—**Canal Boat.**—I do not think that there is such a similarity in the cases of the boat and train as "S. J." supposes. It is possible to lean back when dropping on to the platform, because you have the handle to support you; but on the boat there is no support, and you cannot lean back and jump forward at the same time. But

) need to run before jumping in the direc- A standing jump will give an impetus even miles per hour—more than sufficient act any tendency to a backfall.

CALDEMONE.

| — **Pidgeon English.** — This is not spelled Pidgeon, but Pigeon English. It is of English and Portuguese words formed ıese idiom used by English and other ı in their conversation and bargaining with traders of China. It has been suggested erm is for *business* English.

N. EDWARDS-ROBSON.

|—**Magnetising Steel.**—Steel is mag- drawing a magnet over it from end to eferably from the middle to the end, or, l, by passing a coil of rather thick insulated it while sending a current through the ngsten steel, hard, is the best. Full have been given many times, and will be Mr. Sprague's book, if back volumes e seen. The size of the wire does not ter, provided it is large enough to carry ing current.

J. A. F.

—**Magic Lantern.**—I was as much ıs "A. Z." by the breaking of the glass lgent lamp, caused by the unequal ex- the glass under the intense heat of a lamp. I have lost as many as six glasses in r. I have, however, discovered a remedy. hat the fracture was generally in a hori- across the glass, and I now cut the glass ly across the centre, and join the ends of th strips of gum-paper from the edge of amps. One glass so treated has lasted for 's, and is still intact, and the cut does not ıe light.

W. M. B.

|—**Turbine.** — The horse-power of a oes not depend so much on its special n the water-power available, which in ıds on the quantity in a given time, and ıd or fall. There are several designs in mes and in the textbooks; but whether a r water-wheel would be most suitable stated without more data.

L. H. B.

|—**Water Cycle.**—The water cycles do r well; only a slow speed can be got out o that almost any arrangement of wheel Perhaps the device of old John Keen is any—that, if I remember, had a kind of blade or paddle.

S. E.

—**Launch Boiler.**—I should advise to look up his back numbers, or, if he k a boiler at 80lb., to get a competent ake it.

D. M.

— **Surface Condenser.**—The horse- timated or calculated) of any engine can by the formula so frequently given; a surface condenser for an engine which at only 5lb. pressure, I think the querist the idea the "sack." From what he resume he means Hathorn, Davey, and ne, which was patented and shown at the s Exhibition. If so, he can obtain full s from the patent specification; but I was described in the "E. M." That of course, perfectly safe, and was called ıestic Motor."

R.

—**Dynamo-Winding.** — This query is ; but, whatever it may mean, the querist ll the information he requires by looking ices of his back volumes, as there have nerable replies to such questions.

Q.

— **Sour Claret.**—No cure for sour ıt is it worse than vin ordinaire? Use it a water and a little sugar.

T. M.

|—**Vacuum Tubes.** — Had this querist read up back numbers? There is a dis- present going on which may enlighten than his vacuum tube will illuminate his hy try to do absurdities?

R.

—**Watt's Bleaching Process.**—It is to say why the water won't separate, atching the performances of "Fat." The doing the bleaching process has been ; but it is impossible to provide querists rstanding.

A. W.

|—**Heat of Flue Gases.**—The heat, or ıperature, of flue gases should be as low e, consistent with the production of the lraught, for heat is necessary to produce ything under 600° Fahr. would be con- ir.

STOKER.

—**Seamless Tubes from Solid Blocks** .—This query is a caution. Why anyone e a false address when he need not give puzzle; but so far as the Mannesmann concerned, I believe the querist can the information required from the pages E. M." and the patent specification. I oubt that the company would allow him all the manipulations. So far as I can rocess will suit any dimension of weldless

S. R.

[73033.]—**Swollen Wrist.**—In the early stage of this affection a cure should have been easy, if arising from a strain or rheumatic attack. I advise the following very simple treatment, which for years past I have seen give great benefit. Every morning and evening pour some boiling water into a wash-basin, patiently sponge the affected part till quite red and sore, by using the water as hot as you can bear it. Immediately after this fomentation place the hand and wrist under the pump for ten minutes (if you cannot get iced water), rub continuously till the skin is dry and warm; envelop in a fold of soft flannel, and go to bed. During the daytime wear a stiff leather, tight-fitting collar over the soft flannel. Persevere in this treatment. I recommend a broad Pulvermacher's chain of fifty elements to be worn at night on the enlargement, should the above plain application not suffice. Muscular contraction is the desideratum.

Eos.

[73106.]—**Paddle Steamer.**—I am afraid you will have to use a governor of some kind, as models always run faster than their originals. I take it they meet with less resistance in proportion. You should, however, have reduced the pressure to the same scale.

Materniestr. 3, Dresden. A. F. SHAKESPEAR.

[73118.]—**Blackening Zinc Surface.**—I have tried the weak solution of sulphate of copper. It blackens the zinc and the silver (if it is silver) as well, but only by throwing down on the zinc a powdery precipitate, all of which comes off if touched by the finger, and most of it even under the tap.

C. L.

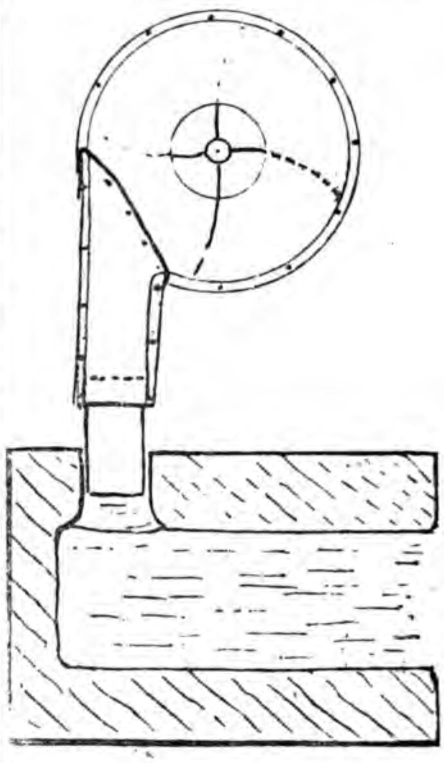
[73118.] — **Blackening Zinc Surface.**—"Beedury ware" has been manufactured for centuries at the old Mohammedan city of Beedur, near Hyderabad, and, on the authority of Dr. Heyne, consists of copper, 16oz.; lead, 4oz.; tin, 2oz., melted together. To every 3oz. of this alloy 16oz. of zinc are added, and in which state the alloy resembles pewter. I cannot say how the black ground is produced, not having visited Beedur. I bought many handsome articles of this metallic industry before leaving India, and I was told the goods were made to order by workmen who have emigrated to other places. The specimens are remarkable for having mixed gold coloured and silvery designs on a dark body—trays, caskets, vases, &c.

Eos.

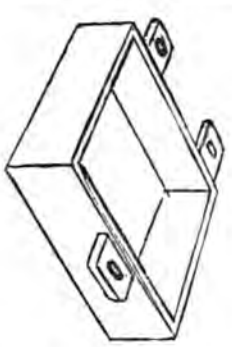
[73155.]—**The Astronomical Telescope.**—As a further encouragement to "A. T.," in answer to his query, page 323, I beg to say that my experiences with regard to the non-achromatic telescope are almost identical with those of "W. H. H." (letter 31897, page 375). Not yet being able to find the means wherewith to purchase an achromatic, I have, nevertheless, spent some pleasant hours with a home-made simple astro. telescope. The first of these was one of 2in. o.g., mounted in a cardboard tube, and for an eye-piece I mounted two plano-convex lenses of 3in. and 1in. focus respectively, in a brass sliding tube. With a diaphragm of cardboard, with a hole of ⅜in. diameter, fixed in the focus of the eye-lens, and the o.g. stopped down to about ¾in. linear, I obtained fairly clear views of lunar craters, Jupiter and his moons, star-clusters, the crescent of Venus, &c. Since then I have constructed a larger one of 4in. o.g., 60in. focal length, mounted in an octagonally-shaped wooden tube, supported on a wooden tripod stand and supports. With additional lenses of various foci, mounted in blackened tin cells made to fit the sliding brass tube, I can obtain powers of 30, 60, and 90, andby stopping the o.g. down to from 1in. to 2in., I have been able to make fairly detailed drawings of lunar craters solar spots (the latter with further diminished aperture, and a dark cap to the eye-piece), views of double stars, Saturn, Jupiter and his moons, and other interesting objects. If, then, "A. T." will follow instructions given, he will, I can assure him, be rewarded with views which will fully repay him for the time, trouble, and comparatively little expense of fitting up such an instrument as has been described.

A. W. B.

[73180.] — **Brass Castings for Electrical Work.**—For making these you will require first boxes: may be made of wood, but better cast in iron, a rectangular frame without top nor bottom, with lugs (some with holes and some with pins in), to enable them to fit together always in the same place (see sketch). For most work one top and one bottom box will be enough, but for many jobs a middle part is required; this has lugs top and bottom, one set of lugs with holes and the other with pins. These boxes should be about 1in. at least larger than your largest job. Secondly sand, which may be got from most foundries, called loam; or new sand may be used over and over again if the burnt sand on the castings is not mixed with it. When it is very dirty you may cover your pattern with new sand, then ram up with the old. Parting sand may be made by burning sand on a red-hot plate over a brisk fire, not merely drying, but burning it; then sift through a fine sieve. The brass-pot should be a plumbago crucible. The furnace: if possible use kitchen range with gas coke, but if not, you must build yourself one with bricks or lime, a tin or iron pot with fire-resisting cement. Induce a good draught with a chimney consisting of 12ft. or 15ft. of stove pipe, unless you can adapt it to an already existing chimney. If you cannot well do either of these, you must make a fan. I intend to make a furnace and fan with a tin lined with cement. Two



8in. tin plates or pans for the case of fan, and four 1in. plate blades in a wooden hub with, perhaps, a central disc, to which the blades will be soldered. I shall drive it with a small strap from a hand-wheel for short jobs, but when I want to make a number of casts I shall drive by an electro-motor direct on the shaft. As to the moulding, I have I



fear, taken up too much space already, and it is very little use trying to "mould on paper." You should see some done—that is the only way to get any real knowledge; but if you cannot, I shall be ready to give a few hints if our Editor can find space.

L. W. APPRENTICE.

[73186.]—**Benzole and Benzoline.**—Benzole is bicarburet of hydrogen—a colourless liquid compound obtained during the compression of coal-gas. It is very closely allied to benzoline, or coal naphtha, extracted at the gasometer during the distillation of coal in making gas. Those tiny bottles sold so dear by the druggists as "Benzine Collas" have always disgusted me, and I could never get satisfactory explanations on the product from gas-manufacturers or chemists when I wanted a quantity as a solvent for rubber. "Jeyes' Perfect Purifier," at about one shilling the large bottle, smells exactly like the above, and I find it an effective remover of grease and every kind of dirt. Though dark in colour, like tar, when dissolved in water, the liquid becomes milk-white, and gives no stain. I have a milk-white dog, and however dirty her coat may become, she is rendered her natural colour quickly in a warm bath of the solution; so I tried it on shooting-clothes, when the grease-spots and blood of game were dissolved in like fashion. I recommend a trial of the same on discoloured gloves; perhaps alcohol might prove better than water as a wash.

Eos.

[73197.]—**Model Boilers.**—Charcoal and spirit will burn equally well with ½in. tubes. I have used $\frac{5}{16}$in. tubes for charcoal, but cannot recommend them, as they soon get choked with ashes. As to the pressure a model will carry, that depends on the thickness of the plate and the material. Iron is best, but is difficult to work. Copper is easier to work, but has only half the strength of iron. The smallest boiler I remember carrying 100lb. pressure was that of a loco.; the length was about 9in., diameter 2½in., material, iron, ⅛in. full thick.

Materniestr. 3, Dresden. A. F. SHAKESPEAR.

[73202.]—**Indian Jugglery.**—I never witnessed the almost miraculous feat described, though I have seen sufficiently wonderful doings by the Oriental jugglers to fill a volume. I never cared much for the illusory tricks, but was greatly impressed by the long-trained agility and flexibility of the performer's bodies, the result of infantile practice, such as a girl slowly stooping backwards, and picking up a coin with her eyelids, keeping her feet almost unmoved; a man on his hands and feet face upwards, throwing a high leap over numerous dagger blades thickly arranged with their points in air; a girl with her bosom resting on the end of a pole, poised on a man's chin—such were the "Nuths" (or Mohammedan Gipsies). EOS.

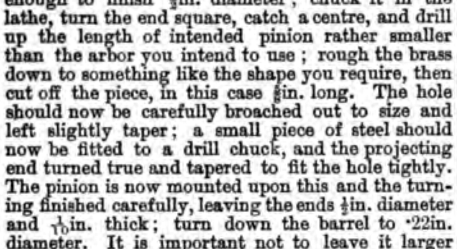
[73202.]—**Indian Jugglery—Occult Forces.**—On p. 361, "A. W. G." says, in reference to occult forces, "That these phenomena do occur there is overwhelming evidence, and it is rather too late in the day to deny their existence." I have spent considerable time in studying natural forces, but have never met with any occult ones. I would very much like to study the latter, and will feel obliged to "A. W. G." if he will be good enough to explain to me how I am to proceed. It may perhaps save trouble and space if I say that I do not want to be told some wonderful stories about these forces. I wish to be told, as clearly as possible, what I must do in order to obtain evidence of their existence in my laboratory.

WM. JOHN GREY, F.C.S.,
Analytical Chemist, Newcastle-on-Tyne.

[73252.]—**Hon. E.I. Artillery.** — I should think you could find what you require at the War Office or Colonial Office. CORAL.

[73260.]—**Lantern Pinions.**—For pinion of 12 as described in 72855, get a piece of brass rod thick enough to finish ½in. diameter; chuck it in the lathe, turn the end square, catch a centre, and drill up the length of intended pinion rather smaller than the arbor you intend to use; rough the brass down to something like the shape you require, then cut off the piece, in this case ⅝in. long. The hole should now be carefully broached out to size and left slightly taper; a small piece of steel should now be fitted to a drill chuck, and the projecting end turned true and tapered to fit the hole tightly. The pinion is now mounted upon this and the turning finished carefully, leaving the ends ½in. diameter and $\frac{1}{10}$in. thick; turn down the barrel to ·22in. diameter. It is important not to leave it larger than this, or the points of the wheel-teeth will touch it. On the outside end mark a circle very lightly ·32in. diameter; this is the pitch circle. Fit a piece of steel to drill spindle, turn and file it down to pass easily No. 60 steel-wire gauge (about ·035), remove from spindle, and give just one blow with hammer to flatten the point, sharpen to a drilling point, and harden. It should now drill hole to hold tightly No. 60 steel wire. Place the drilling spindle exactly in line with the lathe mandrel, and bring the point of drill exactly on the pitch-line of pinion, and drill right through both ends. Have the cord of drill just tight enough to drive it, as a long thin drill like this is soon broken, unless great care is used. The divisions are, of course, set out by the division plate. Short pieces of No. 60 steel wire are now driven into the holes and the ends riveted over and filed smooth. It is then returned to the lathe, the ends stoned smooth and polished. For pinion of 10, turn off piece $\frac{7}{16}$in. long, ends $\frac{1}{10}$in. thick and ⅜in. diameter, barrel ·18 diameter. I have tried twist drills for drilling pinions, but they don't enter truly in these small sizes; they have a tendency to run slightly before entering. BOD.

[73265.]—**Three-Wire System.**—I am pleased to find my old friend "Anglo-Dane" once again in "Our" paper. Annexed is a brief exposition of the principles of the three-wire system:—"On this plan the negative terminal of the first dynamo (there must be two) is connected to the positive terminal of second dynamo, and the three conducting cables A, B, C (see figure) are attached respectively to the positive terminal of the first dynamo, to the connecting-wire between the two dynamos, and to the negative terminal of the second dynamo, the lamps being arranged between the conductors A and B, also B and C. The central conductor B acts as the return for the first, and the lead for the second dynamo." (See Bromley Holmes' "Practical Electric Lighting," pp. 140, *et seq.*) May I inquire of "Anglo-Dane" as to what success he had with the dynamo for which I gave him the plan, and which Mr. Eaves condemned to the scrap-heap? I ask this, because I have had a similar machine working at Bath for nearly five years without a break. S. BOTTONE.



[73261.]—**Problem.**—Let the prices of the eggs be $a$ pence and $a\,x$ pence each respectively. Suppose—

| | | | | | |
|---|---|---|---|---|---|
| A. bought | | $p$ | eggs at | $a$ | pence each, |
| and— | | $(10 - p)$ | ,, | $a\,x$ | ,, ,, |
| and B. | ,, | $q$ | ,, | $a$ | ,, ,, |
| and— | | $(30 - q)$ | ,, | $a\,x$ | ,, ,, |
| and C. | ,, | $r$ | ,, | $a$ | ,, ,, |
| and— | | $(50 - r)$ | ,, | $a\,x$ | ,, ,, |

Then we get the equations—

$$p + (10 - p)x = q + (30 - q)x = r + (50 - r)x.$$

Or—

$$x = \frac{p - q}{p + 20 - q} \quad \ldots\ldots\ldots\ldots\ldots(\text{i.})$$

$$x = \frac{q - r}{q + 20 - r} \quad \ldots\ldots\ldots\ldots\ldots(\text{ii.})$$

Eliminating $x$—

$$\therefore\ (p - q)\ (q - r + 20 = (q - r)\ (p - q + 20).$$

Or— $$20\,p - 20\,q = 20\,q - 20\,r.$$

Or— $$p - q = q - r.$$

i.e., $p, q, r$ are in A. P ............($\alpha$)

And since $x$ must be positive—

From (i.) $p$ cannot have a value between $q$ and $q - 20$..............($\beta$)

,, (ii.) $q$ cannot have a value between $r$ and $r - 20$..............($\gamma$)

From $\alpha, \beta, \gamma$ we get the following 25 solutions:—

$$\left.\begin{array}{llll}(1) & r = 0, & q = 1, & p = 2\\ (2) & r = 1, & q = 2, & p = 3\\ (3) & r = 2, & q = 3, & p = 4\\ (4) & r = 3, & q = 4, & p = 5\\ (5) & r = 4, & q = 5, & p = 6\\ (6) & r = 5, & q = 6, & p = 7\\ (7) & r = 6, & q = 7, & p = 8\\ (8) & r = 7, & q = 8, & p = 9\\ (9) & r = 8, & q = 9, & p = 10\end{array}\right\} \therefore x = \tfrac{1}{21}$$

$$\left.\begin{array}{llll}(10) & r = 0, & q = 2, & p = 4\\ (11) & r = 1, & q = 3, & p = 5\\ (12) & r = 2, & q = 4, & p = 6\\ (13) & r = 3, & q = 5, & p = 7\\ (14) & r = 4, & q = 6, & p = 8\\ (15) & r = 5, & q = 7, & p = 9\\ (16) & r = 6, & q = 8, & p = 10\end{array}\right\} \therefore x = \tfrac{1}{11}$$

$$\left.\begin{array}{llll}(17) & r = 0, & q = 3, & p = 6\\ (18) & r = 1, & q = 4, & p = 7\\ (19) & r = 2, & q = 5, & p = 8\\ (20) & r = 3, & q = 6, & p = 9\\ (21) & r = 4, & q = 7, & p = 10\end{array}\right\} \therefore x = \tfrac{3}{23}$$

$$\left.\begin{array}{llll}(22) & r = 0, & q = 4, & p = 8\\ (23) & r = 1, & q = 5, & p = 9\\ (24) & r = 2, & q = 6, & p = 10\end{array}\right\} \therefore x = \tfrac{1}{6}$$

$$\begin{array}{llll}(25) & r = 0, & q = 5, & p = 10\end{array} \quad \therefore x = \tfrac{1}{5}$$

These are the only possible integral solutions, as the next would be $r = 42$, $q = 21$, $p = 0$, and $x = 21$, which is evidently only a repetition of No. (9).

D. S. B.

[73279.]—**Crystoleum Pictures.**—I will give you a short description how to proceed. Having your glasses and photo., rub your glass (which must be quite clean—best to polish it with a chamois leather) with fixing paste; then place the photo. into hot water for half a minute to soften it, take it out of the water, let it drain on clean blotting-paper, place it on the glass face downwards. Get a piece of parchment a little larger than the glass, place this over the photo., and with the wooden extractor work out all the fixing paste you can until the surface is free from silver lines, and place it on one side to dry. When quite dry you may rub the back of photo. with a little fine sandpaper (very little); then apply about ten or twelve drops of preservative medium, and the same quantity of crystoleum medium, on the back of photo., rub it over, and leave it. It should get quite transparent in twelve or fourteen hours. Rub off any superfluous oil, and commence to paint—jewellery, eyes, lips, &c., on first glass; complexion, dress, &c., on second glass. The mediums, &c., are supplied by artist's colourmen—Reeves, Winsor and Newton, &c., of London—for very little. I have done several pictures this way perfectly, and they look very handsome, and are well worth the trouble. I shall be pleased to help you, if I can. CORAL.

[73297.]—**Photographic Exposure.**—The scale on the lens mount gives the aperture and exposure.
For instantaneous pictures use the largest
that will give a sharp picture. For port
full aperture. If it is the usual single
exposure may be from one to three seco
copying, focus with a medium aperture an
with a small one. Expose from one to o
half minute in a good light, but not sunlight
to Lancaster's for "How to become a S
Photographer," inclosing six stamps. It is
work you require. W.

[73301.]—**Boiler.**—The small boiler of
as represented, is the most powerful; but,
and number of tubes are not given, cannot s
power, but should imagine it large enough
engine if latter is run at moderate speed, a
not leak—but probably it does. You sho
the small boiler and overhaul engine. The
of little use. It is only a dome at best, an
at, say, 40lb.

Bristol.

[73304.]—**Digitorium.**—If you have a
piano, you have the above ready made: o
lid, suspend a few slips of soft paper, &c.,
the hammers and strings of the high notes
have no dampers; a hook on top will preve
from slipping down. The ear should be tra
well as the hand. Sometimes it may be desi
practice five-finger exercises without dis
one's neighbours.

[73306.]—**Acid-Water for Boilers.**—
it away; the neutralising is not certain.

Bristol.

[73307.]—**Engine.** — Ports will do; bu
exhaust a trifle larger—about ⅝ to ¾ for h.p.

Bristol.

[73307.]—**Engine.**—The "nominal" po
J.C.'s engine will be 2¼H.P. but the ac
indicated H.P. in stationary engines varie
2½ to 3 times the nominal. His proporti
about right.

[73309.]—**Electric Bells.**—Relays are ne
here. Your best plan is to provide plenty of
power, and, if necessary, balance the bel
resistance. Use the large size cells. I exp
two bells stopped ringing when you inser
relay, because the relay coils were of high
ance, and thus did not allow enough current
other bells to pass. See my book, "P
Electric Bell Fitting." F. C. A

165, Queen Victoria-street, E.C.

[73310.]—**Telephones.**—To MR. F. C.
—Yes, ¼oz. will be sufficient, and you will
four No. 2 cells at each end. The Bell
having expired, you can use these. They
come cheaper as they require no battery.

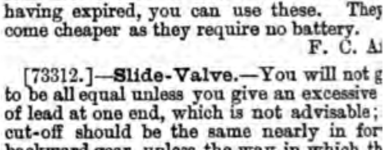
F. C. A

[73312.]—**Slide-Valve.**—You will not g
to be all equal unless you give an excessive
of lead at one end, which is not advisable;
cut-off should be the same nearly in for
backward gear, unless the way in which th
hung causes it to slide on the block. See
block goes equally to top or bottom of lin
can only make a compromise at best.

Bristol.

[73298.]—**Telephones.**—Telephones sho
permanent magnets when used in circuit
duction coils, and, indeed, in all cases w
degree of perfection is expected of them.
meant by a permanent with an iron cor
there is a permanent magnet (made of stee
in Fig. 1 at A), into the end of which
a piece of soft iron, B. This soft iron cor
netised inductively by the permanent m
and round it the coil is placed, as shown
C. The way in which telephones should
up in circuit with an induction coil is
Fig. 2, where stations A and B are joine
speaking—T being the telephones, I the
coils, M the microphone, and B the batte
induction coil, I presume "Telephones" w
is made up of two coils—one called the prin
the other the secondary, represented in the
as P and S. The primary coil is wound wi
insulated copper wire to the resistance of
ohm, and the secondary is wound to about
resistance with thinner wire, the diam. of

FIGURE I



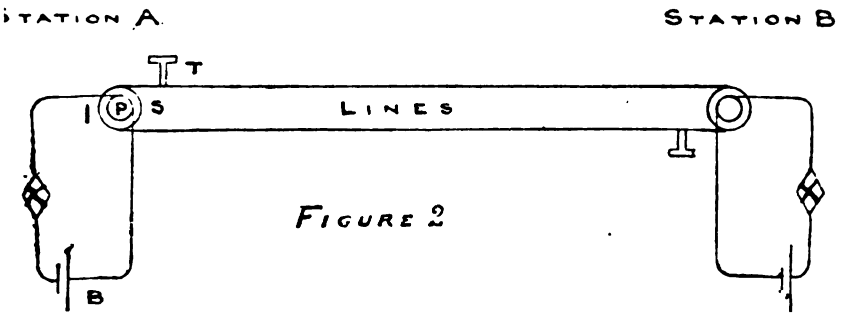


FIGURE 2

. It does not matter which coil-end of the ary you join up to your telephone. Wind lephone coils to between 50 and 100 ohms ace, and make the diaphragms about 1½in. ar, for if they are too large, there will be a sharpness in speech, owing to the elasticity ferrotype, which I suppose you will make f.

castle-on-Tyne. PERCY REID.

16.] — **Roller Bearings.**—Cast iron for , and steel or iron for pins. If the shaft is ent carried on centres, all you need do is to ingle wheel directly under shaft, say 3in. by nd let it run on that, and just slack centres they keep shaft in place. It will run lighter s you propose, the wheels are so small.

tol. T. C.

16.] — **Roller Bearings.** — The intended bearings seem to offer as much friction as earings. Why not run such a small lathe on points? At any rate, let the rollers be of or lignum vitæ, and the pins of thin steel. rollers nearly half overlapping each other not take up more room. But there is nothing se-hardened points and centres.

OLD CADET.

16.] — **Roller Bearings.** — In reply to . P.," who intends fitting roller bearings to nk-shaft, I say, don't. If well made and uite clean, they no doubt reduce the friction ; but if dirt and chips get in, they make a bominable vibration, or even bumping, of the -shaft. If "E. T. P." likes to fit his shaft so e of this, let him make the rollers of hard and case-harden the part of the shaft in conith them. A much better fitting is a swivel g about 2in. long and 1in. diameter. If he the bearing of cast iron and runs the soft iron n it, it will last for years and run light and h.

A. GRAY.

317.]—**Magnetism.**—A sheet of iron, or other etic metal, is the only thing that will shield s from the effects of a magnet.

S. BOTTONE.

319.]—**Bunsen's Battery Zincs.** — See X. "E. M." p. 660 "Sigma," replying to a r query, says: "There is no particular rule joining the ends into a complete cylinder or g them open. If joined, the conductivity be very slightly improved; if open, freer is allowed for the diffusion of the liquid, ing that outside to find its way to the interior, e advantage lies with this."

AN A.I.E.E.

320.]—**Steam.**—It will depend on how much rottle is open when engine is running. If open, the pressure would be reduced very ly.

tol. T. C.

21.]—**Finishing Leather.**—In working ookbinders' calf, care should be taken while ng it to have the water perfectly clean. If nds are also kept clean, and metal tools exl in the manipulation of it, there should not black spot. Good flour paste only should be Make only a little at a time, for if alum or her thing is put into it, it is apt to stain the r. Glue comes through damp calf, and this l be avoided. When thoroughly dry, rub the e all over with paste, and wash off again with water. The articles can now be varnished bookbinder's varnish, to be had from Mr. adorf, Shaftesbury-avenue, London, W.C. ot know of a process of enamelling, neither f a textbook on the subject. I hope this will he querist. PRACTICAL BOOKBINDER.

323.] — **Electric Bell.** — See my book ctric-Bell Construction," in which you will cale drawings of electric bells, &c. As regards ngth of time the porous pot of a Leclanché ts, this depends altogether on the amount of the cell does, and varies from three months to years. F. C. ALLSOP.

, Queen Victoria-street, E.C.

323.]—**Electric Bell.**—If you had read my ctric Bells" you would have found exactly formation you need. However, I extract here the sizes, &c., required for a 5in. gong: Length of magnet cores, 3¼in.; diameter of ditto, ⅝in.; length of bobbins, 3in.; diameter of bobbin-heads, 1⅝in.; gauge of wire on bobbins, No. 18; amount of wire on bobbins, about 10oz.; weight of hammer-head, 1oz.; length of hammer-rod, with spring, 6in. to 7in. The number of cells to be used will depend a good deal on the distance and on the frequency with which the bell is to be used. Two cells of the largest size (3 pints) will be enough for ordinary work. The duration of the charge of the porous cell of a Leclanché depends entirely on the work put upon the cell. With ordinary work, six months is a fair duration. S. BOTTONE.

[73324.]—**Wimshurst Machine.** — Except in appearance, iron or leaden balls are as effective as brass ones. But as it is almost impossible to get them hollow, they are very heavy, and require extra stout rods to support them. If you cannot get brass balls, better use wooden ones, turned up nice and smooth and coated with tinfoil, glued on and smoothed down with the polished bone handle of a knife. Tinfoil sectors are the right things to use, brass ones are always chipping off. Vacuum tubes can be well and easily lighted by a Wimshurst machine, because it gives, and they require, a small current of high voltage; but incandescent lamps cannot be lighted by the Wimshurst, because they require a large current. (See reply 73299.) The agglomerate cell will work without the porous cell, provided the zinc is kept out of contact with the carbons. The Leclanché cannot be charged from a unidirection machine or dynamo. No Leclanché cell will ever light a 2½c.p. lamp for an hour or two; 20 minutes is the utmost. It takes four cells to light a four-volt 2½c.p. lamp. Magneto machines are no use for this kind of work; better make a small dynamo. S. BOTTONE.

[73325.]—**Tennis Court.**—Red cinders (burnt ballast) can be obtained of any builders' merchants or gardeners. OTTO.

[73326.]—**Cardboard Puzzles.**—If you use a thin knife—such as a shoemaker's-knife—and keep it well sharpened at the point, you should have no difficulty in making the edges of your cardboard sharp. When you have finished cutting, rub the burr down with the handle of the knife or the end of a tooth-brush. PRACTICAL BOOKBINDER.

[73327.]—**Hughes' Magnetic Machine.**—"Scissors" had better get a copy of Prof. Hughes' paper, read before the Inst. Mech. Engineers, entitled "On the Physical Condition of Iron and Steel." In this he will find the professor's description of the instrument, and the method of using the same. I would not advise "Scissors" to use this instrument for the practical magnetic tests of iron and steel, for it is very hard to keep the small magnetising current constant, which it is essential to do. The instrument I have is made by Grove, of Bolsover-street, W.

Brymbo. T. G. L.

[73327.]—**Hughes' Magnetic Balance.**—I do not know of any book that gives a fuller description of this instrument than Prof. S. P. Thompson's "Electricity and Magnetism" (1890). There is, however, the inventor's own description in the *Proceedings* of the Royal Society, Dec. 10, 1883, in his paper "On a Magnetic Balance and Experimental Researches made therewith." Also the experimental work done is dwelt on at some length in the same author's paper before the Society of Telegraphic Engineers on May 24, 1883, on "The Causes of Evident Magnetism in Iron and Steel and Other Metals." The apparatus is arranged on a long board, and there is a coil with a hollow core, into which the specimen to be operated on is inserted, there being a stop fixed to the coil which makes all the specimens come through the same distance. The specimen when magnetised affects a finely-suspended needle placed in front of it. The magnetising effect due to the coil without the specimen is balanced by an opposing smaller coil, and these three—the two coils and the needle—are movable relatively to each other. The coils are connected to the battery through a small reversing switch, and there is a set of resistances (generally ten) in circuit. The deflections of the needle under the influence of the magnetised core are neutralised by moving a large magnet on the end of the board. This magnet has a semicircular scale, so that its neutralising effect, and therefore the relative magnetism of the specimen under treatment, can be read off in degrees. With this apparatus Prof. Hughes tested about sixty specimens of iron as to the effect of hardness and temper on magnetic permeability, and utilised the facts afterwards in his "Theory of Magnetism." C. A. JONES.

[73328.]—**Transmitted Heat.**—No amount of steam at 85lb. will give 400° to 600° Fahr. You must use hot air, or else super-heat the steam. You will do better with the air.

Bristol. T. C.

[73328.]—**Transmitted Heat.**—The heat of steam at 85lb. per square inch is about 327° F. To obtain a temperature of 400° F. would require a pressure of 237lb. The best way for "Daconne" is to use a stove with fan. A stove of the kind known as the "Gurney" is the best for the purpose.

A. GRAY.

## UNANSWERED QUERIES.

*The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.*

Since our last, "Armourer" has replied to 72668.

72694. Permanent Way, p. 195.
72720. Luminous Crayons, 195.
72737. G.E.R. Goods Tanks, 196.
72738. G.W.R. Locos.

73021. Tin and Steel Ironwork, to Flange, p. 280.

## QUERIES.

[73332.]—**Wood.**—Will some reader inform me what is the meaning of the term "texture" as applied to wood, and what is the difference between grain and cross grain? This apparently simple question arises through experiencing a difficulty in translating them into French.—P. M. F. C.

[73333.]—**Magic Lantern.**—Would any of "ours" kindly give a diagram of the rays starting from the lime cylinder in a lantern of the most approved form, and proceeding through the condenser and front lenses? And what relation must be satisfied between the focus of the condenser and front lenses? No doubt the details of the optical part of a lantern would be greatly appreciated by many readers.—J. M. K.

[73334.]—**Varnish for Paper.**—I want a reliable white varnish—either opaque or transparent, but must stand hot water. A practical recipe for making this will greatly oblige.—VERNIS.

[73335.]—**Crystallised Fruit.**—Can anyone give me instructions how to prepare crystallised fruit? I have, I fancy, all necessary apparatus, but require full details of the process.—SUCROSE.

[73336.]—**To "Jack of All Trades."**—Thanks very much for your information. Could you further oblige by telling me how to get the sulphuretted hydrogen gas, and the best way of exposing the oxide of lead to it?—BOB.

[73337.]—**To Mr. E. M. Nelson.**—Which would you recommend for a ¼in. semi-apochromatic objective—Reichart or Leitz? Would a semi-apochromatic ⅛in. have much advantage over an ordinary achromatic for general (principally botanical) work?—F. R. M. S.

[73338.]—**Hardening Bricks.**—Can any reader inform me how thin bricks are made so hard that a steel knife cannot notch their surface? I have tried glass and borax, mixed with the clay before moulding, and putting in the furnace, but without effect. Is there any recent book on brickmaking?—V. V.

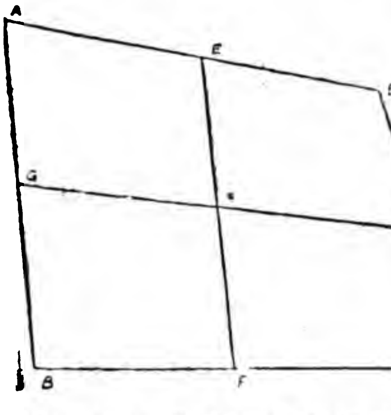
[73339.]—**Hypnotism.**—Will some reader kindly describe how to make a revolving mirror as used to produce hypnosis, and give a few hints about the best methods to use when attempting to remove evil habits by suggestion?—MESMER.

[73340.]—**Sewing-Machine Motor.**—I am in want of a motor sufficiently strong to drive a sewing machine as rapidly as or more so than can be driven by a seamstress. Will some correspondent kindly suggest what he considers to be the cheapest with efficiency, either electrical, gas, hot air, or anything but water, and probable cost per annum of working? Any suggestions will be acceptable by—WEYDEN.

[73341.]—**White Lead v. Lime, &c.**—Would some qualified reader be good enough to explain the relative properties of the above for coating interiors, surfaces exposed to the external atmosphere, and those exposed to the action of salt water—e.g., the bottom of an iron vessel? Also the most suitable drier for the respective paints? What is the best paint for protecting iron surfaces from the action of salt water? What is the precise effect of turpentine on paint? Does its property as a drier depend on its volatility, or has it a chemical action?—H. K. L.

[73342.]—**Saccharimetry.**—I would be glad to be informed of any easy method for estimating the quantity of sugar in a solution, and if there is any reagent that will precipitate the same.—H. K. L.

[73343.]—**Problem in Geometry.**—Will one of our geometrical readers solve the following problems:—1. By the aid of the First Book of Euclid only? 2. By the most simple method? Any quadrilateral figure A, B, C, D, whose sides are not parallel, are bisected at the points E, F, G, H. If from these points of bisection, lines be



drawn—viz., from E to F, and from G to H, do these lines bisect each other?—R. W.

[73344.—**Nickel Plating.**—Would an experienced reader kindly tell me if the surface of iron or steel which is to be plated should be polished or not? I have known the plating on articles which have had all file marks removed, and carefully polished with No. 1 emery cloth, peel off. So, as I have some bicycle fittings to plate, I should like to know in what state to send them to the platers—viz., (1) off the smooth file; (2) after a slight touch of emery; (3) or polished? Can the plater not avoid rounding the sharp edges of nuts, &c., when polishing the plating? Answers to the above would much oblige.—ONYX.

[73345.]—**Smoke Consumer.**—I have a complete smoke consumer, and the only difficulty I have is the durability of the tubes. I have had them made out of different mixed clays, but they soon crack. What material should I have them made out of for durability? The tube is placed in the furnace above the fire, so as to heat the air as it passes through.—ALEX. ANDERSON.

[73346.]—**Pestle and Mortar.**—I have a pestle and mortar. The mortar has crumbled away at the bottom, making a hollow space about 2in. by 1in. by ½in. deep. What can I fill it up with?—TINKER TOM.

[73347.]—**Boiler.**—Being desirous of boiling water by means of steam, I should feel thankful to any of your readers for the following information—viz., the size of a boiler (vertical or horizontal) necessary to boil, say, about 200gal. of water by the above means in about one hour, and the probable cost of the same (steel or iron).—IVES.

[73348.]—**Cooking by Steam.**—Will "Jack of All Trades" or some other kind friend say what is used as floats for self-filling of water in small steamers for cooking purposes? The float is connected on a brass rod through boiler on to a lever which controls a water cock, and as the water rises and falls so float rises and falls. The old ones are made in shape of an ordinary fire-brick, and are about the same size.—FLOAT.

[73349.]—**Ormolu Gilding.**—Will any reader tell me what this is, and how it is done, or if sent to a gilder what would be the probable cost of so gilding a skeleton brass chiming and striking clock, the plates of which are about 11in. by 10in., and elaborately cut out. I am told it is inexpensive, as compared with electro-gilding. I have such a clock nearly completed, and would like to have finished, so as to retain its polish and colour.—AMATEUR CLOCK.

[73350.]—**Sheet Metal-Working.**—I want to make a number of covers to fit over the ends of some 2in. tubes, but can't manage to turn up the edge of plate without buckling and splitting it. The edge to be ¼in. deep, material brass or copper, 1-32in. thick. What is the cause and the cure? I can manage lower edges fairly well.—A. F. SHAKESPEAR, Dresden.

[73351.]—**Polishing Copper Plates.**—I want to polish small copper plates—a true surface and fine polish required. How shall I proceed, taking the sheet metal? Have plenty of power and good strong lathe.—RATIO.

[73352.]—**Telephone Magnets.**—To MR. ALLSOP.—I have some receiver cases which have been made for the "E. M." receivers, and now the Bell patent has expired, I wish to convert them into Bell receivers. The cases are short compared with the usual size of Bell cases, but they would allow a magnet 1in. diameter and 1¼in. long, in addition to the length of core in bobbin. Should I get sufficient magnetism in such a short magnet? I have already made two receivers the same size as your sketch, but with built-up magnets, and they speak beautifully. If the above cases are suitable, would you advise me to use built-up or solid magnets, and which pole of magnet should face the earth when they are hung up at rest? as I understand that if the wrong pole of magnet is facing earth the magnetism will leave it. I am under the impression that north should point down. Then, in magnetising the steel, which do you consider best to rub it on—the field-magnets of a dynamo, or to wind it with wire and use a battery? I know it would be soonest done with a dynamo, but I am not particular about time and labour if I get the best results. Has the Gower Bell patent expired with the original Bell? If not, when will it expire?—F. W. BERNARD.

[73353.]—**Expansion in Series.**—Will "M.I.C.E." or "F.R.A.S." show me how to obtain the series—

$$R = A \left\{ 1 - n \sin.^2 l + \frac{5}{8} n^2 \sin.^2 2l + \ldots\ldots \right\}$$

from the expression—

$$R^2 = \frac{A^2}{1 + (1 - n)^2 \tan.^2 l} \left\{ 1 + (1 - n) - \tan.^2 l \right\}$$

where A = equatorial radius of earth, R = radius corresponding to any geographical latitude l? Also how to express log. R in a series of cosines of multiple arcs.—ESNE CARALITA.

[73354.]—**Casting.**—I should be obliged if some one of your readers would tell the best material to cast very fine small castings in. I at present use sand, but they come out very rough.—CASTER.

[73355].—**Heating Churches.**—Will any kind reader give information respecting the most modern, economical, and effectual method of heating as applied to churches, or give their practical experience.—HEATING. [See advt. pages in the *Building News*. Grundy's Hot Air Apparatus is as good as ever.—ED.]

[73356.]—**Brass Mixture.**—Would any of your numerous readers kindly oblige me with a good mixture for general hydraulic work castings?—BRASSEY.

[73357.]—**Pintsch's Gas.**—Will some reader kindly tell me if Pintsch's gas is suitable for gas-engines? Also what gas is it, what pressure is it stored at, and how many volumes does it expand before being burnt? Where do the makers live?—PANTAGRAPH.

[73358.]—**Killing Cement.**—Would like to know how to kill cement so as not to set for a certain number of hours, as used in tile-laying.—R. E. NEWMAN.

[73359.]—**Induction Coil for Hunning's Transmitter.**—Will anyone please inform me the best resistance for the primary of induction coil for Hunning's transmitter, and how long will it be before the expiration of the patent for the above transmitter?—F. W. BERNARD.

[73360.]—**Surfacing Copper in the Lathe.**—What form of tool is the best to leave a good finish? Have tried several—results in each case being very scratchy and rough.—H. J. J.

[73361.]—**Carbon.**—Will any of "Ours" kindly describe Prof. Silvanus Thompson's valve microphone?—size of carbon points and ball and how put together.—ELECTRO.

[73362.]—**Closed Circuits.**—Will some kind reader please supply full details for constructing a battery and bell for closed circuit alarm installations? How long do these batteries last? and what about recharging? For how long can the circuit be kept closed? Would it be practicable to construct a bell having a high resistance, using say 36 B.W.G. copper wire and No. 1 Leclanché cells in multiple arc? A few hints and particulars will oblige.—FITTER.

[73363.]—**Microphone.**—To Mr. ALLSOP.—Will you please tell me what quantity and gauge of wire should be put on induction coil for telephone? Line wire a mile long and Gower transmitter (Fig. 9.) I have tried it without coil, but it does not speak very well. My pine board is 9 by 5½, and ⅛ thick, bare, packed at four corners with ⅜ cork. Is there any means of adjustment in slacking screws at the corners? And what angle is the best for transmitter to be at? Should the carbons be very loose in the holes? It is connected up as Fig. 52.—ELECTRO.

[73364.]—**Back-Geared Lathe-Head.**—I have castings for a 5in. centre lathe-head, back-geared. Would be glad if any of our readers would tell me the best way to fit up the head, what sort of bearings, and the best way of throwing the gear in and out. My bed is cast for screw-cutting, so I should like the head fitted so that I can turn it into a screw-cutting lathe any time. Should be thankful for sketch.—AMATEUR.

[73365.]—**Small Windmill.**—Would "Jack of All Trades" be good enough to explain fully the details of windmill referred to No. 73129, p. 381. I am also interested in it for doing work similar to "New Subscriber." What would be the H.P. of a 6ft. mill as you describe? What is the meaning of the centre being an eccentric? and is there any means of keeping the speed regular? I have got a most favourable situation for it.—F. M.

[73366.]—**Electric Lighting.**—Would any of "Ours" please say how an installation of electric light will compare in cost to using paraffin oil at 3s. a gallon? And which would be the best way to light electrically a chemist's shop and couple of rooms? Say 60 or 100c.p. in all. Could an accumulator be charged by a windmill turning a dynamo during the day, and used for lighting at night? Being distant from any other source of intelligence upon the subject, I trust one or other of "Ours" will kindly give all information. Freight and erecting would most likely add 50 per cent. to the original cost.—ISAAC MEIRING, Worcester, Cape Colony.

[73367.]—**Mendelejeff's Law.**—Can any of your readers give any information about what is called Mendelejeff's Periodical Law? On what principle is it based? and has it any scientific value?—F.

[73368.]—**To Mr. Bottone.**—Last week, in a reply of yours to a query, you said that you had driven a 15s. dynamo of yours from a bicycle wheel. Could you show me how you fixed your dynamo to the bicycle, as I am rather anxious to try the same; for some time ago I bought a 15s. dynamo of yours, which was very satisfactory. The other day I was doing something to my dynamo when I rubbed some silk off the wire of my armature. Now, how much wire, and what B.W.G. wire does your armature of your 15s. dynamo want?—S. M. B. L.

[73369.]—**Lacquering for Bedsteads, &c.**—Can anyone explain how large surfaces are lacquered? I have done a lot of lacquering of small articles; but I usually get them streaky, although I have tried all ways I could think of. I have scores of times admired the lacquering on a brass bedstead which I have. It is beautifully done—equal to optical work and not a streaky place to be seen. I can get the brasswork up to perfection; but I cannot suit myself with the lacquering, although I have bought the lacquer ready made, and I have also made it up myself from recipes given in the "E.M." If any one of our practical friends will help me out of the difficulty, I shall be extremely thankful, as it is so very annoying to see other people's workmanship superior to your own, and I am one that is ashamed of turning out bad workmanship.—COUNTRY BRASS FINISHER.

[73370.]—**The "Missing" Link.**—What position does the "missing" link hold in the Darwinian hypothesis? Is it only an invention of the opponents of evolution?—E. P. J.

# ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the EDITOR of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

## HINTS TO CORRESPONDENTS.

**1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.**

***** Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

**The following are the initials, &c., of letters to hand up to Wednesday evening, Dec. 31, and unacknowledged elsewhere:—**

JABEZ FRANCIS.—R. Parr.—H. Hunter.—E. R. Dale.—J. Hagger.—A Fellow of the Royal Astronomical Society.—A. Caplatzi.—A. S. L.—R. Y. E.—O. J. L.—S. R. Bottone.—F. H.—C. M. C. B.—T. Hendry.—A Beginner.—S. B. Kincaid.—W. Howe.—Outlander.—W. G. B.—H. Wilson.—Enquirer.—Earlswood Park.—Novice.—C. J. C.—Finem Respice.—C. H. C.—M. C.

FREDERICK DAVIS. (We do not know the price; but information can be obtained from W. H. Walmsley, Limited, 1022, Walnut-street, Philadelphia.)—A. B. (We have an indistinct recollection of something of the kind being done, but not to the extent named. You could see the volumes of the building papers at the British Museum Library or at the Patent Office Library.)—AMETUAR (It is apparently a "gyroscope" top. You do not say what part you want the water to come through, nor do we think there are such tops; but there is Barker's mill, described in most textbooks of Physics.)—GEORGE ROLLER. (See "Hints" above. Dimensions for engines and boilers of various sizes have been given in recent numbers. As to the construction of dynamos, there are many details in back volumes, and several works on the subject are mentioned and advertised in our columns frequently. In fact, all your questions have been answered several times within the last few months.)—F. M (Have you seen the articles on the Model Locomotive, commenced in the number for May 16, 1890? We do not think you would get draught enough in the design sent. See indices, however, for many references to such designs.)—JAMES O. T. (The terms employed in electrical matters are explained in any of the textbooks. See the index to the last volume, or p. 154 April 18, 1890.)—J. M. C. (So far from Lieut. Fiske's Position Indicator not having been described before, you will find that it was actually illustrated in the number for April 11, 1890.)—T. W. F. (We cannot say whether it is possible for you to get into the engine-room of any of the Atlantic liners with your one year's pupilage in a locomotive works; but you can but try. As a rule, the engineers on board such vessels are all certificated men, and a year's service at sea in the engine-room, besides three years in the actual construction of engines, is necessary before you can even sit for the examination.)—R. R. THORPE. (Something depends on the quantity; but for merely keeping or using a still the license is ten shillings per annum.)—HEBBS. (Dry them, and rub up as finely as possible, or pound in a mortar.)—ROSS GEMMELL. (See indices under heading Dynamos. Even in recent numbers you will find the required information as to dynamos of the Manchester type. Why not try your device if you are not satisfied with those which have been proved to be efficient?)—W. MILNE. (Quite out of our way. It never seems to strike correspondents like you that the ENGLISH MECHANIC exists for the benefit of all its readers. If you want to arrange a little private mutual admiration society for the exchange of sketches of locomotives, or old postage stamps, or any other interesting objects, its advertisement pages are open to you by our rules; but it is a little unreasonable to expect that we should devote a couple of columns to a matter which would neither benefit nor interest one reader in ten thousand.)—A. B. T. (You can erect electric bell communication without asking any one's permission; but if the line wires over the two miles interfere with any one's rights you may find yourself in a difficulty. What you propose seems to be simply a telegraphic arrangement.)—BETA. (The liquid used by the "street" men for etching knife blades is usually either solution of sulphate of copper or dilute nitric acid. See indices.)—OTTO. (You can obtain the No. for April 4, 1879, by sending five halfpenny stamps to the publisher. In that you will find an illustrated description of the fan tremolo for American organs.)—C. DICKENS. (If you describe the method so that anyone can construct the apparatus from your published description, no one can obtain a valid patent for it afterwards.)—A CONSTANT READER. (The fault is in the child's food. Stop all greasy foods, and feed sparingly on brown bread and milk, with a baked apple once a day.)

**H.M.S. "Irresistible."**—Mr. F. Putney, R.N., who whilst suffering severely from nervous exhaustion, procured one of Harness' Electropathic Belts, writes:—"I feel greatly benefited after wearing it only a week." The mild invigorating electric currents which it imperceptibly generates cannot fail to do good in all cases of nervous muscular, or organic weakness, rheumatism, and kindred ailments. Thousands of men and women have been already restored to health by this perfectly harmless, natural, and convenient method of cure. Descriptive pamphlet and book of testimonials may be had free on application to Mr C. B. Harness, President, the Electropathic and Zander Institute, 52, Oxford-street, London, W.

in the spectrum of the Orion Nebula, and narrated how their results showed that while it was asserted (in support of the meteoritic hypothesis) that this line was the remnant of a "fluting" in the spectrum of magnesium at a low temperature; it was, indeed, and in truth, nothing at all of the sort, but had its origin in some other substance in a truly gaseous condition. This conclusion was, of course, severely attacked, much as was that, in days gone by, of those who presumed to deny the terrestrial origin of the Solar Corona; and, of necessity, Dr. and Mrs. Huggins returned to their research and repeated all their observations with that patience and minute attention to accuracy which is their most distinguishing characteristic. As a final result, they became more convinced than ever that the nebula line had nothing, proximately or remotely, to do with magnesium at a low temperature, and that assuredly it was a line, and formed no part of a fluting. Mr. Lockyer's observations had been made with comparatively small dispersion, and, although that employed by Dr. and Mrs. Huggins was greater, it was not so much greater as to silence their antagonist. But a fresh observer now appeared in the field, in the shape of Mr. Keeler, of the Lick Observatory, who attacked the problem of the comparison of the spectra of nebulæ with that of magnesium, with the tremendous dispersion of the spectrum of the fourth order in a Rowland grating of 14,438 lines to the inch—i.e., about the equivalent of the dispersion of 24 prisms of 60°, which he was enabled to do by the aid of the light-grasping power of the mammoth Lick telescope. His verdict is final. The chief bright line is a line, under any and every condition, widening when the slit is opened, and narrowing to the finest line of equal sharpness on both edges when the slit is sufficiently closed. It not only forms no part of the magnesium fluting, but does not pertain to any fluting whatever. But as if a sufficiently staggering blow had not been inflicted on the meteoritic hypothesis by these observations of Mr. Keeler, another assault at least as deadly, although of a different kind, has been made upon it by Profs. Liveing and Dewar; who, in a paper read before the Royal Society on November 20th, showed experimentally and conclusively that solid particles of sufficient minuteness would *not* act like gaseous molecules in an electric discharge, nor become luminous with their characteristic special radiation. It may seem that we have accorded an undue proportion of space to the discussion of this question; but this meteoritic theory has been so persistently puffed and advertised in the true soap and pill fashion that, as impartial historians, we feel bound to present the facts of the case as they stand, to the reader who is but too likely to have heard only one side of the question. The strongest current will scarcely now suffice to galvanise the corpse of the meteoritic hypothesis into the semblance of life again.

Spectroscopy, as applied to the heavens, has been zealously pursued. Anything more exquisite than the photographs of the solar spectrum, produced by Mr. Higgs and Mr. MacLean, it would be impossible to imagine. From an examination of seventy photographs of the spectrum of ζ Ursæ Majoris, taken at Harvard College, Prof. Pickering has arrived at the conclusion that the K line is doubled at intervals of 52 days. From the calculated period he predicted that this line should be double on December 8, 1889, and January 30, 1890; three separate photographs confirming its duplicity at the former of these dates. Similar periodicity has been detected in two other stars, β Aurigæ and *b* Ophiuchi. In ζ Ursæ Majoris, the hydrogen lines appear broader when the K line is double, and several other lines are simultaneously duplicated. Prof. Pickering explains these phenomena by assuming that the large star in ζ Ursæ is itself so close a double as to be inseparable with our optical means. Bright lines have been found by Espin in both $\theta^1$ and $\theta^2$ Orionis. Every fresh discovery tends to confirm the intimacy of the relation between these stars and the surrounding nebula.

Celestial photography continues steadily to advance. MM. Trépied and Rambaud have obtained a good photograph of the ring nebula (57M) in Lyra. Another one of the region of this nebula, taken at Toulouse by M. Baillaud, shows more than 4,000 stars within an area of three square degrees. At the December Meeting of the Royal Astronomical Society Mr. Isaac Roberts exhibited on the screen some negatives of the Pleiades, the great nebula in Orion, the spiral nebula in Canes Venatici, &c. In one of the photographs Neptune and his satellite were beautifully shown. In another the planet Vesta had moved so perceptibly during the lengthened exposure as to leave a trail like a string of beads. Some splendid photographs of the moon have been produced during the past year at the Paris Observatory by the MM. Henry *frères*.

We hear indirectly that a series of most valuable experiments have been in progress at the University Observatory at Oxford, under the active direction of the venerable Savilian professor, as a preliminary to the international star-charting by photography in which that observatory is to take part. We hope that we are not violating any confidence in mentioning that astronomers may speedily look for a chart of the Pleiades by Prof. Pritchard, surpassing anything that has hitherto appeared.

In astronomical literature we have to note the appearance of parts one and two of Vol. I. of the monumental "Bibliographie générale de l'Astronomie," (of which Vol. II. appeared first), commenced by MM. Houzeau and Lancaster, and in process of continuation by the latter. Its Introduction by the lamented quondam Astronomer Royal of Belgium, which takes the form of a history of astronomy from the earliest ages, is very much more interesting and absorbing than an overwhelming majority of novels. The general character of the work absolves us from the necessity of uttering a panegyric on it here. Vols. II. and III. of the new edition of Chambers's well-known "Handbook of Astronomy," complete what may fairly be regarded as a small encyclopædia of the science. The "Old and New Astronomy" of the late Richard A. Proctor, which was to have been completed by a gentleman currently reported to be of Mrs. Proctor's own selection, seems to have come to an untimely end altogether. Since Mr. Proctor's death a number has now and then straggled out at an interval of some months, more or less; but now the interval has become so inordinate that the work has practically dropped out of the public ken. Among the most important works of the year must be reckoned Miss A. M. Clerke's "System of the Stars," which is unsurpassed as an exposition of our existing knowledge of the sidereal universe by any volume which has so far appeared. Another work, on different lines, is probably also destined to become an astronomical classic: we refer to Dr. Dreyer's scientific Biography of Tycho Brahe. In theoretical astronomy, emphatically the book of the year is M. Abel Souchon's "Traité d'Astronomie Théorique"; but, *ex necessitate*, it must address a comparatively limited public. "The Greenwich Ten Year Catalogue of Stars," though nominally published in 1889, was really not in circulation until 1890. It contains the places for 1880 of 4,059 stars, and forms a noble monument of scientific accuracy. A third edition of Yarnall's well-known and very useful Star Catalogue has been published. Prof. Frisby has obviously taken immense pains to eliminate every recognisable erratum in the previous edition. Among minor works we may mention Mr. J. E. Gore's "Scenery of the Heavens"; Sir R. S. Ball's "Star Land"; and Miss E. Brown's "Caught in the Tropics" as each and all of interest to the amateur astronomer.

The solitary invention in the shape of an instrumental aid to astronomical observation that we have to chronicle here is the compound wedge photometer of Dr. Spitta. It consists simply of two precisely similar wedges, placed in opposite directions, so that one will slide over the other, and so form a parallel plate, whose thickness varies as the bases of the wedges approach or recede. The advantage of this instrument in comparing the light of a disc with that of a point will be immediately obvious.

Among the events of general astronomical interest which have distinguished the year gone by, the establishment of the British Astronomical Association must have pre-eminence. It may be said to have had its inception in a letter in these columns by Mr. E. W. Maunder some five short months ago: and already it numbers between 500 and 600 members. A more vivid illustration of the great and rapidly-growing taste for the study of astronomy it would be impossible to conceive. We have to chronicle the appointment of Dr. Raoul Gautier as Professor of Astronomy and Director of the Observatory in the University of Geneva, and the resignation of the Directorate of the Pulkowa Observatory by Prof. Otto Struve. The University of Cambridge has finally arranged to accept Mr. Newall's great telescope; Mr. Newall's son having offered, not only his own services for five years gratis as observer, but to give £500 for initial expenses and £200 a year for maintenance during the same period, conditionally on the University itself supplying the small balance needed. This they have done, and, according to a statement by a correspondent in these columns, have further gone begging to an American lady for (and have succeeded in obtaining) a spectroscope.

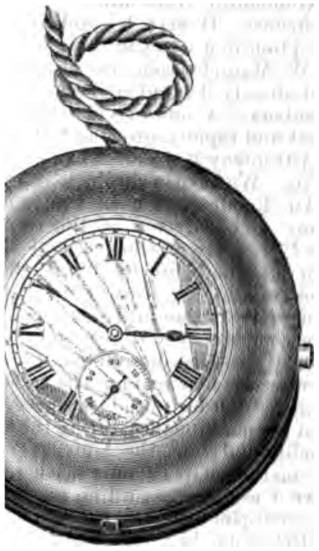
The splendid gift of Mr. F. McClean of £12,000 to the University of Cambridge to found three "Isaac Newton" studentships in Physical and Gravitational Astronomy, demands, as it so well deserves, a paragraph to itself. To add anything to the mere record of this munificence would seem almost an impertinence.

The leading astronomers who during the past twelve months have "joined the majority" are Dr. Wentworth Erck, who died on January 15th—formerly well known as an able amateur astronomer, he latterly devoted himself wholly to the Irish Land Question; M. Ch. Montigny, whose death on March 16th deprived the world of its very first authority on the subject of scintillation, one which he had made pre-eminently his own; M. Fievez, the spectroscopist of the Royal Observatory at Brussels, who, beginning life as a soldier—like many other men in the service—beat his sword into a ploughshare, and relinquished the paths of war for those of science; Dr. Herman Schultz, the director of the Upsala Observatory; Dr. C. H. F. Peters, Professor of Astronomy at Hamilton College, U.S.; the head of the Christiania Observatory, M. Carl Frederick Fearnley; Senor Oom, the director of that at Lisbon; and Prof. Rosenberger, of Halle, who had been for fifty-five years an Associate of the Royal Astronomical Society. The death of Mr. Nasmyth has also been announced. He will be principally remembered among astronomers as the constructor of a series of most beautiful (if not rigidly accurate) models of portions of the moon's surface, and as the author (in conjunction with Mr. Carpenter) of a work on "The Moon, considered as a Planet, a World, and a Satellite."

uding our necrology, we may iat the memorial erected to the C. Houzeau has taken the useful priate form of a meteorological ith a barometer, thermometer, the moon's phases, wind vane, ary sphere. The latitude and f the column are engraved on it. ial to Father Perry is to take the propriate shape of a large object- at observatory which he loved so ı which he did so much good and ork.

## ND CO.'S TEMPOLUX, OR TRIC WATCH LIGHTER.

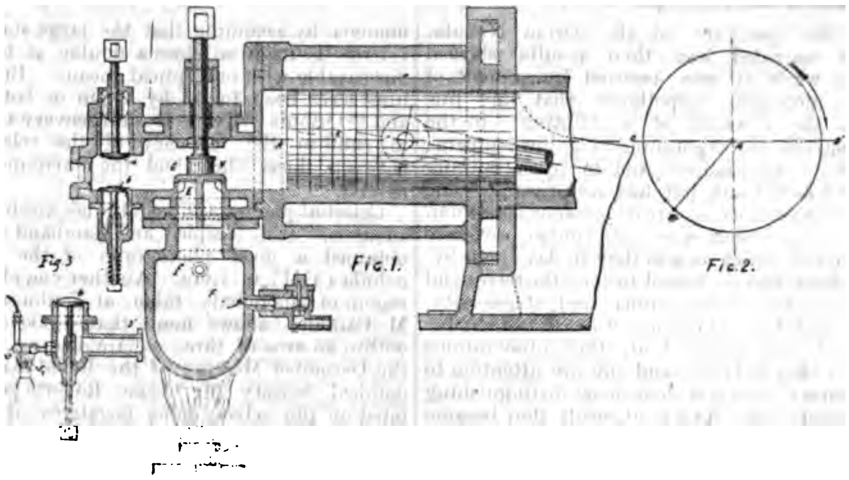
levices have been placed before the c from time to time intending to by different methods what this firm ve done with their *dry batteries*— provide an easy, safe, and constant



ıminating a watch or clock at any night by an electric lamp. The a small divided case with a minute lamp and reflector fixed in the rim llow so that the watch may be laid e case closed up, when, upon press- tud, the face of the watch will be luminated. The source of electricity r dry battery, which may be put ıpboard or other convenient place, a reaching from it to the head of the on which the watch is placed. The ee from smell, no chemicals are used will last for this purpose for years. with defective eyesight, a special with magnifying lens is provided. are Messrs. Gent and Co., of Fara- Leicester.

## 'S PETROLEUM ENGINES.

ravings annexed show the principle ich Herr Otto Lindner, of Brussels, petroleum engine working on the ystem with compression of the ex- ure. The invention has been recently this country, and its object is to engine in such a manner that the chamber can be highly heated by ıns before the engine is started, and hile it is at work, in order to ensure oration and complete combustion of m supplied to the engine; also to premature explosion of the com- ture during the period of suction and ion, which explosions frequently cooled and therefore highly heated chambers. The principal feature of ists in the combination of a cooled nder with an entirely uncooled com- nber and with a valve adapted to communication between the said manner hereinafter described. In nying drawings, Fig. 1 is an axial ring the rear part of the working



cylinder, as well as the combustion chamber and valve-box of a petroleum engine embodying my invention, while Fig. 2 is a diagram of the crank or crank disc, and Fig. 3 is a detail view showing the means for producing a mixture of air and petroleum-gas in one of the methods of working hereinafter described.

A is the working cyliner surrounded by a cooling jacket C, K the working piston, G the valve chamber fixed to the rear end of the working cylinder and provided with a cooling jacket; F the combustion chamber fixed to the bottom or side of the valve chamber, and provided with an inlet *p* for petroleum, and with an igniting tube *f* or other suitable device for igniting the combustible mixture, *b* is the valve for the admission of air and combustible mixture, *a* the exhaust valve, and V the valve which serves to open and close the passage E between the combustion chamber F and the working cylinder A. The chamber F is a separate metallic vessel which projects from the valve chamber, so that it can be heated all round. The valves are connected with the engine shaft, or other moving part, in such a manner as to open and close automatically at the required moment of each cycle. The mechanism for operating the valves from the engine shaft is analogous to that used in other engines, and therefore not shown by the drawings.

The engine may be adapted for two different methods of operation. 1st method.—During the suction period, the combustible mixture (mixture composed of petroleum gas coming from a vaporiser *v*, heated by a flame $v^1$, Fig. 3, and atmospheric air coming from the tube $b^1$) enters through the valve *b* and valve-box G into the cylinder A; during the following return stroke (compression period) the mixture is compressed to about two atmospheres, at which moment the crank pin occupies approximately the position indicated in the diagram, Fig. 2 by the letter *m*, if *o* and $o^1$ indicate two dead centres. In this position, the valve V opens and allows the compressed gaseous mixture to enter through the passage E into the combustion chamber F, in which it is highly heated and ignited at *f* by one of the well-known automatic devices usually employed for this purpose. Then follow the generation of gases by combustion, their expansion in the working cylinder, and subsequent discharge through the valve *a* in the usual order. If, during the working of the engine, the chamber F becomes so hot that its walls will ignite the combustible mixture before ignition takes place at *f*, this is an advantage rather than a fault, because at this moment the piston is always at its inner dead centre, and therefore ready to commence the working stroke.

2nd method.—During the suction period, air alone is drawn into the cylinder A through the valve *b* (which in this case has no vaporiser), while the valve V remains closed and the petroleum is forced or injected inte the heated chamber F through the inlet opening *p*. The petroleum may be evaporated by means of a vaporiser before its admission through the valve O, in a manner similar to that shown by Fig. 3; or a petroleum spray may be forced through the said valve O, and be transformed into gas by impinging against the heated walls of the chamber F. In both cases the valve O is automatically closed after having admitted the petroleum. At a suitable moment during the compression period the valve V is opened, and thereby the compressed air allowed to enter the chamber F, in order to mix with the petroleum vapour in the proportion necessary to produce perfect combustion. By this manner of supplying petroleum to the chamber F, the contact of the same with the working cylinder is entirely prevented, waste of petroleum is avoided, and the cylinder kept clean. The valve V is sufficiently cooled by the current of air which is coming from the valve *b*.

## HOW BOOKS ARE BOUND.—XIV.

By "Practical Bookbinder."

When we have gilded the back of half-bound books (at which stage we have left our copy of "Moore's Irish Melodies") it is necessary to put the sides on and "paste up."

The sides may either be cloth or paper—i.e., marble paper, although for the volume under discussion cloth sides will be best.

Bookbinder's cloth is made in every variety of colour and grain. We will require a piece of green as like the shade of the leather as possible, a little darker rather than lighter. When we have selected it we cut a piece sufficient for both sides—a little larger—so as to turn in ½in. all round. Square one edge, and lay it close to the leather at the back, and fold back the corners and cut them out, as shown at Fig. 43. After the sides have been cut they are glued with warm, thin glue, and laid on to the leather evenly and turned in neatly, after which they are rubbed with the folder so as to make them stick. The turn-in of the side is shown at Fig. 44. Now trim it round neatly so that the leather and cloth will be square, and not present a lumpy, uncouth appearance when the book is opened. The part of the end-papers which we tore out and laid aside are now cut to fit exactly between the turn-in of the leather and cloth; these are pasted and placed upon the inside of the board, and rubbed down carefully.

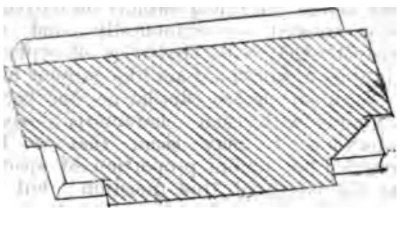


FIG. 43.

After the two boards have been lined, the next leaf of the end-paper is "pasted-up." This is done by opening the board, and pasting the first leaf. It is then lifted up and placed carefully against the board, allowing it to come up to the foredge, at the same time allowing sufficient play to the joint, so that it will not break when the book is in use. The book is turned over, and the other side treated in like manner. It is then laid aside to dry, with both boards standing open. This is called "pasting-up open," and is the method adopted for all the better classes of books. Common work, such as cloth-work, is pasted-up in the press. The former method will be best for amateurs, as they are not likely to be blessed with many presses. Care must be taken to rub the end-paper down well to insure it sticking to the board, and the same care must be exercised with the joint, so that the book will shut without wrinkling.

The operation following pasting-up is "burnishing" the edges. When the book has become sufficiently dry, it is closed and put in the lying press between boards, with the foredge up; a tool called a dog-tooth burnisher is taken, and the edge is burnished with it, rubbing the edge carefully—moving the arms to and from the body. These burnishers are generally made with a pebble or agate, mounted on a wooden handle with a brass ferrule; the shape will be seen from Fig. 45. Whether the edges have been marbled or sprinkled, it will be best to burnish them, as it adds much to the appearance of the book. The three edges are, of course, treated alike.

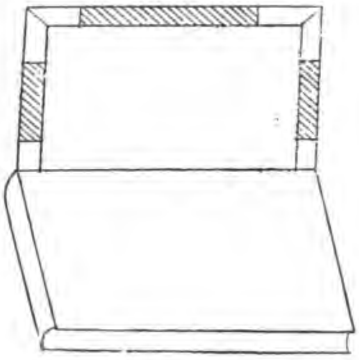


FIG. 44

FIG. 45

When the edges have been burnished, the book is pressed; if possible, smooth tins are put inside and outside the board, so as to make the leather nice and smooth. When pressing morocco books it is necessary to protect the grain, so, instead of tins, boards covered with flannel are used; when these are not procurable, a few sheets of good blotting may be substituted.

Before pasting-up full-bound work, it is usual to tool the inside of the squares; sometimes this is very elaborate, at other only a plain roll, such as a simple flower-roll. To do this the squares are glaired, and the gold laid on and impressed in usual manner: it is then polished with the polisher, and the book pasted-up as already described, and afterwards pressed. When sufficiently pressed, the half-bound book is taken out, and as it has to be ornamented with a gilt roll along the edge of the cloth on the leather, it is glaired evenly with a camel's-hair pencil close to the cloth, broad enough to take the roll. When it is dry the roll is heated, and a leaf of gold taken upon the cushion and cut into narrow strips, the roll receives a rub with the gold-rag, which makes it lift the gold from the cushion when it is run over it. The roll is filled with the gold and run up the book, starting carefully at the edge, and running evenly until the other edge is reached, exerting all the while a nice steady pressure to insure the gold sticking. The surplus is now wiped off as directed for other work.

As soon as the gilt roll has been put on, the parts of the leather upon which there is no tooling is washed with clear water and a soft sponge. After it has become dry it is usual to put a blind line alongside the gilt roll on the side; when this has been done, the squares are polished with a warm polisher both inside and outside. This being done, the books are brushed up, which finishes them.

When working with light-coloured calf, such as "London brown" (which is really a bright yellow), red, or light blue, sometimes through a little careless handling slight stains may get upon the work; to remove this put a little oxalic acid in the water. This, although very handy, should be used very carefully, or the colour of the leather may be completely spoiled. If you get a pennyworth of acid at the chemist's, and put it into a pint bottle and fill it up with water, it will be plenty strong enough; a few drops of this put into the water when washing the colours mentioned will, besides removing stains, brighten them up: indeed, this is always done in the shops; but the amateur must be careful, or he will spoil his work. Some colours are very fast—red and blue for instance, whilst others, such as green and maroon, are easily spoiled. I have taken out an ink stain from red calf with the above solution.

It is often desired to put a ribbon mark in a book. This is usually done before covering it with leather, but if it has been left out by an oversight, or if it may be an after-thought, it can be done in the following manner: Lay the book open about the centre upon the table, and after having cut a length of ribbon, which, if measured from corner to corner lengthways, will be about right; paste about ⅛in. of the end both sides; lay the pasted part in at the top of the book, and press it down into the centre of the fold with a pen-knife, or some other tool; turn over a few leaves, and put the rest of the ribbon in edgewise, leaving a little loop at the head, and the end of the ribbon at the tail. This, besides being useful to the reader, preventing the necessity of dog-ears, is quite ornamental, and should always occur in the better class of books, especially those books which have gilt edges.

Books bound in light-coloured calf are often seen with black tooling: to get this effect is a very simple matter, and I am sure that all amateurs will be pleased to know the dodge. It is *not* done with printer's ink—I know you will think it is. No! after you have tooled it blind, as we say—that is, without any gold, merely the impression of the warm tool—hold the tool over the gas flame until it is blackened all over, then re-impress the tool upon the work; this will leave it a dull black. When you have all the parts blackened, clean the tool, and go over all again, impressing again and again until the tooling shines as if it had been varnished. It can be, and in the case of lines, it is much easier to varnish with black varnish, made of shellac varnish and gas soot. This must be painted into the impression of the lines very carefully with a camel's hair pencil.

In reply to "Nomad" (query 73173), my next article will be devoted to mending books, albums, &c. I am certainly much pleased with the interest taken in these articles, and I may state here, that as I am and have been for a very long time a regular "taker-in" of the "E. M.," I will be very pleased to answer any question relating to bookbinding, or anything in connection with the stationery trade at any time, to the best of my ability.

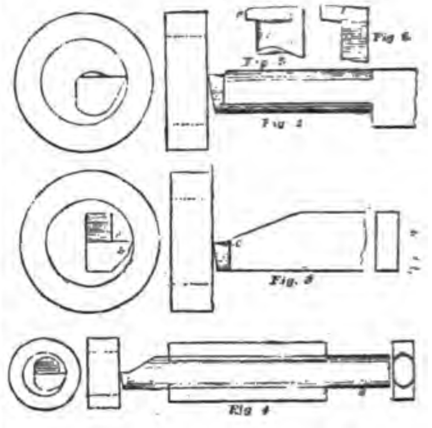
## REFORM IN BORING TOOLS.*

SOME years ago, while working in a jobbing shop, a shopmate had occasion to get up a boring tool in a hurry. I met him when coming from the blacksmith shop, and he showed a tool like Fig. 3. He said, "I didn't have time to get one drawn out, but as the hole I am going to bore is quite large, I guess this will do. I guess the blacksmith did not understand me very well, for he made this upside down." That "upside-down" tool did do his job all right, and also a great many other fellows' jobs, who were lucky enough to find it not in use.

In Fig. 1 we see the style of boring tool most in use. Of course when boring a small hole we have to use a tool that will go in that hole, but there is no excuse for making all boring tools like Fig. 1: Fig. 3 will bore quite a small hole when made of the same size steel as the usual turning tools. Of course, if we have the point of tool about flush with the top of body, as in Fig. 1, and made in the usual way (the idea the shopmate must have had when he spoke about "upside down"), we could not then use it as I show in Fig. 3. Theoretically I suppose it would not make any difference whether the point of tool is the same height as the centre or not, provided that the line A (in Fig. 3) is kept radial, and the angle B is kept the same, but practically I believe most lathes work best when the tool is shown as in Fig. 3.

Most shops do not have a great variety of boring tools, and so when the kind like Fig. 1 are used, a great many times a job that will admit of a short tool has to be done with one a great deal too long and slender.

In Fig. 3 the tool can be either long or short a will, by just pushing it through the tool-post. I believe that tools like Fig. 3 and Fig. 4 will cover the whole ground. Fig. 3 is as stiff, probably, as the lathe will carry, and is just as stiff as Fig. 1 would be if the rounded part had twice the stock in it that the part that goes in the tool-post has. No part of the tool need be stronger than its weakest place, and as we cannot exceed a certain size steel (provided we use the tool-post), then Fig. 3 is as stiff as we can use.



For small holes, Fig. 4 is the best rig I have ever used. We can use different sizes of steel for tools, and cover all sizes that Fig. 3 will not.

I wish to say a few words about the shape of the point of boring tools. Fig. 5 is the form used when a man finds it necessary to get his lathe to bore a taper of about ½in. to the foot, when trying to bore a straight hole. That round point is a great help to make the tool crowd away from its work.

I find that a point shaped like Fig. 6 works well. I just take the sharp corner off the point.

Sometimes when boring a long hole in cast-iron where there is scale, a tool with quite a radical hook ahead will hook under the scale and keep to its work, where one with a round point would spring and crowd away. I like to have quite a good top rake on a boring tool, especially when boring wrought-iron. In some lathes we could not get a tool like Fig. 3 high enough.

When there is no adjustment that will allow of this height being reached, and the slot in tool-post is not high enough to allow the tool to be blocked up, it is a fault of the lathe, and ought to be remedied.

I have found many lathes where the cross-screw was so short that the tool-block could not be moved to the centre without running off the screw. With such lathes it is necessary to have an offset in a boring tool, which is a nuisance. It seems to me that anyone who is competent to build lathes ought to make such screws long enough.

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* By A MECHANIC, in *American Machinist*.

## THE ELECTRO-MAGNET.—X.*

### The Coil-and-Plunger.

FIRST let me deal with the apparatus whereby an iron core is attracted into a tubular coil or solenoid, an apparatus which, for the sake of brevity, I take the liberty of naming as the *coil-and-plunger*. Now, from quite early times (from 1822 at any rate), it was known that a coil would attract a piece of iron into it, and that this action resembled somewhat the action of a piston going into a cylinder—resembled it, I mean to say, in possessing an extended range of action. The use of such a device as the coil-and-plunger was even patented in this country in 1846 under the name

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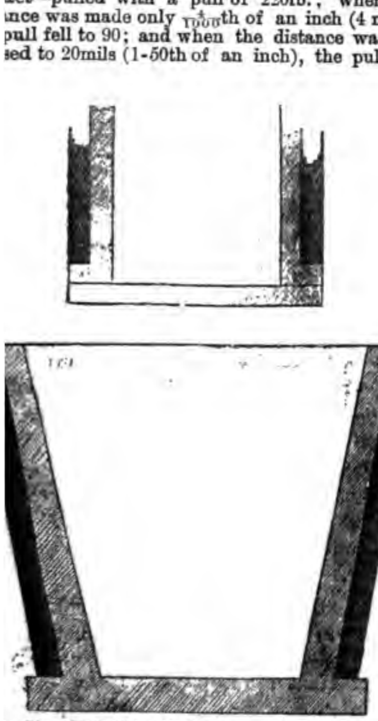
* Extracted from the Cantor Lectures delivered by Prof. SILVANUS P. THOMPSON, B.Sc., before the Society of Arts.

"a new electro-magnet." Electro-magnetic ines, or motors, were made on this plan by Page, afterwards by others, and it became generally wn as a distinct device. But even now, if you iire into the literature of the textbooks to know it are the peculiar properties of the coil-and-iger arrangement, you will find that the books you next to no information. They are con- to deal with the thing in very general terms by ng: Here is a sort of sucking magnet; the core ttracted in. Some books go so far as to tell you the pull is greatest when the core is about half- in, a statement which is true in one particular, but false in a great many others. Another k tells you that the pull is greatest at a point centimètre below the centre of the coil, for igers of all different lengths—which is quite rue. Another book tells you that a wide coil s less powerfully than a narrow one—a state-t which is true for some cases and not for others. books also give you some approximate rules, ch, however, are very little to the point. The on why this ought to receive much more careful ideration is because in this mechanism of coil--plunger we have a real means not only of ilising, but also of vastly extending, the range he pull of the electro-magnet. Let us take a simple example for the sake of contrasting the ge of action of the ordinary electro-magnet with range of action of the coil-and-plunger.

ere are some numbers which are given in a paper which I have long been familiar, a paper read he late Mr. Robert Hunt in 1856 before the itution of Civil Engineers, and discussed with eminent engineer, Robert Stephenson, in the r. Mr. Hunt described the various types of ors, and spoke of this question of the range of on. He recounted some experiments of his in which the following was the range of action. re was a horse-shoe electro-magnet which at ince zero—that is, when its armature was in act—pulled with a pull of 220lb.; when the ince was made only $\frac{1}{1000}$th of an inch (4 mils), pull fell to 90; and when the distance was in-sed to 20mils (1-50th of an inch), the pull fell



3. 29.—Hjörth's Electromagnetic Mechanism.

nly 36lb. The difference from 220 to 36 was in a range of 1-50th of an inch. He contrasts with the results given by another mechanism, quite the simple coil-and-plunger, but a variety ectro-magnet, brought out about the year 1845 Dane living in Liverpool named Hjörth, ein a sort of hollow truncated cone of iron 29), with coils wound upon it—a hollow ro-magnet, in fact—was caused to act on ner electro-magnet, one being caused to plunge the other. Now we have no information what pull was at distance zero with this curious igement of Hjörth's, but at a distance of 1in. ull (with a very much larger apparatus than 's) was 160lb., the pull at 3in. was 88lb., at 72lb. Here, then, we have a range of action not over 1-50th of an inch, but over 5in., and g not from 220 to 36, but from 160 to 72, ob-ly a much more equable kind of range. At nstitution of Civil Engineers on that occasion mber of the most celebrated men—Joule, er, Sir William Thomson, Mr. Justice Grove, Prof. Tyndall—discussed these matters—dis-d them up and down—from the point of view inge of action, and from the point of view e fact that there was no means of working them at that time except by the consumption of zinc in a primary battery; and they all came to the conclusion that electric motors would never pay.

Well, from the discussion in 1856—when this question of the length of range was so distinctly set forth—down to the present, there have been a large number of attempts to ascertain exactly how to design a long-range electro-magnet, and those who have succeeded have, as a general rule, not been the theorists; rather they have been men compelled by force of circumstances to arrive at their result by some kind of—shall we call it—"designing eye," by having a sort of intuitive perception of what was wanted, and going about it in some rough-and-ready way of their own. Indeed, I am afraid had they tried to get much light from calculations based on orthodox notions respecting the surface distribution of magnetism, and all that kind of thing, they would not have been much helped. There is our old friend, the law of inverse squares, which would, of course, turn up the first thing, and they would be told that it would be impossible to have a magnet that pulled equally through any range, because the pull was certain to vary inversely according to the square of the distance. I notice that, in a report of my second lecture in one of the London journals, I am announced to have said that the law of inverse squares did not apply to electric forces. I beg to remark that I have said no such thing. It is well to be precise as to what one does say. There has been a lively discussion going on quite lately whether sound varies as the square of the distance—or rather, whether the intensity of it does—and the people who dispute on both sides of the case do not seem to know what the law of inverse squares means. I have also seen the statement made in the columns of the *Times*, by one who is supposed to be an eminent authority on eyesight, that the intensity of the colour of a scarlet geranium varies inversely with the square of the distance from which you see it. More utter nonsense was never written. The fact is, the law of inverse squares, which is a perfectly true mathematical law, is true not only for electricity, but for light, for sound, and for everything else, provided it is applied to the one case to which a law of inverse squares is applicable. That law is a law expressing the way in which action at a distance falls off when the thing from which the action is proceeding is so small compared with the distance in question that it may be regard as *a point*. The law of inverse squares is the law universal of action proceeding from a point. The music of an orchestra at 10ft. distance is not four times as loud as at 20ft. distance; for the size of an orchestra cannot be regarded as a mere point in comparison with these distances. If you can conceive of an object giving out a sound, and the object being so small in relation to the distance at which you are away from it, that it is a point, the law of inverse squares is all right for that, not for the intensity of your hearing, but for the intensity of that to which your sensation is directed. In no case, however, are sensations absolutely proportional to their causes. When the magnetic action proceeds from something so small that it may be regarded as a point compared with the distance, then the law of inverse squares is necessarily and mathematically true.

You all know how a long tube of coil such as this will act on an iron core. Let us make an experiment with it. I turn on the current so that it circulates around the coil along the tube, and when I hold in front of the aperture of the tube this rod of soft iron, it is sucked into the coil. When I pull it out a little way it runs back, as with a spring. The current happens to be a strong one—about 25 ampères.

There are about 700 turns of wire on the coil. The rod is about 1in. in diameter and 20in. long. So great is the pull that I cannot pull it entirely out. The pull was very small when the rod was outside, but as soon as it gets in it is pulled actively, runs in, and settles down with the ends equally protruding. The tubular coil I have been using is about 14in. long; but now let us consider a shorter coil. Here is one only half-an-inch from one end to the other, but I have one somewhere still shorter, so short that the length, parallel to the axis, is very small compared with the diameter of the aperture within. The wire on it consists of but one single turn. Taking such a coil, treating it as only one single ring, with the current going once round, in what what way does it act on a magnet that is placed on the axis? First of all, take the case of a very long, permanently magnetised steel magnet, so long, indeed, that any action on the more distant pole is so feeble that it may be disregarded altogether, and only one pole, say the north pole, is near the coil. In what way will that single turn of coil act on that single pole? This is the rule: that the pull does not vary inversely as the square of the distance, nor as any power at all of the distance measured straight along the axis, but inversely as the cube of the slant distance. Let the point O in Fig. 30 represent the centre of the ring, its radius being $y$. The line OP is the axis of the ring, and the distance from O to P we will call $x$. The slant distance from P to the ring we call $a$. Then the pull on the axis towards the centre of this coil varies inversely as the cube of $a$. That law can be plotted out in a curve for the sake of observing the variations of pull at various points along the axis. Allow me to draw you attention to Fig. 31, which represents a section or edge view of the coil. At various distances right and left of the coil are plotted out vertically the corresponding force, the calculations being made for a current of 10 ampères, circulating once around a ring of 1 centimètre radius. The force with which such a current acts on a magnetic pole of unit strength placed at the central point is 6·28 dynes. If the pole is moved away down the axis, the pull is diminished; at a distance away equal in length to the radius it has fallen to 2·22 dynes. At a distance equal to twice the radius, or one diameter, it is only 0·56 dynes, less than $\frac{1}{10}$ of what it was at the centre. At two diameters it has fallen to 0·17 dyne, or less than three per cent.; and the force at three diameters is only about two per cent. of that at the centre.

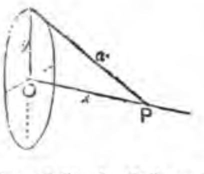


FIG. 30.—Action of Single Coil on Point-pole on axis.

If, then, we could take a *very* long magnet, we may utterly neglect the action on the distant pole. If I had a long steel magnet with the south pole 5 or 6 feet away, and the north pole at a point 3 diameters (i.e., 6 centimètres in this case) distant from the mouth of the coil, then the pull of the current in one spiral on the north pole 3 diameters away would be practically negligible: it would be less than two per cent. of what the pull would be of that single coil when the pole was pushed right up into it. But now, in the case of the tubular coil, consisting of at least a whole layer of turns of wire, the action of all of the turns has to be considered. If the nearest of the turns of wire is at a distance equal to three diameters, all the other turns of wire will be at greater distances, and, therefore, if we may neglect such small quantities as 2 per cent. of the whole amount, we may neglect their action also, for it will be still smaller in amount. Now, for the purpose of arriving at the action of a whole tube of coil, I will adopt a method of plotting devised by Mr. Sayers. Suppose we had a whole tube coiled with copper wire from end to end, its action would be practically the same as though the copper wire were gathered together in small numbers at distant intervals. If, for example, I count the number of turns in a centimètre length of the actual tubular coil which I used in my first experiment, I find there are four. Now if, instead of having four wires distributed over the centimetre, I had one stout wire in the middle of that space to carry four times the current, the general effect would be the same. This diagram (Fig. 32) is calculated out on the supposition that the effect will be not greatly different if the wires were aggregated in that way, and it is easier to calculate. If, beginning at the end of the tube marked A, we take the wires over the first centimètre of length and aggregate them, we can draw a curve, marked 1, for the effect of that lot of wires. For the next lot, we could draw a similar curve; but instead of drawing it on the horizontal line, we will add the several heights of the second curve on to those of the first, and that gives the curve marked 2; for the third part, add the ordinates of another similar curve, and so gradually build up a final curve for the total action of this tubular coil on a unit pole at different points along the axis. This resultant curve begins about 2½ diameters away from the end, rises gently, and then suddenly, and then turns over and becomes nearly flat with a long level back. It does not rise any more after a point about 2½ diameters along from A; the curve at that point becomes practically flat, or does not vary more than about 1 per cent., however long the tube may be. For example, in a tubular coil 1in. in diameter and 20in. long, there will be a uniform magnetic field for about 15in. along the middle of the coil. In a tubular coil 3 centimètres in diameter and 40 centimètres long, there will be a uniform magnetic field for about 32 centimètres along the middle of the coil. The meaning of this is that the value of the magnetic forces down the axis of that coil begins outside the mouth of the tube, increases, rises to a certain maximum amount a little within the mouth of the tube, and after that is perfectly constant nearly all the way along the tube, and then falls off symmetrically as you get to the other end. The ordinates drawn to the curve represent the forces at corresponding points along the axis of the tube, and may be taken to represent not simply the mag-

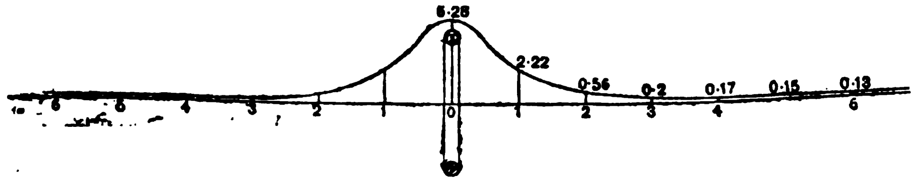


FIG. 31.—Action along Axis of Single Coil.

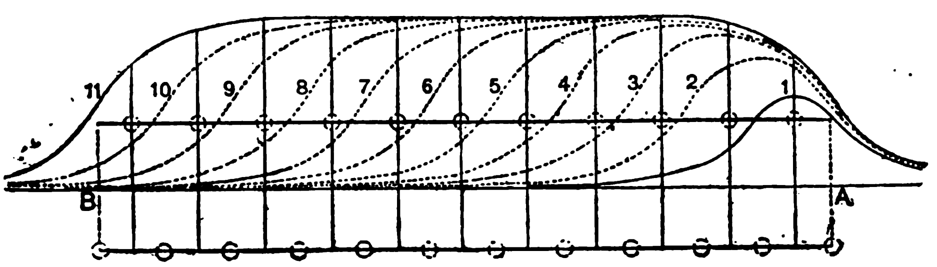


FIG. 32.—Action of Tubular Coil.

netising force, but the pull on a magnetic pole at the end of an infinitely long, thin steel magnet of fixed strength.

The rule for calculating the intensity of the magnetic force at any point on the axis of the long tubular coil within this region where the force is uniform, is—

$$H = \frac{4}{10} \pi \times \text{the ampère-turns per cm. of length.}$$

And, as the total magnetising power of a tubular coil is proportional not only to the intensity of the magnetic force at any point, but also to the length, the integral magnetising effect on a piece of iron that is inserted into the coil may be taken as practically equal to $\frac{4}{10}\pi \times$ the total number of ampère-turns in that portion of the tubular coil which surrounds the iron. If the iron protrudes as much as three diameters at both ends, the total magnetising power is simply $\frac{4}{10}\pi \times$ the whole number of ampère-turns.

Now that case is, of course, not the one we are usually dealing with. We cannot procure steel magnets with unalterable poles of fixed strength. Even the hardest steel magnet, magnetised so as to give us a permanent pole near or at the end of it—quite close up to the end of it when you put it into a magnetising coil—becomes by that fact further magnetised. Its pole becomes strengthened as it is drawn in, so that the case of an unalterable pole is not one which can actually be realised. One does not usually work with steel; one works with soft iron plungers, which are not magnetised at all when at a distance away, but become magnetised in the act of being placed at the mouth of the coil, and which become more highly magnetised the further they go in. They tend, indeed, to settle down, with the ends protruding equally, for that is the position where they most nearly complete the magnetic circuit; where, therefore, they are most completely and highly magnetised. Accordingly, we have this fact to deal with—that whatever may be the magnetising forces all along a tube, the magnetism of the entering core will increase as it goes on. We must, therefore, have recourse to the following procedure. We will construct a curve in which we will plot not simply the magnetising forces of the spiral at different points, but the product of the magnetising forces into the magnetism of the core which itself increases as the core moves in. The curve with a flat top to it corresponds to an ideal case of a single pole of constant strength. We wish to pass from this to a curve which shall represent a real case, with an iron core. Let us still suppose that we are using a very long core—one so long that when the front pole has entered the coil the other end is still a long way off. With an iron core of course it depends on the size and quality of the iron as to how much magnetism you get for a given amount of magnetising power. When the core has entered up to a certain point, you have all the magnetising forces up to that point acting on it: it requires a certain amount of magnetism, so that the pull will necessarily go on increasing, and increasing although the intensity of the magnetic force from point to point along the axis of the coil remains the same, until within about two diameters from the far end. Although the magnetic force inside the long spiral remains the same, because the magnetism of the core is increasing, the pull goes on increasing and increasing (if the iron does not get saturated) at an almost uniform rate all the way up until the piece of iron has been poked pretty nearly through to the distant end. In Fig. 33, a tubular coil, B A, is represented. Suppose a long iron core is placed on the axis to the right, and that its end is gradually brought up towards B. When it arrives at X, the pull becomes sensible, and increases at first rapidly, as the core enters the mouth of the tube, then gently, as the core travels along, attaining a maximum, C, about at the further end A of the tube. When it approaches the other end A it comes to the region where the magnetising force falls off, but the magnetism still goes on increasing, because something is still being added to the total magnetising power, and these two effects nearly balance one another, so that the pull arrives at the maximum. This is the highest C on the curve; the greatest pull occurring just as the end of the iron core arrives at the bottom or far end of the tubular coil; from which point there is a very rapid falling off. The question of rapidity of descent from that point depends only on how long the core is. If the core is a very long one, so that its other pole is still very far away, you have a long, slow descent going on over some three diameters, and gradually vanishing. If, however, the other pole is coming up within measurable distance of B, then the curve will come down more rapidly to a definite point, $X_1$. To take a simple case, where the iron core is twice as long as the coil, its curve will descend in pretty nearly a straight line down to a point such that the ends of the iron rod stand out equally from the ends of the tube.

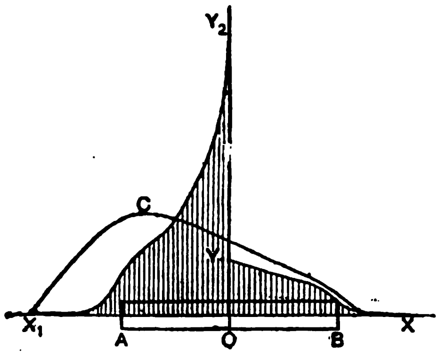


FIG. 33.—Diagram of Force and Work of Coil-and-Plunger.

Precisely similar effects will occur in all other cases where the plunger is considerably longer than (at least twice as long as) the coil surrounding it. If you take a different case, however, you will get another effect. Take the case of a plunger of the same length as the coil, then this is what necessarily happens. At first the effects are much the same; but as soon as the core has entered about half, or a little more than half its length, you begin to have the action of the other pole that is left protruding outside tending to pull the plunger back; and although the magnetising force goes on increasing the further the plunger enters, the repulsion exerted by the coil on the other pole of the plunger keeps increasing still faster as this end nears the mouth of the coil. In that case the maximum will occur at a point a little further than half way along the coil, and from that point the curve will descend and go to zero at A; that is to say, there will be no pull when both ends of the plunger coincide with the two ends of the coil. If you take a plunger that is a little shorter than the coil, then you will find that the attraction comes down to zero at an earlier period still. The maximum pull occurs earlier, and so does the reduction to the pull to zero; there being no action at all upon the short core when it lies wholly within that region of the tube within which the intensity of the magnetic force is uniform. That is to say, for any portion of this tube corresponding to the flap top of the curve of Fig. 32, if the plunger of iron is so short as to lie wholly within that region, then there is no action upon it; it is not pulled either way. Now these things can be not only predicted by the help of such a law as that, but verified by experiment.

These actions of the coil on the core are capable of being viewed from another standpoint. Every engineer knows that the work done by a force has to be measured by multiplying together the force and the distance through which its point of application moves forward. Here we have a varying force acting over a certain range. We ought, therefore, to take the amount of the force at each point, and multiply that by the adjacent little bit of range, averaging the force over that range, and then take the next value of force with the next little bit of range, and so consider in small portions the work done along the whole length of travel. If we call the length of travel *x*, the element of length must be called *dx*. Multiply that by *f*, the force. The force multiplied by the element of length gives us the work, *dw*, done in that short range. Now the whole work over the whole travel is made up of the sum of such elements, all added together; that is to say, we have to take all the various values of *f*, multiply each by its own short range *dx*, and the sum of all these, writing $\int$ for the sum, would be equal to the sum of all the work; that is to say, the whole work done in putting the thing together will be written—

$$w = \int f\, dx.$$

Now what I want you to think about is this: here, say, is a coil, and there is a distant core. Though there is a current in the coil, it is so far away from the core that practically there is no action; bring them nearer and nearer together; presently they begin to act on one another; there is a pull, which increases as the core enters, then comes to a maximum, then dies away as the end of the core begins to protrude at the other side. There is no further pull at all when the two ends stand out equally. Now there has been a certain total amount of work done by this apparatus. Every engineer knows that if we can ascertain the force at every point along the line of travel, the work done in that travel is readily expressed by the area of the force-curve. Think of the curve X C X in Fig. 33, the ordinates of which represent the forces. The whole area underneath this curve represents the work done by the system, and therefore represents equally the work you would have to do upon it in pulling the system apart. The area under the curve represents the total work done in attracting in the iron plunger, with a pull distributed over the range $X X_1$.

Compare that with the case of an electro-magnet where, instead of having this distributed pull, you have a much stronger pull over a much shorter range. I have endeavoured to contrast the two in the other curves drawn in Fig. 33. Suppose we have our coil, and suppose the core, instead of being made of one rod such as this, were made in two parts, so that they could be put together with a screw in the middle, or fastened together in any other mechanical way. Now first treat this rod as a single plunger, screw the two parts together, and begin with the operation of allowing it to enter into the coil, the work done will be the area under the curve which we have already considered. Let us divide the iron core into two. First of all put in one end of it; it will be attracted up in a precisely similar fashion, only being a shorter bar, the maximum would be a little displaced. Let it be drawn in up to half way only. We have now a tube half-filled with iron, and in doing so we shall have had a certain amount of work done by the apparatus. As the piece of iron is shorter, the force-curve, which ascends from X to $Y_1$, will lie little lower than the curve $XCX_1$; but the area under that lower curve, which stops half way, will be the work done by the attraction of this half-core. Now go to the other end, and put in the other half of the iron. You now have not only the attraction of the tube, but that of the piece which is already in place, acting like an electro-magnet. Beginning with a gentle attraction, it soon runs up, and draws the force-curve to a tremendously steep peak, becoming a very great force when the distance asunder is very small. We have, therefore, in this case a totally different curve made up of two parts—a part for the putting-in of the first half of the core, and steeper part for the second; but the net result is, we have the same quantity of iron magnetised in exactly the same manner by the same quantity of electric current running round the same amount of copper wire—that is to say, the total amount of work done in these two cases is necessarily equal. Whether you allow the entire plunger to come in by a gentle pull over a long range, or whether you put the core in in two pieces—one part with a gentle pull, and the other with a sudden spring up at the end—the total work must

ame; that is to say, the total area under our
r curves must be the same as the area under
curve. The advantage, then, of this coil-
nger method of employing iron and copper
hat it gets any more work out of the same
ture of energy, but that it distributes the
r a considerable range. It does not, how-
ualise it altogether over the range of travel.
nber of experimental researches have been
om time to time to elucidate the work-
the coil-and-plunger. Hankel, in
xamined the relation between the pull
iven portion of the plunger and the
power. He found that, so long as
n core was so thick and the exciting
small that magnetisation of the iron never
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re of the current, and was also propor-
the square of the number of turns of wire.
these two facts together, we get the rule—
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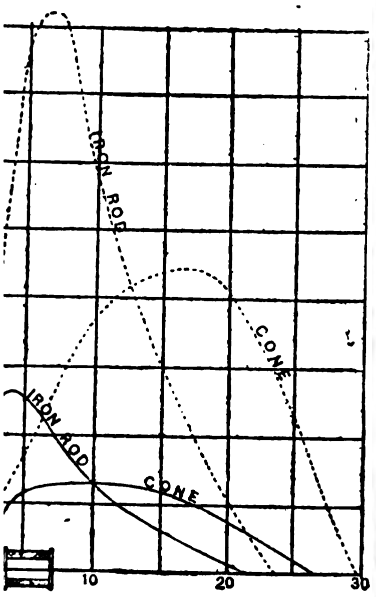
nost careful researches of late years are
de by Dr. Theodore Bruger, in 1886. One
researches, in which a cylindrical iron
was used, is represented by two of the
n Fig. 34. He used two coils, one 3½ centi-
ong, the other 7 centimètres long. These



.—Bruger's Experiments on Coils and Plungers.

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**ect of Using Coned Plungers.**

ead of employing a cylindrical core, you
ne that is pointed, you find this completely
position of the maximum pull, for now
is insufficient to carry the whole of the
lines which are formed in the iron rod.
not come out at the point, but filter
so to speak, along the sides of the core.
on where the magnetic lines come up
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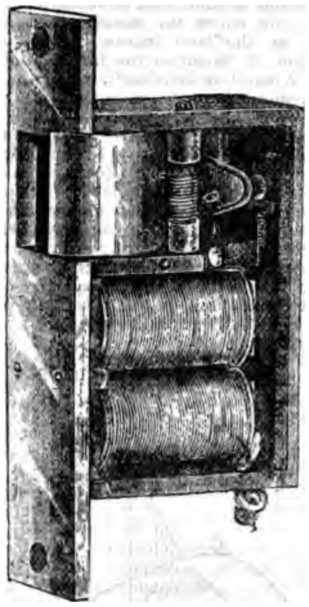
t or near the end of the rod; but is dis-
ver a considerable surface; consequently
point begins to poke its nose out, you
a larger portion of iron up the tube, and
instead of coming to a maximum at
ion, is distributed over a wider range.
making the experiment roughly with my
ance and a conical plunger, and I think you will be able to notice a marked difference between this case and that of the cylindrical plunger. The pull increases as the plunger enters; but the maximum is not so well defined with a pointed core as it is with one that is flat-ended. This essential difference between coned plungers and cylindrical ones was discovered by an engineer of the name of Krizik, who applied his discovery in the mechanism of the Pilsen arc lamps. Coned plungers were also examined by Bruger. In Fig. 34 are given the curves that correspond to the use of a coned iron core, as well as those corresponding to the use of the cylindrical iron rod. You will notice that, as compared with the cylindrical plunger, the coned core never gave so big a pull, and the maximum occurred not as the tip emerged, but when it got a very considerable way out on the other side. So it is with both the shorter and the longer coil.

## "POSITIVE" ELECTRIC DOOR OPENER.

THE accompanying illustration shows clearly the parts of the "Positive" door opener, manufactured and sold by the inventors, Messrs. Seib and Starkie, 148th-street, New York. When the electric button is pressed the armature leaves its



contact and presses against the back spring, which in turn acts on the centre spring, and this releases the latch and opens the door. When the door is again closed the parts resume their former position, and remains there until again put in action.

## THE END OF THE WORLD.

IT would seem impossible that, in our epoch of civilisation and progress, there could still be found people to announce the approaching end of the world, and, what is much more extraordinary, that there could be found other people to give credence to them. Such is the case, however. A few charlatans, who perhaps descend from the middle-age astrologers, whose ridiculous methods of divination they doubtless employ, have recently predicted that the world is shortly to come to an end, the date being fixed by some at 1898, and by others at 1901. These grotesque predictions, born of ignorance, have suggested to us the idea of succinctly presenting to our readers the rational causes that, according to the present state of scientific knowledge, might lead, not to the end of the entire universe, but only to that of our world—that is to say, to the disappearance of life from the terrestrial globe. We hope thus to reassure those, if there be any such, whom the predictions of sorcerers or jesters may have somewhat frightened.

At the present day the public shows itself very incredulous upon this subject, but it was not always thus. In the past ages, when the absurdest superstition reigned, the astrologers found no difficulty in making people believe their idle tales. The year 1000, for example, is especially memorable for the great terror that extended over France and entire Europe at the announcement of the end of the world. The advent of comets and the eclipses of the sun and moon were the chief pretexts for the frightful astrological predictions. The mortal terror with which France was seized in 1564, upon the news that a total eclipse of the sun was to occur, has remained particularly celebrated. The people, believing that the end of the world was at hand, ran to the churches in crowds to confess. A certain chronicler of the time tells us that a country curate, not being able to fulfil his task, was obliged to say to his parishioners: "My brethren, don't be in such haste; the eclipse is postponed for a fortnight!" In reality, there is nothing very alarming in the prospect of the ending of the world. That happens to every man on the day of his death, and the supreme event would not be any more terrible if it happened to all on the same day.

Terrestrial life depends entirely upon the light and heat of the sun, which is the sole source of its maintenance. It is, therefore, with the star of day that we have to begin the strange tableau of the probable causes of the end of the world.

### The Sun, its Spots, and its Final Extinction.

The surface of the sun is often strewed with black spots, the smallest of which are as large as the diameter of the earth, and the largest of which are sometimes visible to the naked eye. These spots, which are variable in number and position, mark regions in which the luminous and calorific activity of the sun is in a state of temporary diminution. As the great radiant star is an incandescent mass (1,372,000 times more bulky than the earth) that unremittingly distributes its elements of life around it, it is continually losing (though slowly, it is true) the powerful energy that is stored up in it. A day will come in the distant ages when the spots that are already darkening the sun will cover its entire surface. A solid crust will afterwards form, as one has formed upon the earth, which also traversed these phases of the life of a star, for our earth was a sun that had the moon for a planet, and perhaps even (according to Mr. Stanislas Mennier) a second satellite that is now broken up. The sun will therefore be extinguished some day for want of fuel; but that fatal date will be far in the distant future, for we can estimate the time necessary for the extinction of the sun at more than twenty million of years, and the time during which a state of life analogous to the present one will be able to exist upon the earth may be estimated at half that long period.

Long before the end of these far distant epochs the progressive decrease of the solar heat will cause the glacial zones of the poles to extend towards the equator. Man, remaining almost alone upon the *débris* of terrestrial life, after having reached a transcendent civilisation, will employ all the resources of his vast genius to fight a supreme battle with death. Perhaps he will then descend, one by one, the steps of his physical and intellectual development, and lead the miserable life of the Laplander and Esquimo under the Equator. Then, the last human family, exhausted by cold and hunger, will sleep its eternal sleep upon the frozen and depopulated earth.

Although the existence of animate beings is still far from being endangered upon our planet through the extinction of the sun, the terrestrial world is none the less exposed to

### Catastrophes of Other Kinds.

When a brilliant comet appears and grows in magnitude in the depths of the heavens, popular superstition beholds in it an omen of dire misfortune, without knowing the only danger that the haired star threatens us with—that of a collision.

We may find examples of this superstition in ancient as well as in modern times. Here is what we may read in Pliny, and which relates to the comet of the year 48: "In the war between Cæsar and Pompey, we saw an example of the terrible effects that the advent of comets carries in its train. Toward the beginning of this war the darkest nights were illuminated, according to Lucan, by unknown stars, the heavens seemed to be on fire, glowing firebrands traversed the depth of space in all directions, and the comet, that appalling star, which overthrows the powers of the earth, exhibited its terrible coma."

These superstitious terrors inspired by comets have exerted their influence in our own age. The famous Encke's comet, that appeared in January, 1819, was the cause of lively apprehension in France, where sinister prophecies had been disseminated. At Paris, the previsions of the end of the world were taken more pleasantly, and songs and caricatures were made concerning it.

Among the millions of comets that are submitted to the attraction of the sun, there are relatively few that approach the radiant star as far as to the orbit of our globe. The majority of the immense comets that occasionally traverse the heavens should therefore leave timid people indifferent. Those which, in their trip around the sun, pierce the plane of the terrestrial orbit, can alone menace us with some danger. We know that these celestial bodies have a very irregular course, and a most erratic conduct, for the least attraction of a neighbouring star suffices to swerve them from their primitive route and make them approach the disturbing mass. In order that a collision may occur between a comet and the earth, the orbit of the first star must intersect the orbit of the second, and the latter must be at the point of contact of the two orbits at the time of the passage of the comet. It will be understood that such a combination of circumstances, although possible, has few chances of occurring. In fact, when a comet appears that is to approach the sun as near as we do, a calculation of the probabilities demonstrates that out of 280,000,000 chances, there is but one that it will collide with the earth!

We can consequently remain very tranquil on this subject. Yet, since we are assured that such a collision is among the number of facts possible, let us see what might be the consequences of this celestial meeting of the earth (travelling 18 miles per second) and a comet that had at least an equal velocity. If the comet had a consistent nucleus, the terrestrial crust would be staved in by the impact, and the torrents of lava that it conceals would produce a terrible commotion in contact with the waters of the ocean. In addition, the axis of the earth would be abruptly displaced. This is the sole plausible hypothesis to explain the inclinations of the axes of planets upon their orbits; but it is only right to say that no comet with a consistent nucleus has as yet been observed.

Were the comet formed of dense gases, it would cause an enormous pressure upon our atmosphere, and would bring on a hurricane a hundred times more terrific than the great cyclones, and would level the surface of the earth. It might also render the air unsuited for maintaining life by altering its chemical composition through the introduction of a new gas, or kindle an immense fire, such as the temporary stars sometimes offer us the spectacle of.

It is difficult to imagine the frightful consequences of such cataclysms for the animate beings who would be liable to perish amid this chaos of unchained elements. Shooting stars, those strange meteors that shine for scarcely a second in tracing a line of fire upon the celestial vault, are now considered by numerous astronomers as having a cometary origin, they being, so to speak, the *débris* of the haired stars. There exists a convincing example of this that will prove to us the possibility of a collision between the earth and the erratic bodies under consideration.

In 1832, Biela's comet, which accomplishes its revolution around the sun in the short period of six years and a half, intersected our orbit on the 29th of October, at the point that the earth reached on the 30th of November, say a month later. At the time of its appearance in 1846, the comet had divided into two, and in 1852 the two twin comets were observed travelling together. Since this last passage, astronomers have not seen Biela's comet, but on the 27th of November, 1872, at the epoch that it crossed the terrestrial orbit, we traversed a mass of cosmic dust, which, on penetrating our atmosphere, gave rise to a true shower of shooting stars. On the 27th of November, 1885, we beheld a new conflagration of the heavens. Here, then, we have a demonstrated collision between the earth and the *débris* of a comet—a collision that will be repeated under the same condition in 1898, a fact that has furnished an improvised scientist an occasion to announce the end of the world at that date. Let us hope that fate will protect our globe for numerous ages by preventing it from running against a good, healthy comet, and let us see what are the

### Other Dangers that Threaten Terrestrial Life.

Before reaching the present period of its history, the earth passed in succession through great geological phases, during which its continents and seas were several times deranged by the internal forces that its nucleus of matter in fusion developed. None of these revolutions has been able to destroy the powerful germs of life, and it is to-day more impossible than ever for a geological cataclysm to cause such a result.

The most important of the historic catastrophes of this kind is contemporaneous. We refer to the gigantic eruption of Krakatoa, 1883, which claimed 50,000 victims, and totally transformed the configuration of the Strait of Sunda. Despite their great violence, such phenomena are always local, and consequently without untoward influence upon animate beings collectively. The internal activity of our planet is now greatly reduced. So the earth has entered upon the calm period of its existence. A rapid examination of this progressive diminution of internal energy is to lead us to a particularly rational solution of the problem of the world's end.

When the solid crust of our globe formed, it surrounded an incandescent fluid spheroid, which afterward condensed toward its centre under the action of cooling. In measure as it contracted this nucleus diminished in volume, and the external covering gave way in places, and cracked in order to follow the motion of shrinkage. It is in this way that were produced the large folds that formed the principal reliefs of the surface. Consequently, the terrestrial crust, having become thicker, will be covered with enormous crevasses through which the oceans and atmosphere will be gradually absorbed in the numerous internal spaces.

The surface of the moon, deprived of air and water, with the immense furrows that traverse its plains and mountains, presents the spectacle of this beginning of rupture, for our satellite is more advanced in development than the terrestrial globe.

Having passed this stage, the dead star, cracked in all directions, will break in pieces, and the fragments will be scattered along its orbit.

This destiny of the earth is still a thing of a very remote future. Yet it seems as if the natural evolution of our globe will cause the disappearance of life long before the extinction of the sun. It is, moreover, easy to see that in the geological epochs lost in the night of ages the vital forces were more powerful than those of our day. We have a proof of this in the exuberance of life that then gave birth to animals and plants, beside which the present gigantic beings are but dwarfs.

The day on which, through such general weakening of vitality, man will have fallen into a physical decadence that his refined intelligence will not be able to supply the place of, will probably be also the day on which the last representatives of our race and of the entire creation will have to live in the bowels of the earth in the pursuit of air and water, which will slowly descend towards the centre of the earth.

Deprived of atmospheric fluid, the surface of the globe will thereafter have for temperature only that of interstellary space, say a hundred Centigrade degrees below zero! And while our human race will be reimmersed in the nihility from which it had emerged for a few thousands of centuries, other humanities will succeed one another upon the innumerable stars that people infinite space.—*Jacques Leotard, in La Nature.*

## SPECTROSCOPIC MEASURES OF STELLAR MOTIONS.*

EVERYONE knows that the so-called "fixed stars" are not really fixed at all, but are moving very swiftly. So remote, however, are even the nearest of them, that it takes centuries to make their drift perceptible, and for all but a very few the displacement in an entire century is so slight that it can be detected only by the most careful observations. Obviously, too, if a star happens to be moving "head on," so to speak—i.e., either directly towards us or from us—it will not change its apparent place in the sky, and its motion cannot be ascertained by any comparison of ancient observations with modern. One might, perhaps, think that such a motion could be detected by the change in the star's apparent brightness; but a very short calculation will show that even our nearest neighbour (Alpha Centauri), if it were rushing towards us at the rate of one hundred miles a second, would increase its brightness only about two and a half per cent. in a century, and in the case of remoter stars the change would be correspondingly less; so that the method is practically useless.

But there is a way in which such a motion can not only be detected, but even measured with some approach to accuracy; a method which is not affected by the distance of the object observed, except in so far as remoteness dims its light. The instrument used is the spectroscope, and the principle involved is that when the distance between us and a star is changing with any considerable rapidity, all the lines and markings in its spectrum are shifted in position as compared with the spectrum of a similar body at rest. The reason is that light consists of pulsations, or waves, coming to us at regular intervals of time, and regularly spaced in distance, each coloured ray having its own place in the spectrum according to its wave-length, or "pitch," so to speak. Now, if a star is coming nearer, then the waves due, say, to the hydrogen in the spectrum of its atmosphere, are encountered with greater frequency than if it were at rest, and so are virtually raised in pitch, and shifted towards the violet end of the spectrum, where the waves are shortest; and *vice versâ*, of course, if the star is receding.

A good illustration is what would happen if we were in a boat anchored in a stream flowing steadily at the rate of, say, 10ft. a second, while another person is in a second boat a little way up stream, throwing a cork into the water each second. So long as both boats are at rest, the corks will pass us one a second, at equal intervals of 10ft.; but if the cork-thrower has his boat rowed up-stream at the rate of 2ft. a second, his corks will strike the water 12ft. apart instead of 10ft., and will reach us with 12ft. spaces between them, and at intervals of one and one-fifth seconds. If, on the other hand, he lets his boat drop slowly down stream at the same rate, the spaces between the corks will be reduced to 8ft, and the time interval to four-fifths of a second. If our own boat is put in motion, it is easy to see that the effect will be similar.

Speaking generally, we may say that whenever the distance between the observer and any source of regularly produced pulses is diminishing their interval will be lessened, and *vice versâ* if the distance is increasing. All that is necessary, then, in order to ascertain the speed with which a star is approaching or receding, is to form its spectrum, and then to confront it with the spectrum of a so-called "Geissler tube," giving the bright lines of hydrogen, or some other substance known to be present in the star's atmosphere. If the lines in the star spectrum fail to coincide with the lines in the spectrum of the Geissler tube, we infer that the star is changing its distance from us, and we can determine its speed by measuring the amount of displacement in the lines of the star spectrum.

We hasten to say, however, that while the operation is easy to describe and understand, it is by no means easy to perform; there is no observation in the whole range of practical astronomy more delicate. The amount by which the lines in the spectrum are shifted is always minute, depending as it does on the ratio between the star's velocity and that of light. Now, light moves so swiftly—over 186,000 miles a second—that, in comparison with this, a velocity of even ten or twenty miles a second is almost insignificant, and produces a displacement of the lines so slight that it can be detected only by using a very high "dispersion"—i.e., by making the spectrum of the star very long, and that means making it very faint. A large telescope is therefore necessary to collect the requisite quantity of light, the spectroscope must be powerful, and the most scrupulous precautions must be taken to have everything in absolute adjustment. If the observation is made with the eye, the observer must have keen and untiring vision, and skill in the most delicate measurement. If, as is now beginning to be common, a photographic process is used, the most sensitive plates must be employed, with continual vigilance to keep the image of the star exactly on the slit of the spectroscope, and to maintain the adjustments of the instrument absolutely unchanged, sometimes for hours together.

Dr. Huggins, the father of astronomical spectroscopy, was the first to make an actual observation of this kind, in 1868, when he ascertained in this way that Sirius was then receding from us at the rate of about nineteen miles a second—a motion which appears to have been reversed since then, probably in consequence of the orbital connection of Sirius with its small companion. He also made similar observations upon a number of the brighter stars; but it soon became obvious that the means at his command would not enable him to attain satisfactory accuracy. Since then the Greenwich observers have been following up the same line of work, but not with very much greater success. The published measures have shown discordances that are rather disheartening, and indicate that the results can be accepted only as provisional approximations to the truth.

Very recently, however, the matter has assumed a new aspect through the work of Vogel in Germany and Pickering in this country. The former has applied photography with great success to a spectroscope of the ordinary form—i.e., with slit and collimator. The instrument is so contracted that it is limited in range to a very small portion of the spectrum near the line known as G (where, however, there are numerous identified lines, some of which are sure to be found in the spectrum of every star); but within this range the instrument is extremely powerful. By the use of very sensitive plates and long exposures it is possible to photograph spectra that the eye cannot see at all, and Vogel has thus been able to secure negatives upon which, in favourable cases, a stellar velocity of a single mile a second produces a measurable shift of the lines. With this apparatus the "head on" motion of nearly sixty stars has already been determined at Potsdam with reasonable accuracy.

Vogel's most interesting results are those relating to the stars Algol and Spica Virginis. The former is a variable star, which acts as if it were partially eclipsed at regular intervals of 68·8 hours by a dark companion large enough to cut off nearly five-sixths of its light. Now the observations show that about 17 hours before the minimum, Algol is receding at the rate of 24·4 miles a second, while 17 hours after the minimum it is approaching with a speed of 28·6 miles. From this it follows that the "system" composed of the two stars is approaching us about 2·1 miles a second, while the bright star is moving in a nearly circular orbit around the common centre of gravity between it and its dusky acolyte with a velocity of 26·5 miles. We have not the space to explain how, from the known data, Vogel is able to show that the smaller star must be moving more than twice as fast, that the distance between the two stars must be about 3,270,000 miles, and that their diameters are about 1,075,000 and 811,000 miles, the smaller star being very nearly as large as the sun. These are fair inferences, however. It appears further that the larger star has a mass about four-ninths that of the sun, the smaller one being but half as large; so that their density must be less than one-fourth that of the sun—hardly exceeding that of cork.

The case of Spica is different, in that this star is not variable; but it presents the same kind of backward and forward motion, with a velocity of

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*From *Popular Science News*, Boston, U.S.A. By Prof. C. A. YOUNG, Assoc. R.A.S.

# SCIENTIFIC NEWS.

THE elements of Spitaler's Comet (*f.* 1890), discovered on the 16th of November, have been computed by Herr G. Rosmanith, the perihelion passage taking place on Oct. 26·50833 Berlin mean time. The comet is moving in an elliptic orbit with a period of about 6·4 years, its aphelion distance being smaller than that of Encke's Comet. The ephemeris for Jan. 13, Berlin midnight, reads R.A. 4h. 51m. 58s., N. Dec. 40° 25·5′. The comet is slowly decreasing in brightness.

As an appendix to the fiftieth volume of the *Monthly Notices*, the Royal Astronomical Society has published a "Comparison of the Places of the Moon, deduced from Burckhardt's and Hansen's Lunar Tables for every Greenwich midnight during the years 1847-62, together with a corrected comparison of Hansen's Tables with the Greenwich Observations during the years 1847-61." It is prefaced by some notes from the pen of Prof. Adams. The expense has been met by a Government grant of £320 from the Royal Society.

The observations of the Leonid meteors, made under the direction of the Italian Association for the Observation of Luminous Meteors, show, according to a note by Prof. Denza in the *Comptes Rendus*, that the Leonids were more frequent last November than in previous years, and the augmentation will probably increase until the next shower in 1899.

Applications for the Government Grant of £4,000 for the promotion of scientific research must reach the secretaries of the Royal Society before March 1st next; must be written on printed forms to be obtained from the assistant secretary, and will be considered at the annual meeting of the Government Grant Committee.

The death is announced of Mr. John Marshall, F.R.S., president of the General Medical Council and Professor of Anatomy to the Royal Academy. Mr. Marshall, who died on the 1st inst. at his house in Cheyne-walk, was born at Ely in 1818, and studied medicine at University College Hospital, where his industry and ability attracted the notice, and secured the friendship, of the late Prof. Sharpey. In due course he was elected upon the staff of the hospital, from which he ultimately retired as consulting surgeon; and he was Emeritus Professor of Surgery to University College. He was also consulting surgeon to the Consumption Hospital at Brompton, a past president of the Royal College of Surgeons, and a past president of the Royal Medical and Chirurgical Society. He was the representative of the Royal College of Surgeons on the General Medical Council; and, on the retirement of Sir Henry Acland from the presidentship, was unanimously elected by his colleagues to the vacant office, in which his tact and sagacity were of the greatest value. Mr. Marshall's contributions to surgical literature, although not numerous, were of very high quality.

The death is also announced (from Havannah) of Prof. Nicolas Gutierrez, the well-known Cuban scientist, president of the Academy of Sciences.

One of the most distinguished mathematicians died the other day in the person of Prof. Carey, LL.D., F.R.S., Fellow of the Royal University of Ireland, corresponding member of many of the scientific societies of Europe, and author of several works on the higher mathematics, as well as of many elementary manuals which have been widely adopted, not only in Ireland, but in several foreign countries. Prof. Carey had reached 70 years, and was in good health until seized with bronchitis.

The Battersea Polytechnic Committee have arranged for a course of ten popular lectures on the "Chemistry of Arts and Manufactures," to be given by Prof. Vivian B. Lewes, at the Crichton Hall, Clapham Junction, on Tuesdays, at 8 p.m., commencing Jan. 13. Previous lectures have been well attended by artisans and others, and as the subjects to be treated in the course announced include colour, paint and pigments, iron, steel, copper, lead, zinc, tin, alloys, acids, soap, soda, and glass, they will, no doubt, attract many members of the industrial population of the wide district known as Battersea. Tickets for the course cost 4s., and may be obtained of the hon. secs., Mr. H. Genochio and Mr. J. Harwood, at Crichton Hall, on the evenings of the lectures.

At a meeting of the Balloon Society on Jan. 2, after the reading of a paper by Mr. J. Kendal on the "Equation of Time and the Prime Meridian Conference at Rome in 1891," it was resolved that it would be inexpedient to disturb the prime meridian of Greenwich, as already agreed to by a majority of the previous conferences, and that the Government be requested to use all legitimate means in their power to prevent, at the approaching Conference at Rome, Jerusalem being fixed upon as the prime meridian of the world—a place without an observatory, and at present only accessible by an open roadstead at Jaffa, and no railway communication to the spot.

On Tuesday last Mr. Fred. Davis read a paper before the City of London College Science Society on Salicylic Acid, and Certain Impurities which are alleged to be present in Commercial Specimens. Mr. Davis illustrated his subject with photographs, and as salicylic acid is now used extensively, it is important that it should be free from suspicion.

The beautiful flowering plant known as Primula obconica, has been accused—not without some reason—of causing irritation of the skin, simulating eczema, if not actually that disease, and now Dr. E. Lycett Burd, writing to the *Lancet*, gives some notes of a case which points to the Virginian Creeper (Ampelopsis) as a cause of eczema, the skin irritation and eruption following the operation of gathering the leaves of the species known as A. Hoggii. It has been asserted that in sensitive or super-sensitive subjects merely touching the leaves of P. obconica, or plucking a flower, produces eczema.

The Bacteriological Institute which Prince Alexander Petrovitch, of Oldenburg, has founded in St. Petersburg is said to be very complete in its appointments. Dr. Chamberlan, Prof. Pasteur's assistant, declares that it is the most conveniently furnished and most thoroughly workmanlike institution of the kind, so far as he knows, in Europe. It is stated that the Prince proposes to invite eminent men of science to utilise the institute for experiments in bacteriology, physiology, chemistry, biology, and veterinary research.

That the transmission of power by means of electricity will, when satisfactorily accomplished, be a great boon to many "small workers" is well known, so it is satisfactory to learn, on the authority of Herr Lembcke, director of the School of Weaving at Crefeld, that the trials made with electro-motors in driving weavers' looms at their own houses have been very successful.

M. Camille Gonzy, proprietor of farms in the commune of Millas (Western Pyrenees) to the extent of 1,500 acres, has utilised the power of a neighbouring waterfall to generate electricity, not only to light his property, but to work a wine press and to pump water for irrigating the vines. Some 62 miles of wire are required to connect all the apparatus.

The announcement that the cable to connect the land lines of the Paris to London telephone had been laid seems to have been premature; but the land lines are approaching completion and the cable is ready for laying.

M. Clarétie, the author, uses a greenish paper, in writing, with a view to save his eyes from the glare of white paper. Yellow paper is also better than white, but according to M. Guyot, in the *Revue de la Presse*, the best is whitey-brown paper, especially that of the *teint mastic*. This shade is favourable to the eyesight and the ink shows clearly on it.

**Watkins's Exposure Meter.**—In connection with his exposure meter, Mr. Watkins, of Hereford, has issued a useful little pocket-book in which the photographer can make notes for future reference as to the time of exposure, plates used, subject, lens, and development, with remarks. There is much useful matter in this pocket-book—from the practical or working point of view.

TINPLATE manufacture is to be started on novel lines at the works of Messrs. Norton Brothers, Maywood, Illinois. In order to avoid the waste of tinplate now unavoidable, this firm intends to try the plan of making the various utensils out of sheet iron, and tinning the finished article. They hope in this way to economise tin very materially, and so compete successfully with the Welsh makers.

# LETTERS TO THE EDITOR.

*[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]*

*All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

*All Cheques and Post-office Orders to be made payable to* J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

## THE ANEMOMETER — EQUATORIAL MOUNTING FOR THE MELBOURNE PHOTOGRAPHIC TELESCOPE — THE BELGIAN ROYAL OBSERVATORY — GLACIATION OF THE MOON: THE LUNAR ATMOSPHERE — TESTING TELESCOPES — THE NON-ACHROMATIC TELESCOPE — THE AFTER-GLOW — INDIAN JUGGLERY: PERCEPTION AND INFERENCE — ERRATUM — AN INTERESTING TAIL (IN ONE VOLUME) — THE SOLAR PHOTOSPHERE — HOPELESS CONDITION OF A "MAGNIFICENT THEORY."

[31938.]—MAY I crave the aid of some brother correspondent who is familiar with the working of an anemometer? I possess one of these instruments of the form known as Robinson's, i.e., the motive power of the recording mechanism is four cups at the ends of cross arms, and the alleged velocity of the wind is recorded on five dials; the first four divided into ten equal intervals each, and the fifth into a hundred. Beneath the first dial is engraved the words "1,000 miles," beneath the next, "100 miles," beneath third "10 miles," beneath the fourth "1 mile," and beneath the fifth "$\frac{1}{10}$ mile." Supposing the figures on the dials then to read from left to right 409152, I have interpreted this as 4091·52 miles. But now comes my difficulty. If, adopting this method as the correct one, I have again read the instrument after a lapse of a few hours and divided the difference of the two readings by the hours and fractions of the hours that have elapsed, I have got out such velocities as, according to standard works on meteorology, pertain to a "most violent hurricane," which is obvious nonsense. Does, then, the "1,000" miles mean that the wheel must make an entire revolution to record it, and that the sub-divisions only signify 100 miles each? If this be so, then my illustrative reading given above should be 409·152, although this supposes that the anemometer gives correct indications within the 1000th of a mile.

All who are interested in the modern development of equatorial mountings should read a beautifully-illustrated description of the Photographic Telescope just completed by Sir Howard Grubb for the Observatory at Melbourne, which appears in your contemporary, *Engineering*, for December 19.

"Everything," said Lord Beaconsfield, "comes to him who waits," and I am pleased to learn that the transfer of the Belgian Royal Observatory to Uccle is, at last, *un fait accompli*. May it sustain those traditions in its new home which have so worthily distinguished it in the past in its former one.

Without presuming to discuss the hypothesis propounded by "Ja. Ha." in letter 31895 (p. 375), I should like to invite the attention of that gentleman to a few matters of numerical fact. *Imprimis*, I have before pointed out in these columns that as the molecules of an atmosphere have weight, and its elastic force must diminish with rarefaction, we must ultimately arrive at a point where such elastic force and the gravity of the constituent particles of the atmosphere must balance—and there will be its surface. I say nothing as to the otherwise necessary liquefaction of any gas at the temperature of space. I fail to see the force of your correspondent's argument that "the moon's atmosphere . . . . should extend further into space than that of the earth." It would occupy a greater *comparative* volume, but nothing more. Furthermore, if we take the mass of the moon as $\frac{1}{81}$ of that of the earth, we shall find by a very elementary calculation indeed that the attractions of the moon and the earth would be neutralised at a point from the moon situated at $\frac{1}{10}$th of her distance from the earth. In other words, 23,884 miles from her centre! Does "Ja. Ha." seriously conceive that her atmosphere ever has, or ever can have, extended to this distance?

I cannot, of course, take upon myself to say what the British Astronomical Association may be induced to do; but I certainly see grave difficulties in the way of its adoption of the suggestion made in letter 31896 on p. 375. To begin with, some station would have to be obtained to which the instruments to be tested would have to be sent, and a competent observer or observers must be on the spot to examine all those submitted for inspection. Would "a small fee" cover the inevitable cost of this? What seems to me much more practical is that some telescopic expert among the members of the Association should be invited to give an illustrated lecture on testing and adjusting objectives and mirrors, and so to instruct their possessors how to do so for themselves.

"W. H. H." (letter 31897, p. 375) need be under no apprehension that "F.R.A.S." will bring down "the proverbial thousand of bricks" upon him. He may accept my assurance that I shall be infinitely more ready to take off my hat to a man who has shown so much zeal and enthusiasm in the pursuit of astronomy as he has done in the construction of the instrument he describes. Any one who is so much in earnest as to make a telescope with a spectacle lens, rather than not have one at all, is worthy of respect rather than of sneering or condemnation. But, having said this, I an constrained to reiterate that a simple convex lens is a most imperfect substitute for the smallest achromatic one, and that a decent opera or—better still—field glass is decidedly more effective. To obtain moderately-decent definition with a single convex lens its focal length must be so enormous in proportion to its aperture as to render its use most inconvenient.

In connection with letter 31898 (p. 376), I may say that the so-called "after-glow" was very beautifully visible at the place whence I write after sunset on Sunday, December 21st. So far, I have seen no intimation of any fresh eruption (public or private) of Krakatao.

I can, from my own personal experience, entirely endorse what Mr. Blackburn says in reply 73202 (p. 382) as to the frequently extraordinary misinterpretation of his perceptions by the average observer. Like your correspondent, I am a bit of an amateur conjurer, and, like him, have been at once amazed and amused to hear subsequent descriptions of what the narrators firmly believed they had seen me do. But particularly, as I have said formerly in these columns, have I been struck with this substitution of inference for perception at so-called "spiritualistic" séances, where I have seen the wretched gobemouches among the faithful go nine-tenths of the way to meet the scoundrelly "medium" in his but too often very clumsy imposture. Anyone who needs an illustration of the way in which an estimable but weak-minded man may be thoroughly humbugged, should first read carefully poor Mr. Sinnett's book, "The Occult World," published by Trübner and Co., and afterwards peruse, with equal care, Part IX. of "The Proceedings of the Society for Psychical Research" (also published by Trübner) for December, 1885.

In paragraph six of letter 31893, on p. 375, the sentence, "with a width exactly equal to this eccentricity," should, quite obviously, read "with a width exactly *double* this eccentricity."

I am much afraid that the truly charitable supposition which you adduce at the end of the first paragraph of your "Scientific News," on p. 400, as a possible explanation of the marvellous character of a recent message from Grahamstown, will have to be given up; for I have information, on which I can rely, that a detailed account of the apparition of Mr. Eddie's amazing "comet" appeared in the local papers, one, at least, of which Mr. E. has himself sent to England as containing a good account of that celestial cock-and-bull, which has excited so much harmless mirth in this country. *What* Mr. Eddie saw (or thought he saw) I should be very sorry indeed to speculate.

Your contemporary, *Knowledge*, for the current month, contains a paper by the Editor on the "Solar Photosphere," which will be found alike interesting and instructive to the student; combating, as it does, by the most simple and apprehensible reasoning more than one popular fallacy in connection with the physical constitution and condition of the great centre of our system. I may mention that, incidentally, Mr. Ranyard shows conclusively that the light of the Corona (and, *a fortiori*, that of the Sun itself), cannot possibly have its origin in the collision of any solid bodies like meteorites. The paper is illustrated by two remarkable photographs of sunspots, taken at periods of maxima and minima respectively by Dr. J. Janssen at Meudon. The amount detail on the solar surface shown is surprising.

The *Observatory* for January, too, contains papers Miss A. M. Clerke and Mr. J. E. Keeler, which should be carefully studied by anyone who has a lingering faith that the "Meteoritic Theory" even may possibly have some truth in it.

**Fellow of the Royal Astronomical Society.**

## GLACIATION OF THE MOON.

[31939.]—"Ja. Ha." is quite correct (letter 31895, p. 375) in saying that ice and snow would evaporate rapidly if there were no atmosphere about the moon. But his assumption that the evaporated molecules of aqueous vapour would leave the moon will not bear examination. Even if the velocity of the evaporated molecules was sufficient to carry them when projected perpendicularly upwards out of the region of the moon's attraction, it may be shown that an atmosphere would rapidly form which would hinder the dispersion into space of subsequently evaporated molecules. For there would be collisions between some of the obliquely projected molecules which would cause them to fall and accumulate in an atmospheric stratum that would act as a cushion or buffer on which the perpendicularly projected molecules would expend their energy, and such an atmosphere would continue to accumulate until the pressure of the lunar surface was equivalent to the elastic force of aqueous vapour at the average temperature of the lunar surface.

The elastic force of aqueous vapour has been carefully measured. At a temperature of −29° Fahr. it is equivalent to the pressure of a column of mercury 0·0105in. high. At 0° Fahr. it is equivalent to the pressure of a column of mercury 0·0439in. high, and at 32° Fahr. it is equivalent to a pressure of 0·1810in. of mercury at the sea-level in lat. 53° 21′, the mercury being also at a temperature of 32° Fahr. These figures are taken from a table showing the elastic force of aqueous vapour given in Balfour Stewart's "Elementary Treatise on Heat," and "Ja. Ha.'s" 0·17 of an inch for the freezing temperature is quite sufficiently near to make no practical difference in the conclusions I am about to draw.

On the earth the pressure of the atmosphere is halved at a height of 19,570ft. (a little more than 3½ miles) above the sea-level, and it may be shown that if there were no reduction of temperature as we ascend into the upper air, the pressure would again be halved in ascending through another 3½ miles, and so on, the pressure halving with each ascent of 3½ miles, which would give a pressure of $\frac{1}{512}$ part of the pressure at the sea-level at a height of a little more than 32 miles. As a matter of fact, we know that the temperature does decrease rapidly as we ascend in the earth's atmosphere, so that the actual rate of decrease of pressure is even faster than the theoretical law would indicate.

One five hundred and twelfth part of 30in. of mercury is ·0585in. of mercury, which is a little more than the pressure of aqueous vapour at 0° Fahr. There are many observations which show that there cannot be an atmosphere surrounding the lunar limb which causes a deviation of rays grazing the moon's limb equivalent to $\frac{1}{512}$th part of the deviation of rays which pass through the earth's atmosphere, so as to graze the earth's surface at the sea-level.

The horizontal refraction at the sea-level is about 34′, so that in passing into the atmosphere and out again after nearly grazing the earth's surface, a ray of light would be bent through an angle of 1° 8′. If half the earth's atmosphere were removed so that the density of each stratum of air were reduced by one half, the horizontal refraction would as nearly as possible be reduced by one half, for the refractive index and density of a gas vary together, so that if $\mu$ be the refractive index, and $d$ be the density of the gas, the fraction $\frac{\mu - 1}{d}$ is constant. Consequently, a ray of light traversing the earth's atmosphere at a height of about 3½ miles above the sea-level would suffer a deflection of only about 34′, and a ray of light traversing the earth's atmosphere at the height (whatever it may be less than 32 miles) where the density of the atmosphere is $\frac{1}{512}$th part of the density of the air at the sea-level, would suffer a deflection of about eight seconds of arc. If the atmosphere above this level were taken to the moon's surface, where gravity is about one-sixth of gravity at the earth's surface, it would occupy a column six times as high, and the atmosphere at its base would be one-sixth as dense as when acted upon by terrestrial gravity. (This follows from the fact that the moon's mass is about $\frac{1}{80}$th of the earth's mass, while the diameter is only 2,163 miles, or about 0·273 of the earth's diameter. A body situated at a point in space an earth's radius above the moon's centre would be attracted towards the moon's centre with a force equal to about $\frac{1}{80}$th of its weight at the earth's surface; and since attractions vary as the inverse squares of the distances, the same body would, at the moon's surface, be attracted towards the moon's centre with a force equal to $\frac{1}{80}\left(\frac{1,000}{273}\right)^2$ of the force of attraction at the earth's surface—that is, the weight of a body at the moon's surface is about one-sixth of its weight at the earth's surface.) Taking the greater curvature of the moon's limb into account, this would give a deflection of a little more than five seconds of arc for a ray passing through such an atmosphere at the moon's limb, if the temperature were the same as in our own atmosphere; and if it was colder the deflection would be still greater. If there were any such refraction or deviation in the direction of rays of light in passing close to the moon's limb, the fact would be easily recognised during total eclipses of the sun. Indeed, a very much smaller amount of refraction would be recognised, as well as in the effects produced when the body of the moon occults stars.

This negative evidence gives us some guide as to the average temperature of the moon's surface, if we assume (as I think seems very probable from other considerations) that there is ice upon the moon. The average lunar temperature cannot be as high as 0° Fahr., for with such a temperature we should necessarily have a lunar atmosphere with a pressure at its base equivalent to 0·0439in. of mercury, and very easily observable evidence of refraction at the moon's limb.

Profs. Langley and Very think that they have satisfactory evidence that the lunar temperature rises in the neighbourhood of the lunar equator a little above the freezing point during the lunar day; but this would be quite consistent with the average temperature of the lunar surface being below 0° Fahr. The temperature of the lunar poles and the regions where the sun is rising or setting would naturally always be lower than the temperature of the parts of the equatoreal regions where the sun is shining vertically. **A. Cowper Ranyard.**

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[31940.]—MUCH of what is said by "Ja. Ha." is correct; much is incorrect. If his reasoning were correct, where would the ice and water of the earth be? We are surrounded by the vacuum of space, as is the moon. Of course, for the moment, I ignore the ether, and assume that a vacuum exists; we have water and ice; there must be, therefore, a tremendous hole in his argument. It is this: "Ja. Ha.," by his experiment, does not get rid of his ice or water in his vessel; he merely transfers it from one place to another, in which latter place it exists in a different form, and becomes subject to the attribute of matter, gravity—viz., the attraction of the earth, from which it cannot free itself, whether ice, water, or tenuous vapour. The air-pump only equalises the pressure between the vessel with the ice in it, and the vacuum created by the falling mercury or the piston of the pump. As the pressure is reduced the ice restores it by water vapour until what we call a vacuum is produced as soon as the ice vanishes. No, Sir, we must have something better.

Stroud, Jan. 1. **W. J. S.**

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[31941.]—IN his letter (31919, January 2), "W. J. S." "waits for a reply" to his query: "Am I not right" in assuming that "we on earth should see the mist or cloud at every new moon, and also . . . . . freshly fallen snow," if water (as ice or snow) covers the lunar surface exposed to the solar rays?

I think he is wrong, for the reason that he is mistaken in assuming that the direct, long-continued, solar rays would do much towards melting any snow or ice exposed on the lunar surface.

And this I believe to be the case, because (firstly) we see snow remains long unmelted on the earth, even exposed to direct sunlight, when the temperature is low—as on the mountains and in the Polar regions—and the more so the lower the temperature; (secondly) because also the lunar snow is likely to be surrounded by a very low temperature, and exposed to a still more advanced rarefaction of atmosphere than those which surround the perpetual snow on mountains.

This low lunar temperature I believe to exist, because (*a*) the moon is a smaller, and therefore colder, body than the earth; (*b*) because, also, there is no atmosphere to absorb the radiant heat of the sun and moon, and to thus warm the surface by contact; or to prevent the moon's surface falling in temperature by unchecked radiation into space; (*c*) because as snow or ice surface is a bad absorber of heat; (*d*) and, again, because there is no *a priori*, or experimental, evidence to urge against such a view, for although the experiments of Lord Rosse might thus be urged, yet the later ones of Prof. Langley and others point in the opposite direction. Therefore, as snow on the earth exposed to direct sunlight, under the nearest approach to two of the conditions which exist on the moon (namely, a low temperature and a rarefied atmosphere), does not melt, but leaves the air dry around it, as is notably the case on mountain ranges, and at such places as Davos Platz, St. Moritz, &c., so I do not think that it would form those clouds on the moon which "W. J. S." thinks we ought to see, if there are ice and snow on the moon.

Shanklin, I.W. **H. G. Dixon.**

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[31942.]—THE reasoning of "Ja. Ha." seems to be correct, if we assume that the temperature at the surface of the moon does not widely differ from the temperature at the surface of the earth.

"Ja. Ha." says that, since water boils on the moon at 0° C., therefore $H_2O$ (I use this chemical symbol in order to refer to water without regard to its state of physical condition—I intend $H_2O$ to include ice, water, and steam) will always be at a temperature at which it will evaporate.

Now, in an article which appeared in the "E. M." for June 20, 1884, Prof. Young states, under the authority of Prof. Langley, that it must be considered extremely doubtful whether the surface of the moon ever reaches a temperature as high as minus 100° C.—that is, about 100° C. below either the freezing-point or boiling-point of $H_2O$. This temperature, in spite of the lowering of the boiling-point, is sufficient to keep all the $H_2O$ on the moon in a state of ice.

"Ja. Ha." assumes an atmospheric pressure of ·17in. of mercury on the moon. Now if we assume this, or even a lower pressure, it will bring the boiling-point of water to 0° C. But a diminution of pressure raises the freezing-point of $H_2O$. So that on the moon the boiling-point of $H_2O$ is lower than the freezing-point. So, if we imagine the temperature of $H_2O$ on the moon to rise from a low one to a high one, the $H_2O$ would at first be ice; then, the temperature reaching boiling-point before it reached freezing-point, the ice would immediately pass off into vapour without ever passing through the liquid state.

A similar example of this may be found on the earth. At a temperature of 104° C., and the ordinary pressure, iodine freezes, while it boils at a temperature of 175° C. Now, if we alter the pressure to 250mm., we bring the boiling point below the freezing point, and at this pressure iodine will pass from the solid to the vapour state without becoming liquid. Thus we have a good reason why there are no traces of water on the moon, simply because water is impossible. And vapour is impossible, otherwise we should see it. So the question confines itself to, "Is there ice on the moon or not?" Or rather, "Are the conditions for ice favourable or not?" If we accept Prof. Young's statement, that the temperature of the moon never exceeds minus 100° C., then we must admit that the conditions for ice on the moon are favourable; if we can refute this statement, we must allow that there is no ice on the moon. **C. M. C. B.**

## WATER ON THE MOON.

[31943.]—THE very reasonable comments of Mr. Monck and Mr. Dixon call for recognition on my part. There does not appear to be much difference between the former and myself, except on points of detail; but I could wish him to be a little more precise. He believes in the probability of the moon having an atmosphere, "though a very rare one." Now, what is his idea of a rare one? The density of an atmosphere can be expressed in figures, and I have stated the density and pressure which would be required to check the evaporation of water on the moon: but I do not consider that the atmosphere represented by these figures can be described as very rare. I fully expect that the astronomers will say that their idea of a very rare lunar atmosphere is that it is something like that which exists above the surface of the mercury in a Toricellian vacuum, and that anything more dense would be discoverable by observation of stars occulted by the moon, by solar eclipses, or by spectroscopic evidence.

Mr. Monck says that "the temperature of lunar ice may be very low." No doubt, if there be any, it is so; but there is also good reason for believing that the temperature of the moon is sometimes very high. We have some experience on the earth of a lunar climate. There are portions of the Arctic and Antarctic regions which are deprived of the solar rays for a much longer period than the duration of a lunar night, and we know that in the same regions the pitch is sometimes melted out of a ship's sides. What we have to do with is the average temperature. We do not know what that is; but it is not permissible, in carrying on an argument, to allow all the possibilities to be credited to one side.

The idea that the moon is an immense distillery—the water evaporated on one side being condensed on the other—can be easily worked out; but the phenomena must be very different from what Mr. Monck imagines, and they should be visible from the earth. We have the data before us in our own Equatorial and Tropical regions. The evaporation is greatest at the Equator, and it is there that cloud formation and rainfall are most active. As the vapour rises into the rarer regions of the air it is condensed into clouds, and falls to the earth again in heavy showers not far from where it is raised. The air-currents which flow towards the poles are quite dry, and never reach their apparent destination. They descend to the earth in the Tropical doldrums, but bring no rain with them. If they did, the Sahara would be a well-watered region. Comparatively little rain or snow falls in the Polar regions. Dr. Nansen crossed Greenland on a line south of the Arctic Circle; but in Grinnell Land, 20 degrees further north, the year's snow melts in the summer. The conditions for the establishment of a distillery exist on the earth, but somehow they do not work as the theorists would wish. I may be told that things are managed differently on the moon. If so, let it be shown. The theorists will find some difficulty in carrying their vapour, without the production of clouds, across that line on the moon where, night after night and hour after hour, the very coldest part of the moon is brought into illumination. But really, if there be water on the moon, the cloud and rain phenomena would be looked for in its warmest region.

I cannot agree with Mr. Monck in supposing that the evaportion of water is checked by its being deprived of air. Indeed, the whole of my experiments were made with water deprived of air, the air having been pumped out before much vapour was formed. When I speak of the boiling-point of water, I do not mean the ebullition point, for that begins below 212°. The condensed water with which our marine boilers are supplied is airless, and yet the steam is kept up. Besides, as Mr. Monck believes in a lunar atmosphere, what reason has he for supposing that it is airless?

Mr. Monck then asks, "What effect has the reduction of gravity to one-sixth on so susceptible a substance as water?" Well, I think that he should work out that problem for himself, and tell us how the reduction of a restraining force can serve as a substitute for pressure. I should be glad to be enlightened on that point.

His last supposition is that the water on the moon is as salt as that of the Dead Sea. It so happens that the Dead Sea can speak for itself. Its water is evaporated so rapidly that all the supply carried into it by the Jordan disappears in the same season, leaving the sea at its old level. I know a good deal about the Salt Lakes of Australia, and they find no difficulty in drying up.

Mr. Dixon asks me to consider the case when there is a force present, such as gravity, to keep water and ice in their places. I fancy that that is what I have been doing. I find that gravity does not prevent their evaporation on earth, and its action should not be different on the moon. He also wants to know whether I have a reason to show why the air surrounding the earth does not behave in a similar manner in the boundless vacuum which surrounds it also. The theory that there is a definite limit to the earth's atmosphere is not mine. I think it was Faraday who first suggested that there must be a point at which the weight of an atom or molecule would resist the further expansion of a gas into space, and, since then, a number of calculations have been made as to the height at which this should take place. These are little better than guesses, and those that I have seen range from 40 to 200 miles; but my own opinion (for which I have reasons) is that they are all much too low. Even if there be no limit, my arguments will hold good, because the smaller planets must be the first to lose their atmospheres and their water. Whether the earth may ultimately fall into dotage is a question with which I have nothing to do. I deal with things as they are, and wish to avoid conjecture.

While awaiting the favourable consideration of my appeal for mathematical aid in the determination of the point at which the attraction of the earth exceeds that of the moon, I may be allowed to say that I am aware that the calculation must be one of considerable complexity, involving something more than the comparative force of gravity at the surfaces of the earth and moon respectively. I am also aware that the attraction of the sun, which is greater than that of the earth, must be taken into account. At full moon, the attractions of the earth and sun combine to rob the moon of its atmosphere and water—drawing them earthwards. At new moon, the attraction of the sun is diminished by that of the earth. I can perceive the conditions of the problem, but can do no more.

Jan. 5. **Ja. Ha.**

## THE LUNAR RAYS.

[31944.]—As it seems to me pretty certain that "F.R.A.S." has (in some way) misunderstood my views in regard to the electrical origin of the lunar rays, and the subject interests a good many, I beg to say a few words on this matter. But firstly, *in re* letter 31705, I may say that I do not see why meteoric dust should fall on the moon in a different manner to what it does on our earth. The quantity which fell per annum would probably be small, and it would need several thousand years to produce a perceptible stain, even if on a level surface. In regard to letter 31735, I am aware of the slow secular drift in our magnetic pole, but for the life of me cannot understand why "F.R.A.S." considers prolonged electrical discharge necessary to form or sustain a ray.

Once a disruptive discharge passed out from a "ray centre" and formed the ray, it seems to me that another discharge along the same line would be unlikely to occur for a very long time, inasmuch as the semi-metallic coating of meteoric dust which conducted the former ray is gone. A subsequent discharge would more probably diverge and pass out where the coating of meteoric dust was intact or less disturbed.

With regard to the rays not being at once overlaid and hidden by meteoric dustfall, let me give a homely illustration. Say we take an ordinary one-foot globe covered with size and whiting, having a stout wire through the poles, and suspend it in gimbals, slowly rotating in a dusty atmosphere. We leave it thus for, say, a month or six weeks, and on our return find it covered with a dark-grey dust coating. Now selecting some point, 0, on the surface, let us scrape off a line of dust some 3in. long × $\frac{1}{4}$in. wide, revealing the white surface as a streak or ray 0 1, which contrasts strongly with the neutral grey of the globe generally.

After a day or two we examine it, and find little or no difference in it, and proceed to scrape off another line from 0, as 0 2; and a few days later a third, as 0 3. A week elapses, and starting from another point on the surface X, we scrape a line X 1 in such a manner as to cross 0 1 and 0 2, finding that these latter are just a shade darker than X 1, but so little that all may be practically classed as white when compared to the tint of the globe itself.

In the above, each scrape of our knife I hold represents an electrical streamer, or disruptive discharge on the moon, which, by removal of the meteoric dust, reveals the snow as a white streak, or "ray."

Successive discharges over the same track would seem to me unlikely to occur, as the semi-metallic conducting coat of dust would have been removed. That the rays are a strictly superficial feature I think most students will allow. They neither influence or are influenced by the surface modelling. Yet they generally pass out from visible craters or craterlets, presumably orifices in the surface, and hence seem to be structurally related thereto. The force (whatever it is) evidently emanated therefrom.

It is simply incredible to me that the rays from Tycho, so truly radial, so linear, and so sustained for hundreds of miles, can be due to fracture of the crust.

Examine for a moment the plans of our terrestrial fissures from volcanic centres; they wind about like rivers, and repeatedly cross and fork like the roots of a vast tree. The rays seem to have been laid out over the surface after the modelling of it had been completed. Yet how come they to be emanations from an orifice in the crust? How and why are they related to the orifice? That the *force* passing out and travelling on or causing the rays is not a solid ejected explosively we have very clear proofs; they are not explosive forms generally. Now the peculiar feature about them which to me seems to indicate an electrical discharge is that they often end suddenly as though stopped or quenched at and by another ray centre or crater.

In starting for that goal, there is no hesitation as to the right direction, no winding about now east, now west; the ray at once starts direct for its goal. It is true this feature is not general among the rays, but it is quite common enough to constitute a most remarkable and suggestive peculiarity, which I am sure "F.R.A.S." will say is well worthy the attention and study of experts.

With regard to the long ray from Tycho to Thales, 1,700 miles in length, I consider it is really two rays which (for once) happen to have fallen in one line.

Turning to another portion of the subject, I find that some astronomers consider snow mountains quite impossible, as "the snow would be compressed to ice and glide off as glaciers." Apparently they are unaware that at low temperatures there is no regelation, and ice is not viscous. It becomes less rigid as temperature falls below zero, and is at last as rigid as limestone. (See the Report to the Royal Soc. by Mr. T. Andrews, F.R.S., *Nature*, June 26, 1890, page 214.)

So there are, I take it now, no glaciers on the moon. Lastly, in regard to my argument that if lunar rocks are like ours, we should easily see colour in places. The last mail brings me a note from a geologist, to the effect that I rather understate the extent of the Sub-Himalayan sandstones. "(2) The Bundari sandstones again spread over some thousands of square miles in Central India and Rajputana, and the prevailing colour is red. (3) Laterite is also widely distributed in India, and covers a very large area; colour, dark brown. (4) Deccan trap covers something like 200,000 square miles, often dark green."

Ere long I hope to get instances of vivid colour over vast areas in other parts of the world. It certainly does seem strange to me that we see no colour in lunar detail, especially in cliff faces, and that in cases where lunar mountain ranges have, as it were, split along the axis or crest, and half has fallen out bodily on the plain, as at the north-west ring of Gassendi and other places, *the core of the range which has been exposed is still distinctly white.*

**S. E. Peal.**

Sibsagar, Asam, India, Dec. 2, 1890.

## THE GREAT METEORS OF DEC. 14 AND SEPT. 21, 1890.

[31945.]—THE splendid meteor of Dec. 14, witnessed and recorded by Mr. Spencer and several others in the "E. M.," pp. 353 and 376, bears such a close resemblance in its several observed pecu-

, colour, magnitude, possible detonating er, and observed route (as deduced from Mr. :'s rough estimate) to a similar meteor ed on the night of Sept. 21 of the same year, uggest a common radiant for both these cent phenomena. The following detailed ; of this meteor will make plain and clear have assumed, and is, in substance, what nmunicated to Mr. Denning a few days after irrence.

p.m. on the night of Sept. 21, about mid-stween $\gamma$ Cephei and Polaris, a meteor d, moving slowly, but rapidly increasing in ess. At first it was followed by a luminous reddish hue, the nucleus being yellowish. ly the tail dropped away, and vanished ately, while the nucleus, with equal ness, brightened up enormously, so as to ate the entire sky with its lustre. It was a brilliant bluish white (like a magnesium urrounded by a decided greenish tinge, and itude about half the apparent diameter of moon. At this point it fluctuated violently iancy, until it disappeared behind a cloud nediately vanished in the neighbourhood of 58 Persei. It lasted seven or eight seconds ibited in its later stages some remarkable otions in its downward progress (previously d in the observed falls of other large ), so that it appeared to fall by progressive About three minutes after, a distant sound under was heard, coming from its direction; his I cannot be sure. Of the many hundreds ors I have witnessed since 1882 nothing has en equalling this one in splendour.

to be regretted that no accurate apparent the meteor of Dec. 14 has been noted for ustworthy comparison; but this is not sur-as the sudden appearance of such a mag-object is calculated to absorb the attention nost experienced observer, and throw him uard, so that only an approximate path can ined, when a most accurate one would be of hest value. But I have repeatedly noted ight meteors are sometimes immediately d or followed (generally the latter) by ones, which greatly help in determining the point—a fact previously noted by Mr. g.

ght be argued that the great lapse of time ks) between the fall of these two meteors militate strongly against their assumed n a common radiant; but the discovery of during meteor radiants by Mr. Denning, g in some instances six months of activity, this at rest.

. **D. E. Packer.**

6.]—FROM a collection of the numerous s of the fireball of the 14th of December has been possible to select from among them it data for the determining of particulars, vill probably interest those who have fol-p the subject. Observations derived in the , and under the conditions as those under ration, are either altogether wanting in l data or so inaccurately stated as to be of ractical value. There is, however, in this , an agreement among the most reliable in the radiant point near $\theta$ Aurigæ, nearly nt with the radiant point of the Geminids, epoch occurs from the 12th to the 14th mber, and it is exceedingly probable that the in question belongs to this system; and it interesting to notice, it is a detonating and aërolitic epoch. Numerous examples of ss of phenomena may be found in the cata-of the British Association reports of past The results of the corrected observations thus stated:—

reball first appeared at an altitude of 90 er a spot in mid-channel, between Ostende rwich, and disappeared at an altitude of over a spot 8 miles west of Ipswich; this an atmospheric course of 100 miles, inclined orizon at an angle of 52°, directed from the distant from Woodbridge at disappearance , and from Ipswich 16, obliquely. If the ad been accompanied by an audible explo-would have been heard at the former place and at the latter 1min. 20sec. after dis-nce. It is therefore evident that the sound by the Woodbridge observer as occurring fter could not have proceeded from this whereas if it had been a meteor of the ng class it must have been heard distinctly ces in the neighbourhood of Ipswich, and y those under verticality, where it would ched in 40sec.. As there is no testimony to ect from those neighbourhoods, we may here was no sound. The angular diameters bodies afford no clue to their real ones, but better estimation is obtained by photometry application of the mechanical theory of ccording to the descriptions of the intensity ght by the several observers, we conclude he distance of one mile the intensity of the uld have been equal to 16 times that of the full moon; this would imply that 14lb. of meteoric matter were expended on its production. This was probably loosely compacted matter, or the meteor may have penetrated the atmosphere as a congeries of discrete particles having the total weight as stated. **W. H. Wood.**

Five Ways, Birmingham, Jan. 2, 1891.

[31947.]—MR. SPENCER is quite right in his surmise as to the "rushing" sound accompanying—or, rather, preceding—the appearance of this meteor.

My own experience—about 9.40—was a perfectly audible rushing or hissing sound in the S.E. quarter, and at its termination a remarkable diffusion of light from the body, some 30° from the zenith to the westward, increasing in brilliancy throughout its fall, until within about 30° above the horizon, when the rate of descent was slightly reduced simultaneously with rupture of the nucleus into three, the two smaller portions (whose light almost immediately expired) leaving the centre of a magenta tint, this disappearing from my view about W.N.W. The observations of a witness 250 yards from me coincided with my own.

A letter published in the *Echo* the evening following describes the place of actual "fall" in North London, and at a spot 30 yards only from the correspondent, who frankly admitted being too much astonished to verify distances by search. This he may well be forgiven, for a more startling and wonderful display it has never been my fortune to behold in any quarter of the globe. In size or effulgency no meteor of my experience has ever approached it, the nearest resemblance and equal, in my memory, being the sudden merging into one of several "corposants" (*Corpus Sancti* of the ancients), which occurred during the progress of a magnetic storm in 30° S., and at a much less comfortable distance than 30 yards.

East Margate. **Frank R. Paramor.**

## LIVERPOOL ASTRONOMICAL SOCIETY.

[31948.]—As a member of the Liverpool Astronomical Society, I ask the favour of a small space to suggest the desirability of a fusion of this society with the recently-formed British Astronomical Association.

I have no doubt that a large number of the members, like myself, join chiefly for the sake of the journals, and if the two publications were amalgamated, the result would be a better magazine. It is obvious that the B.A.A. meeting in the metropolis will command more attention and a longer roll of members than is now likely with the L.A.S.

I presume the property belonging to the L.A.S. could be vested in the council for the time being of the "Liverpool branch" of the B.A.A., in such a manner as to secure it under all contingencies. The meetings could be held in Liverpool as heretofore, and the council edit its own share of the journal, simply sending it up to headquarters to be printed, as from the Liverpool branch. It would cost less to print one journal than two. Subscriptions would, of course, be sent to London, and the present members of the L.A.S. would have to pay 10s. 6d. instead of 7s. 6d.; but they would get more for their money. But doubtless the entrance fee would be waived under the circumstances. An allowance would be necessary to cover Liverpool expenses for place of meeting, &c. It may be argued that some members, who at present contribute papers to the L.A.S. *Journal*, would cease to do so to the Liverpool branch, preferring to send them to headquarters instead, and I daresay that would happen to a certain extent—but what matter?

With some members of the L.A.S., possible *amour propre* might militate against my suggestion, but I do not think they should allow it to do so.

Liverpool had the honour of first demonstrating in a most successful manner the necessity of a *popular* Astronomical Society, which no one can gainsay, and I think the time has come when all should join hands in a hearty manner to further, in the interests of all, the advancement of the association which is doubtless destined to exercise a wide influence, and to possess members and correspondents in all parts of the world.

I shall be glad if more competent pens than mine will take up the parable and improve on my crude suggestion.

Liverpool, Jan. 5. **Asteroid.**

## PRACTICAL WORK WITH THE TELESCOPE.

[31949.]—IN a late number of "Ours," "F.R.A.S." very highly commended a paper read before the Lancaster Philosophical Society upon "Practical Work with the Telescope," by the Rev. T. E. Espin. Being anxious to get the paper, I wrote to the printers, and received a courteous reply saying that the paper was printed for private circulation only.

Now what I wish to ask is: Could we not have the paper reprinted in "Ours"? The general disposition of Mr. Espin, and his real sympathy with workers, lead me to think that he would not interpose difficulties, nor refuse to enrich the columns of the "E. M.," which he has often done aforetime. I believe if this could be done it would be appreciated by your readers. **Sparling, B.A.**

## THE REVOLVING NUT, &c.

[31950.]—THOUGH no one noticed my query on p. 314 with regard to the revolving nut, I cannot but think the question of revolving-nut v. clasp-nut is of some interest. A friend inquired for me of Messrs. Cooke, of York, how, after cutting a screw-thread, the saddle can be returned so as to drop the tool into the thread correctly, and they reply that for accurate screws the saddle must be run back by the treadle. I have also written to the London Lathe and Tool Co., and they reply: "For a coarse pitch you may back treadle, or run back by the handle on leading screw, and in either case no dislocation of connections is necessary; for a fine pitch you may disconnect the clutch and run back by the handle on leading screw, or disconnect the click in front and run back by the hand traverse motion. There is no difficulty in making the connection again to run into the same cut. No chalk line is needed, because the clutch and click-plate are both figured." I now see that I did not properly understand or appreciate the value of that clutch of the L.L. and T. Co. front slide lathe, or see that by throwing it out, a handle on the end of the lead-screw would enable one to return the saddle ¼in. per turn without also having to drive the change wheels and the mandrel, which, when geared for fine-pitch screws, would be hard work. The words "disconnect the click in front and run back by the hand traverse" refer to the divided plate with 25 holes on the handle for moving (by skew gear) the revolving nut, and the "lock-pin" holds the nut stationary while the screw is turning within it. (See description on p. 249, Vol. XLVI.) In Messrs. Cooke's lathe, the handle for moving the revolving nut is so geared that one turn moves the saddle $\frac{4}{10}$th of an inch, but this would be rather too fast for giving a hand feed. In the L. L. and T. Co.'s lathe there might easily be a pair of bevel wheels at the right-hand end, say, 4 to 1, which would bring the quick return handle to the front and give a movement of 1in. for each turn of the handle. By the marks on the clutch it should be easy to bring the screw and change wheels together in the same relative position; and by the figures on the click-plate the nut could be brought back to the same position if the handle has made an *even* number of turns. I must say I think the arrangement extremely convenient, though it does not lend itself to the work of planing or slotting, &c., as sometimes practised by means of the rack-handle.

With regard to the eccentric cutter, I have a suggestion I should like to submit to Mr. Ellison and others. The little cutters never fit quite perfectly into the receptacle, and you are told in one book to press the point to one side before fixing with the screw; now would it not be better to have the receptacle formed exactly like that in the drilling spindle, and why not use the drills themselves? Many of them are of suitable form. There should, of course, be a tightening screw, just as there ought to be one on the driller nose? Again, what is the best way of sharpening the V-pointed drills so as to get the point perfectly central when taking a traversing cut? I find it needs a great deal of time and patience and very good eyes to get the point so true that when you traverse the drill along, it shall produce a groove that is really angular at the bottom. What capital articles we are having on "Lathe Appliances"! **F. A. M.**

## DIFFERENTIAL SCREW AND SPIRAL SLOT MOVEMENTS.

[31951.]—CONSIDERING the grave nature of the charge implied in letter No. 31931, it should have been signed (as my own was) with the writer's name. When the writer acknowledges his identity, I am quite ready to go fully into the matter of my claims to the invention of these two appliances.

**A. S. Lukin.**

## LATHE MATTERS—OVAL CHUCK.

[31952.]—THE capital article on the oval chuck was a great treat, but I am glad it did not come a week earlier, when it might have deterred me from attempting the construction of a very far from high-class appliance, for such counsels of perfection come to me, alas, as an unattainable ideal of right workmanship. As it was I was too far gone to draw back, and I went through with it. How I came to want an oval chuck is, in Kipling's phrase, another story; but the manner of accomplishing it may be an encouragement to others of the weaker brethren of the lathe, among whom I must be numbered. First, of course, I turned up the heading in the index of Holtzapffel, and found the usual historical sketch of its development, and one early form appeared such as one might hope to make of wood, and now, ten days later, I am the very proud possessor of an oval chuck, as well as an oval mount and a small wooden tray, the first fruits of my very rough and ready apparatus. The whole thing is made of some scraps of mahogany, with, say, a dozen wood screws and a bit of boxwood, in which is cut the screw socket to fit the mandrel-nose. The chuck itself is a wooden face-plate (which can be fixed at centre by inserting two screws when required), and is substantially the same as its high-class fellow, with the omission of the nose and tangent-screw business; but I have fallen back on the primitive device of screwing the eccentric ring to a piece of plank fastened to the mandrel head by the ready, if somewhat inelegant, method of tying it with a bit of copper wire. The result is much more satisfactory, and the difficulty of holding the tool aright much less than I expected, at all events, in plankwood turning. **Rushlight.**

### LATHE APPLIANCES.

[31953.]—I AVAIL myself of the first opportunity of replying to some correspondence which has appeared in respect of the articles under the above heading.

"F. A. M." (letter 31377) asks how the spherical rest may be connected with the spiral apparatus so that a spiral can be cut on a ball. Now it seems to me that anyone having a spiral apparaus, and knowing the method of using it, would find little difficulty in connecting it to the spherical rest. However, if it be desired, I shall be pleased to write a paper on this subject. The shortness of the tangent screw and its frame is remarked upon by "F. A. M." Practically, there are imperative reasons for constructing in the way illustrated. A winch-handle can be used quite satisfactorily to turn the screw of the circular slide of the spherical slide-rest illustrated; it is, in fact, the usual appliance for turning the tangent screw. The winch handle did not seem to need illustrating, and consequently was not drawn by me. The way in which I have attached it is perhaps not the usual way. A drawing of the lengthening spindle and its frame shall be sent in for illustration. "F. A. M.'s" presumption is correct in respect of the first slide B; it should be shown broken off.

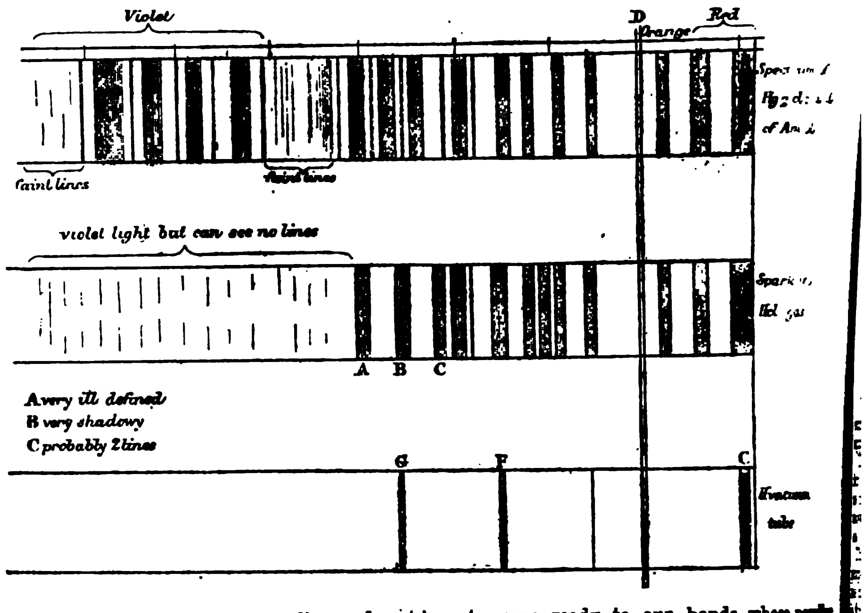
"Colwyn Bay" (letter 31405) asks whether the title *compound* eccentric chuck is not a misnomer. Very likely it is. Compound slide-rest is the term commonly used to designate a plain slide-rest having two slides. The eccentric chuck described has two motions: the sliding and the rotary, and is *compound* as distinguished from one having its false nose fixed. The eccentric chuck owned by "Colwyn Bay" is certainly not constructed in the usual way. For many years I had a similar one, and have drawings or sketches of it now, and can illustrate it if wished.

"Dunelm" (letter 31551) asks if I intend describing a heavier drill spindle. I may say Yes; there are very many lathe appliances that I intend describing, provided that readers are sufficiently interested. The appliance "Dunelm" asks about is a most useful one, and at no distant date I hope an illustration of it will be published. Having recently given a paper on a light drill-spindle, it is perhaps expedient to treat upon other appliances. Readers who feel interested in these articles, as "Dunelm" says at the head of his letter, need not hesitate to write and say if any particular subject is desired.

"W. P. W." (letter 31615) asks me to explain two or three "wrinkles" in the paper on "Drill spindle." Let me first say that "W. P. W." misquotes my words, and probably he has misread them also. Replying to his questions as numbered: 1. In heating the spindle for hardening, an air burner is used, not a smith's fire. The necks which form the bearing parts are heated sufficiently to harden when suddenly cooled, the remainder of the spindle is not. I do not see how to explain further than has been done in the paper referred to. If "W. P. W." finds a difficulty, will he please ask again and explain just where his difficulty occurs? 2. The nose is trued up with a hard graver. 3. The hole for drills is rebored with a half-round bit. There is no doubt that more depends upon the treatment of the steel in the fire than some would be inclined to believe.

"F. A. M." (letter 31637) asks how Holtzapffel's drillers are fitted. On page 2 of the current volume he will find illustrations which show this. In respect of his own drill-spindle, it should not be difficult to regrind the bearings, so that both front and back collars fit properly. He says the smaller cone is loose, and cannot be set up, but the bearing must have been allowed to get very badly worn for this to be so; and even at the worst a new collar is not an impossibility.

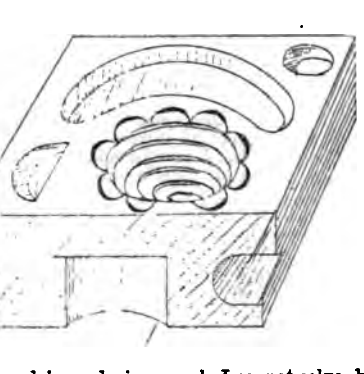
C. C. Ellison (letter 31720) says a very important point—the "binding-screw"—has been omitted in the drill-spindle I would say that I regard a binding-screw in this connection as an unmitigated nuisance. Considering the very heavy work that is done with milling cutters held in taper sockets, it is difficult to see why C. C. Ellison condemns the taper-stem fitting so sweepingly. Binding-screws are commonly put to badly-made and low-class drill-spindles, but the better-class appliances do not have them.



"F. A. M." (letter 31749) asks the meaning of some descriptive matter relating to the French oval chuck. Perhaps the illustrations of a modern oval chuck, given in the fifth paper on "Lathe Appliances," may assist in showing the proper construction of an oval chuck, and perhaps it would be a better model to follow. Any modification could be introduced. The sketch showing how "F. A. M." fits drills to his spindle is instructive; but I have said above that I do not like a binding-screw. **Earlswood Park.**

### TOOL FOR BORING HOLES.

[31954.]—I HAVE not seen in your pages any mention of a tool for boring holes and also recesses flat at bottom. It is, I think, quite new, and likely to be of great service to pattern makers, wood carvers, and probably engravers for recessing blocks. The amateur will find it very useful. It is a kind of centre-bit, but without any point. The end is, in fact, a cylindrical tube, but so grooved as to form a cutter like that of a nose-bit. It is easy to use, and even with the thumb and finger I can cut a recess in a deal block with a bit ⅜in. diam., but they are made to fit an ordinary brace. I had mine from Melhuish, of Fetter-lane. The square is marked as patented on two separate dates, but there is no name on it that I can see. How the cutting end is made is a puzzle I cannot solve, but it is a well-finished tool, and is made in several sizes. I send sketch of a block with recess cut by a set of six. I have often wanted such a router. Moreover, it would bore out soft-wood boxes in the lathe, leaving the bottom flat; and being cylindrical would not stray when once entered. **O. J. L.**



### THE VIOLET-COLOURED FLAME PRODUCED BY THROWING SALT INTO A FIRE.

[31955.]—I OBSERVE that you mention my name in connection with the late resuscitation of this question. I fancied I had settled the matter twelve years ago; but new men apparently do not take the trouble to read what has been already done, and thus they fancy they have discovered something.

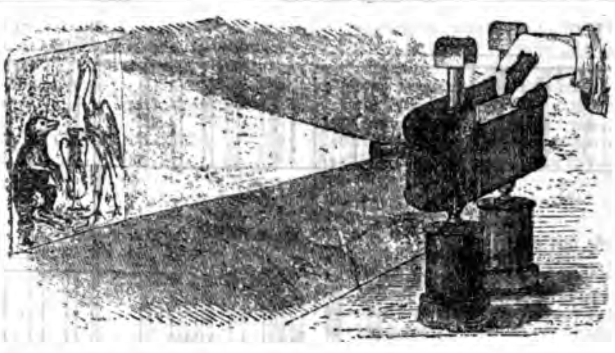
When we endeavour to investigate the cause of a coloured flame, it is the height of absurdity to jump to conclusions and make wild guesses as to its origin, as so many have done with respect to the violet flame, when we have an instrument like the spectroscope ready to our hands whose peculiar province it is to deal with such matters; but there are, unfortunately, too many people who prefer to theorise without submitting their ideas to the test of experiment.

Once upon a time a certain individual, name unknown, noticed that a beautiful violet flame was produced when common salt was sprinkled upon glowing coals. I believe he had been eating walnuts, and emptied his plate into the fire; but History sayeth not. This peculiarity was afterwards observed by others, and even placed on record; but, so far as I am aware, no endeavour was made to solve the problem. In the year [illegible] my attention was drawn to the subject by some correspondence in the scientific journals, and I began an investigation which lasted, with several intervals, until March, 1879. I will not inflict you with the details of my experiments—suffice it to say that in the course of this investigation I proved conclusively that neither copper, carbon, nor sulphur in any form whatsoever could possibly take any part in the reaction, and that chlorides—and chlorides only—were capable of producing this violet flame. The metal present was of no moment. *All* the chlorides I used proved capable of imparting the desired colour; but salammoniac and calomel were most effective. The easiest way to produce this flame for purposes of investigation is to support a piece of wire gauze over the flame of a gas blowpipe, so that there is a black spot on the gauze surrounded by a red-hot ring. Drop on the central spot some calomel, in powder, and the flame burning above the gauze will assume the tint in question. Having reached this point, I was not long in arriving at the conclusion that the cause of the colour was hydrochloric acid, due to dissociation by heat of the chlorine with subsequent combination with the hydrogen of the coal-gas, especially as I was aware that a drop of liquid HCl introduced by means of a platinum wire into a Bunsen flame would give a transient blue flash. However, I could not at first *prove* the truth of this theory. The spectrum of a spark in hydrochloric-acid gas did not agree with that of the chloride, although the two possessed lines in common—notably those of hydrogen; and that of chlorine itself was totally different. When I considered the different conditions under which the two were compared, I did not take the result as disproving my theory; but sought some other means, and was at last successful in producing the violet flame by slowly passing *pure* hydrochloric-acid gas into an ignited jet of *pure* hydrogen. The whole of the apparatus employed was of glass, and every precaution taken to avoid impurity. This method was not at first successful, on account of the HCl being evolved with too great pressure. When the exit tube was widened, I obtained the desired flame, the spectrum of which was identical with that from calomel, or salammoniac, or from common salt in a coal fire. The source of the HCl was varied—in one case I allowed a stream of hydrogen to mingle with one of chlorine before combustion, but the result was the same.

It has never been suggested, by *any competent observer*, that carbonic oxide was the cause of the chloride flame, because the flame of burning CO totally different in appearance, and has been well known for years—I might say for ages. I trust that this question may now be finally dismissed, the extensive circulation of your paper bringing it under the notice of those who may have been debarred from perusing the more expensive periodicals.

**A. Percy Smith, F.I.C., F.C.S.**

Broad-street Corner, Birmingham.



## ENCH SCIENTIFIC TOYS.

—WHEN in Paris I came across two entific toys, which I think are worthy to the "E. M."

: is a kind of double-lamp magic-lantern ing the images of opaque slides as well usual transparent ones, and is so clearly the illustration of this "Lampadorama" lled), as to need no special description.

er is an "electrical map," for teaching The map is mounted on a board, and owns have each a small metallic plug let ith the map. Up the sides of the map ons, "What is the chief town of such Department?" To each of these ques- other metal plug, and there are also a tric bell and a dry pile for working it. puts one end of a conducting-wire on stion plug," and moves the other end r the different "town plugs" till the bell ch shows that that town is the one to question refers.

remember anything of the kind before; s others better acquainted with "Toy- y have seen them. **A. S. L.**

## SPECTACLES.

—I HAVE several times during the last sought without avail for a description, ams, of the *working* operations followed and fitting common and other spectacles sses, and a definition of the terms used e, such as "cylindrical lenses," "peri- &c.

of your oldest subscribers—as Pat says, before ye," with the publications you and I have looked through all the back om No. 1, although I think every other own has been treated. May I ask again, of our optical friends favour us and

**Finem Respice.**

## NESE PAPER FROGS AND BELLOWS.

—I HAVE made these any time the last ; the bellows are made by simply folding like with the last double folds, and then the middle so as to form handles on each frogs' legs repeated on the opposite side. r is pliable and good, a distinct puff of n opening and closing the contrivance, e delight of small housekeepers. I have y to make hens and chickens. Can any ers restore this lost art? they had a most ppearance, and started from a square of the boxes and bellows. **C. J. C.**

## CONTINUOUS BRAKES.

—In reply to letter 31929, p. 402, the ilway Company has completely abolished ous "Clayton two-minute" brake, and with the ball-valve. The Midland ill, of course, work with the North- ondon and South-Western, or any others automatic vacuum brake.

uctions to which "Meteor" refers are complicated, but many of them are out of date. Mr. Webb, it will be d, would not adopt an automatic brake; d a chain brake, then a simple vacuum, omatic vacuum on the vans, and then a lever by which either simple or auto- l be worked. Now, in accordance with y Regulation Act of 1889, the simple ake working has to be discontinued.

**Clement E. Stretton.**

, 5th Jan. 1891.

## IOTIVES AND LOCOMOTIVE RUNNING.

—IN reply to the questions asked by your nt "Nun. Dor." in letter 31930, it *is* an advantage for the Webb compound engines "that coupling-rods are dis- ;" but, on the other hand, it must be d that they have three complete sets of lace of two, and, as a fact, compound locomotives are not nearly the success which some persons would have us believe.

Coupling-rods upon express engines are in many instances absolutely essential. I have always regarded them in the light of a necessary evil: they are liable to break, and they increase the friction, and place extra strain upon the axles. Years ago, when iron rails were used, coupled engines were required; but now, with steel rails, a weight of 20 tons, if necessary, may be placed upon a single pair of wheels. The splendid "single" engines by Mr. Johnson for the Midland Railway have 17½ tons upon their driving-wheels, which, together with the sand-blast, gives them ample adhesion.

Eight-wheels coupled engines are not required in this country; for mineral and heavy goods traffic six-wheels coupled engines are employed. Express goods and fish trains should be worked by four-wheels coupled engines, and be fitted throughout with continuous automatic brakes.

Engine-drivers run with the fire-door open, or partly open, in order to prevent smoke. To properly consume the smoke, it is necessary to carefully regulate the amount of air admitted through the fire-door. If a driver were to run with a closed fire-door, he would be speedily reported, and fined "for making a dense smoke."

Two fog-signals placed ten yards apart, a short distance in advance of a fixed signal, inform a driver that the signal stands "on." When the signal is taken off, the fog-man removes the fog-signals and shows a white lamp or flag to the driver; he also, if possible, communicates with him verbally. In case of a break-down or other emergency, three or more fog-signals are put down ten yards apart; this signal calls on the driver to instantly take every means to stop his train. Detonators, or fog-signals, are carefully kept, and one from each man's stock is frequently tested; they may be regarded as perfectly reliable. One fails occasionally, but the second has the desired effect of calling the driver's attention to the fog-man's red lamp. During the past twenty-five years I can only recall one case in which both fog-signals failed together, and that was many years ago; it may therefore be said that they are not liable to fail.

**Clement E. Stretton.**

Saxe-Coburg-street, Leicester, Jan. 5.

## THE MERIMBA.

[31961.]—SINCE the Field Club of Keith, and perhaps others, take an interest in these original musical instruments, I may be allowed to describe a merimba somewhat differing from theirs in construction.

Whether it is of earlier or later date, or whether it belongs to the same or to a different tribe of people, I cannot say. Imagine a thin branch or split stem 6ft. long, bent to form three sides of a rectangle. The two opposite sides to be joined in the middle by a thin batten, 2ft. long and 2in. wide. On each side of this batten, 6in. apart, are stretched two fibrous cords, and on these are fastened, with strips of raw hide, ten flat lugs of wood all of equal length, but slightly varying in breadth and thickness from 2in. by ¾in. to 1½in. by ½in., and tapering a little towards each end.

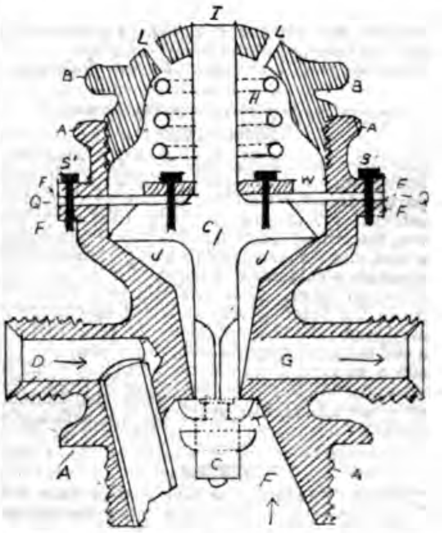
These ten lugs form the notes of my merimba. They are grouped or separated in pairs, between each pair is a notched wooden bar supporting the stretched cords. On the batten behind each lug is cemented a small pear-shaped resonator, apparently constructed out of the thick shell of a fruit by removing its soft contents. Two shells, one to form the body, and one smaller, to form the neck, are used for each resonator. A side hole is made into the larger shell, and a ½in. length of cement tube fastened into it, which also goes into the hole made for its reception in the batten, and a small opening is thus left for the sound to enter. The neck of the resonator is closed.

I can only see a pinhole in each, besides the batten-hole, which varies from ⅜in. to ¼in. diameter. The ball of the largest resonator is about 4in., that of the highest note 2in. diameter. Whoever he was, the constructor of this merimba must have had a fine appreciation of tone. The instrument appears to be used in a horizontal position; it rests on two pins let into the frame on each side. The player could not go inside the empty space inclosed by the frame and the notes, as Mr. Thoburn suggests. The arched third side of my instrument serves for carrying it about, I think. I have not as yet thoroughly examined the notes that the instrument produces, or what kind of scale—major, minor, Grecian, &c.—it was intended for.

If the membranes over the resonators of the "Keith" merimba are not intended merely to stop the ends of the cylinders in order to give them a lower note, they can only be intended to increase it. I cannot see clearly how they could counteract the harmonics by strengthening the bass note, and I think it will be attributing *great* musical knowledge to the Honduras people to assume that they could deal with harmonics in that way. Neither can I see why this merimba should be tuned by attaching wax weights instead of by lengthening the lugs when the tones are too high. As Mr. Thoburn is rather an expert in acoustical matters, he, no doubt, probably has his reasons, which I, for one, should be glad to hear. **A. Caplatzi.**

## AUXILIARY POWER FOR TRICYCLES.

[31962.]—I HAVE read with great interest the letters of "Jack of All Trades," *re*—"Auxiliary Power for Tricycles." I hope it will not offend if I point out, what I think, an error in the construction of reducing valve (letter 31839, p. 294). Referring to sketch, A A A A is the shell, J and K the valves, B B the cap of shell, with two holes, L L, open to atmosphere. I presume, as there is no mention of any arrangement being made to insure a perfect fit of the valve J to the inside, the shell A A A A, it may have been overlooked; as it is shown in the sketch (p. 249) there is nothing to prevent the gas escaping between edge of the valve J and inside of the shell through the two holes, I I,



into the air, which will soon do away with the pressure. I would propose the following slight alteration:—Instead of the shell being cast all in one piece, it should be cast in two, with flanges F F as shown in sketch, the two parts to be fastened together by screws S¹ S¹; between the two flanges a piece of thin indiarubber sheeting, Q, to be introduced, having a hole for spindle I to go through, and to be attached to the valve J by a washer, W, with three or four screws, S S, thus forming a flexible partition or diaphragm, cutting off the lower part of the shell from the top, allowing the spring H to act as before, but keeping in the pressure; I only suggest this as one remedy; perhaps "Jack of All Trades" may think of something more simple. **R. Y. E.**

## OPTICAL MATTERS.

[31963.]—THE occasional appearance of a letter such as that of Mr. J. G. Bartel, on page 336, induces me once more to appeal to the practical opticians who read the "E. M." to commence a series of papers on practical optical work. There have been excellent papers on model work—engine and lathe-making, and the construction of electrical instruments—but optical and scientific-instrument work seems to be neglected, or else studiously kept in the dark. Why this should be so is incomprehensible. To the amateur who has a fairly good lathe there can be no more interesting occupation than the working-up of optical instruments, aided by similar instructions to that given for other branches of mechanics. Cannot some practical man favour us with dimensioned drawings of the various parts, and concise instructions for their fitting-up, similar to those now appearing for lathe, engine, and clockwork? Let me hope that the commencement of the New Year may induce someone to make a start in this direction. Our old friend, "A.S.L.," gives a drawing of a microscope. If the letter had been expanded into an article like the one on the oval chuck, with dimensioned drawings of the various parts, it would have been much more serviceable.

I have often thought it a great misfortune that an opticians' society could not be formed. By this I mean, not such a society as the B.A.A., but, if I may so term it, an ENGLISH MECHANIC Optical Society, in which the members should communicate to each other by correspondence in some cases, but chiefly through the "E. M.," instructions or information, both theoretical and practical, on optical work, and descriptions of new theories and new contrivances in optics. They might also assist each other in making or procuring different parts, or in selecting suitable glass, &c. Such an association for mutual help could not fail to be beneficial to all concerned, and would greatly increase the scientific culture of optical art. Let me hope that the old optic hands, both amateur and professional, will again rally round the "E. M." standard, as in days now past. **Orderic Vital.**

## SPEECH OF LOWER ANIMALS.

[31964.]—RE the letter signed "A. S. L." in No. 1343, will he, or some other reader who has a phonograph with the means postulated for regulating the speed, kindly try the experiment of sounding into it, say, for a minute continuously, a sustained note, such as that of a harmonium reed, or an organ pipe, and then reproducing with the drum at half-speed, and publish the result in "E. M." In this case, as there would be no tune, it is not a question of producing it faster or slower: the question is, Will the note be the same as that impressed, and if not, what will be the relation of the second note to the first? In the letter referred to, the word "octaves" is italicised, but it is obviously no matter whether the lowering be measured by octaves or tones, or even fractions of tones.

Woodbridge. **Sidney Bolton Kincaid.**

## THE NEW PHOTOGRAPHIC. OBJECTIVES.

[31965.]—THE particulars of the photo-lens described on page 347 seem to indicate a distinct departure from the old lines in forming such combinations. If I judge correctly from the data there given, the principal action is due to a single meniscus lens, and the errors of this lens are corrected by a separate combination designed for this purpose and for no other. This principle will, I believe, have in the future a very extended application in optical combinations, especially in telescopes. I am still sanguine that the dialytic principle can be made a success, theory notwithstanding being in opposition. It is the correct thing in photo. and microscope o.g.'s; why should it not be so for astro-objectives? **Orderic Vital.**

## ETHER.

[31966.]—THERE are certain matters dealt with in my last communication on the above subject which perhaps require some amplification. I have remarked that, on the assumption that the energy of a battery is conveyed across the dielectric we may find, *à priori*, what ought to be the intensity of the magnetic field in the neighbourhood of a rectilineal current. How this can be done I now proceed to show. The energy is conveyed to the wire by a series of ring-shaped converging waves; the field in the neighbourhood of the current being something in the same state as a sheet of water after throwing in a stone, only that the waves here *contract* on the wire instead of *enlarging*. Let us direct our attention to one such annular wave as it converges on the wire. Then, if the wire is sufficiently long compared with the diameter of the wave, and far enough from any other part of the current, the centre of the annular wave will coincide with the centre of the wire. Now, as the wave converges, its energy remains constant, and so does its velocity. Hence, the amplitude must increase, and the mean square of the velocity of vibration (which, of course, is not the same thing as the velocity of wave-motion referred to above) will be inversely as the radius of the wave. But the statical effect of a fluid in motion is proportional to the square of the velocity. The pressure of a gas, for instance, is proportional to the mean square of the velocity of its molecules. Hence the statistical effect of the wave varies inversely as its radius. This statistical effect, however, is simply the intensity of the magnetic field, which must consequently vary, in this case, on the simple inverse ratio of the distance from the current.

I ought also to point out that the arguments against transmission along the wire do not apply to transmission across the dielectric, because in the latter case the transmission is effected without dissipation.

With respect to the location of the energy in a charged conductor, one idea is that it may be contained by the film of air in contact with the surface of the conductor. If this be the case, removing the film should remove the charge. The experiment can be tried in two ways—one is to connect an insulated conductor to an electroscope, and direct a stream of air against it. A better experiment is to use a hollow conductor, provided with an orifice, and to blow air into it through an insulated tube, thereby causing a jet of air to issue from the orifice. Such a jet should have a powerful effect in drawing away the adhering film of air. I tried these experiments some time ago, with purely negative results. A stronger reason, to my mind, against the superficial distribution of the energy is that the electric face is uniformly distributed between the opposing faces of a plate condenser.

With respect to the connection that exists between opacity and conductivity, I offer a few words of further explanation. The ether between the sides of a charged condenser is in a state of strain. Discharge is the release of the ether from the strained condition. Charge and discharge can, therefore, only take place when the ether in the insulator is elastic. Hence, in all good insulators the ether must be in an elastic state. But it is the elasticity of the ether that enables it to transmit the vibrations of light; consequently an insulator should be transparent. The reason that this is not always the case is because elasticity in the ether, although a *necessary*, is not the *sufficient* condition for transparency.

The following appear to me the two strongest objections against the ether theory. The first objection is based upon the relation that must subsist between the ether which is at rest in space and the earth which is in motion through it. According to the hypothesis of Young, the ether passes through the solid mass of the earth "as freely as the wind passes through a grove of trees"; in fact, much more freely, since the motion of the earth is not resisted. This is a sufficiently improbable supposition in itself; but it becomes incredible if we are to suppose that the phenomena of electricity are due to strains and waves set up in this same medium. One hypothesis is that one portion of ether is at rest absolutely, and the other part is bound up with, and accompanies matter, in its journey through space. I do not see that this supposition mends matters much; for how are we to suppose that the space is bridged over from one particle of ether to the next, the intervening space being occupied by ether in motion? Besides, this separating the ether into two parts amounts practically to having two media—one to transmit light, and the other to serve as the agent for electrical phenomena—a complication which greatly detracts from the intrinsic probability of the theory.

The other objection is a metaphysical one. When we say that "matter exists," we mean that we can perceive it by means of our senses. When something is said to have existed in time past, we mean that a percipient mind, if it had been present, would have been the subject of certain sensations. Things, in fact, only exist for us as objects of perception by the senses. But ether, from its nature, cannot be so perceived. How, then, can we predicate existence of what is not an object of sense-perception? Or we may put the matter in this way. Existence implies cognition, and cognition implies a subject; granting that ether exists, what is the subject of cognition? It may be replied that the form or manner of existence of the ether is not a matter with which the experimental philosopher need concern himself. Matter and ether are merely names that each connote a bundle of coexisting properties; if these properties are consistent with each other and with observed facts, that is all that is required. If ether fulfils this condition it exists for all practical purposes as much as matter. All this is perfectly true; but it is rather shelving the objection than replying to it.

I will conclude my contribution to the above subject by a quotation from Ferrier's "Metaphysic," which, though used in reference to the subject of his work, is just as pertinent to experimental science, "The two things required in a system of philosophy are that it should be reasoned and that it should be true; but it is much more important that it should be reasoned than that it should be true." In judging a theory the first test is not its truth, but its ratiocinative character.

**G. J. B.**

## CONTRACTION BY DAMP.

[31967.]—A COUPLE of weeks ago a correspondent asked the reason of damp causing linear contraction in cord, catgut, &c., of which "Sm." gave the generally-accepted explanation. This reminds me of an experiment which I made some time ago. I took an E violin string, tuned it to pitch, and then damped it. The result was that the note fell about half a tone. Now this seems a paradox. The string must have been further stretched by contraction, and yet the note was lower than when the string was dry. I wrote at the time in reply to a querist who wanted to know if damp caused strings to break, that "damp should not cause the string to break, since it lessens the tension." I half expected that this would be contradicted, but it was allowed to remain: therefore I suppose that the phenomenon has been noticed before. But has any reason been assigned? Can it be that the cross-sectional expansion counterbalances the effect of the linear contraction **Caldemone.**

# REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[72685.]—**Yew.**—To "NUN. DOR."—In my father's garden at Glen Magna, Leicestershire, there is an avenue of twenty-three fine old yew-trees, the largest of which I find measure 7ft. 3in. in circumference. About eighteen years ago I made in my workshop here, a number of useful articles, paper-knives, turned ring and watch-stands, and boxes, &c. The wood is very hard, durable, takes a splendid polish, and turns well in the lathe. If "Nun. Dor." will forward his address to me, I shall be very happy to send him a specimen of this yew wood in order that he can try it and form his own opinion thereon.

CLEMENT E. STRETTON, C.E.

Glen Magna, Jan. 3.

[72685.]—**Yew.**—Either the writers in the "E.M." relative to yew have been mistaken in the wood they have taken for yew, or it has been very old and decayed before it was cut down. I have in my possession a snuff-box which I turned from a log of yew grown at Castle Eden, about 12 miles south of Sunderland, over 60 years ago, and as sound now as it was when I turned it, and I believe in another 60 years it will be equally sound. The yew at Fountains Abbey, said to be over a thousand years old, was in existence when I was last there. The inside was hollow, and a young yew-tree was growing up inside of it. I thought at the time that this was probably the manner it existed so long, as the young tree might live hundreds of years.

Sunderland. WM. GRIMSHAW.

[72685.]—**Yew.**—I consider "Holtzapffel," who was long the head of the turning trade, as an indisputable authority. In his chapter on "Woods," he gives it a high-class character for lathe work and cabinet uses. The tree is unmistakable—its semi-transparent crimson fruit, each containing a dark seed, rendering it very conspicuous, and attracting large flocks of winter birds. In "Evelyn's Sylvia," a large book on British trees (and which I unluckily gave away some years ago), there is sure to be an account of its timber value. I know that the yew wood I cut for myself in the Himalayahs was sound, very hard, and springy as steel. The only modern "Bowyer" I can remember was Buchanan, of Oxford-street. Should the firm still exist, they might give much valuable information. At the "archery meetings," once so popular, I have seen yew bows in the hands of male competitors, and lancewood preferably among the ladies—there being a vast difference of "pull" in the two woods. "Cloth-yard shafts" were the regulation army arrows in the olden time, and there are wonderful accounts extant of the projectile force which sent them through sheets of mail at long shots. Here is a brief description of the largest known yew—it is, or was growing at Hedsor, in Bucks: diam. above 27ft., supposed age 3,240 years—truly a patriarch.

Eos.

[72685.]—**Yew.**—"Nun. Dor." asks for more information, and I may say in response that I consider yew the most valuable of English woods by far to the turner; but it, like all others, must be felled when at its best, carefully cut into planks, seasoned, and prepared for use. Few persons are so barbarous as to cut down a grand old yew; but long-lived as yews are, time, or it may be lightning, destroys them, and then it is no wonder that you can't get veneers or anything else good out of them. There is a great quantity of very fine yew in the "Dukeries" in Notts, and for the last 40 years I have turned it into almost every sort of article, and I now send you, Mr. Editor, a pair of soda-water bottle stands which will not only prove useful, I hope, but will enable you to append an Editorial comment as to the quality of the wood, which was cut from a plank 2ft. wide, and was as sound as a bell. That is not a very large size, for if I remember rightly I measured one in the New Forest last year that would yield a plank nearly five feet in width. The assertion of "C. M."—viz., "Bows are never made of yew at present"—astonishes me, for I have shot with them for more than 25 years, as did everyone who could afford to pay for them. The Spanish and Italian wood is the cleanest and the best, the "Self" bows the most costly, and the yew-backed-yew the easiest to shoot with. There is not the smallest reason to doubt but that our ancestors largely used the English yew for bows as well as, more sparingly, other woods. I shot with one for many years. It is no more to be expected that one can find wood suitable for bows amongst

:ees than that our cherries should ›e-stems of the Turk. If William ived he would probably have used s-bow of his native land. Mr. Piccadilly, would probably supply a bow of English yew, and he, I ɔt, knows where, in England, to find :h to fashion them. Mem.—Retail seasoned yew is 5d. per foot, 1in.

C. C. Ellison.

of the wood certainly leaves nothing -Ed.]

**?ulvermacher Chain Bands**— 28 should read No. 20 zinc wire; read voltametre; for sparks read

A. Caplatzi.

**ɔise on Cello.**—An expert might ıuse of the noise complained of by instrument; but as a guess, it may s a crack somewhere practically in- :t would require some experiments to ıs it sounds worse in the given posi- d be the place to look first of all. I is nothing loose in or on the cello, rings are up to pitch. Viola.

**'ood: to Slice.**—Does this querist ›me, or what? If he wants slices of microscopical purposes, he will find s for cutting them in back volumes, k all the best section-cutters have 1.

M. T.

**etroleum as Fuel**—I fancy that present price of coals petroleum is as fuel in furnaces; but the dead out 1½d. to 2d. a gallon have been

L. H. W.

**ɔat Engine.**—Several replies to ns have appeared, but how can any peed the querist "should get"? It experimental affair; but the boiler bly be of the locomotive type in such uerist does not state depth of boat.

Chiswick.

**ames on Pencils.**—Impress the ie; rub in gold size or printer's off the surface, and dust in bronze n dry or fixed, wipe off with cotton

R.

**ınd-papering.**—A good and simple machine was illustrated in the 'ov. 30, 1888, and there are several k volumes. Some of them are ed with glass-paper which revolve ; others are discs which are worked motion being imparted by a vertical speed of running depends to a certain character of the wood.

W. W. M.

**old Line.**—The gold lines can be ld ink; but the best way is either to ranted in gold size or printer's varnish e powder, wiping off the superfluity otton wool, or with a hare's foot, e reply 73061. R.

**ɔlit Organ Pipes.**—Solder the cleaning surfaces, with tinman's hloride of zinc as flux. O. B.

**reenhouse Construction.**—I am to "Eos," whose communications I ith the greatest interest, for his notice nd shall certainly obtain the manuals I am still of opinion, however, that arpentering particulars mentioned by lained, an amateur should be able to enhouse which would give him satis- ɔuld, of course, be necessary to use proper proportionate strength to size If some kind reader could therefore iculars asked, with a few sketches nts, &c., and add any information as e for roofing, &c., he would greatly ize of house I should wish to con- e about 15ft. by 12ft., or even a little

Glasshouse.

**Mechanical Similitude.**—If l" wishes to follow up the question performances of similar vessels— l-sized steamer—he should consult Mr. R. E. Froude in the *Trans.* of of Naval Architects of recent years. of sufficient data, I must conjecture volutions, with 10lb. of steam, drive speed of 0·4 knot, or 40ft. a minute, evolutions will drive it at two knots. revs., with 50lb. of steam, drives teamer at 14 knots, all that we can this is that the full-sized engine is imes more efficient than "Paddle lel. At this rate, then, a pressure of e inch in the model would only drive , because the corresponding pressure the full-sized steamer might be re- in consequence of the efficiency of ıg fifty-fold. In the comparison of the mechanical similitude of the model and the steamer, there is not only the geometrical similitude to be maintained, but also the similitude of speeds—as square root of the lengths, steam-pressures as the lengths, and revolutions inversely as the square root of the lengths. And if "Paddle Wheel" varies any of these ratios, the mechanical similitude no longer exists; but keeping closely to these relations, then Froude's experiments tell us that the resistances of the steamer and its model are as their displacements. As to the 20-knot steamer, Froude's law then tells us that, if similar to the 14-knot steamer and only larger in geometrical scale, it must be larger in the ratio of the square of the ratio of 20 to 14, or say twice as long, that is, 500ft. in length, and of eight-fold tonnage. The revolutions would now be 44 × 14 ÷ 20, or 31 per minute, while the steam-pressure would require to be 100 on the square inch. A smaller vessel would, of course, be designed to make 20 knots, but then the engine-power would require to be increased out of proportion. What is now the tonnage, horse-power, &c., of a steamer to cross the Atlantic in five days, if made "exactly to scale" to the *Teutonic* or *City of Paris*, which cross in six days, taking them as of 10,000 tons displacement and 20,000 H.P.? A. G. Greenhill.

[73118.]—**Blackening Zinc Surface.**—Why not try a weak solution of nitrate of silver? It will not blacken the silver. Inca.

[73162.]—**Lamp for Telescope.**—A lamp to have the faults enumerated must be badly constructed—have too short a body, too large a wick-holder, or be insufficiently ventilated. If its parts were properly proportioned, there should be neither boiling over nor smoke. How you attach your lamp to the telescope that it shall always remain a vertical in whatever position the telescope may be placed, is not quite clear. In transit with hollow axis and side illumination, this is an easy matter; but in the ordinary reflector or refractor, some skill is required to properly attach an ordinary oil-lamp. Now that we are becoming so used to the electric light, the simplest lamp to use is a tiny incandescent lamp placed in a hollow brass ball, from which a segment has been cut away to form an easy bearing against the telescope tube just outside the wire net. Fed by three Leclanché No. 2 cells, and the line provided with a switch to put out the light when not wanted, a year's lighting ought not to cost more than 10s., and give no trouble. A. Caplatzi.

[73186.]—**Benzole and Benzoline.**—Benzol, or benzole, is the portion of liquid boiling about 80° C. obtained by distilling gas-tar. Benzoline is the more volatile liquid obtained by distilling petroleum or rock oil, such as is obtained from America or the Baku region, or from Persia. The latter is a mixture of those bodies known as paraffins, and the former the starting-point of the aromatic series, from which the aniline dyes are prepared. "Eos" would find that the "Benzine Collas" would not dissolve the indiarubber; but if he obtains some of the higher members of the same series he will effect what he wishes—xyline, if he wishes a comparatively odourless fluid; but if the odour be of no moment, then coal naphtha will do. Mind "coal," not "wood," naphtha, because the latter is a parallel series to the paraffins. Benzol, benzole, or benzine mean the same thing, and it is used for cleaning gloves. Benzoline would also do; but it is so very volatile, that the saving would be little. Being so volatile, it is much more dangerous than benzol, and it leaves behind it an odour often unpleasant. If "Nomad" uses much, he should go to a distiller and get it first-hand. There is the question of carriage, benzol being classed amongst the dangerous goods. Inca.

[73202.]—**Occult Forces.**—To W. J. Grey.—I am afraid I cannot help you to get what you wish. I presume that if everyone and anyone were able to produce phenomena of this kind at will in their laboratories, it would no longer remain an "occult" force. I can only refer you to works on the subject and well-attested cases. I understand, however, that you do not care to take this as evidence. Would "Sigma" kindly give us his views on the matter? A. W. G.

[73240.]—**White Letters on Glass.**—I suppose you are a new subscriber, or you would have seen a complete answer to your query (1283) Vol. L., p. 178, by myself. You will do nothing satisfactory by the fumes of acid, and as to trying to make your own, it is absurd; it (white acid) can be obtained fit for use. If you cannot get it, advertise your address. A. N. H.

[73254.]—**Electric Railway.**—To Mr. Bottone or Mr. Askew.—The sizes given of the motor you describe are much too large for my purpose. I want one that is about 3in. long by 1in. in width. If made to your sizes, viz., 7in. by 3in., the train (composed, say, of three carriages, engine, and tender) would total in length about 3ft. 6in. at least, and this would not have much of a run on 12ft. of rail (the length of the railway). Could not I send the current through the rails instead of having the batteries on the engine?

W. Howe.

[73261.]—**Problem.**—"D. S. B." will find many more answers to this problem than those he has given, if he considers that although $p$, $q$, and $r$ are in arith. progression, yet there is nothing to show that the only common difference is unity. I have therefore sent a solution in which we are supposed to be given the sum expended, so as to limit the answers to a reasonable number.

Bath. M.I.C.E.

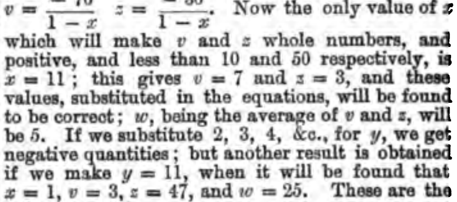
[73261.]—**Problem.**—This is a problem in indeterminate (not "intermediate") equations; but the amount spent by each should be given, or else we get no end of answers to the question. Let $x$ and $y$ represent the two rates at which the eggs are bought, let $v$ = number of eggs bought by A at the rate of $x$ pence per egg, let $w$ = the same for B, and $z$ the same for C; then we get the equations—

$$\begin{aligned} vx + (10 - v)\,y &= c \\ wx + (30 - w)\,y &= c \\ zx + (50 - z)\,y &= c. \end{aligned}$$

It will be found from these that $w = \frac{v + z}{2}$, or the average between $v$ and $z$, and as 30 is also the average between 10 and 50, we see that B's purchases are the averages between those of $v$ and $z$; hence the second equation does not help us in the solution, and we have only the first and third to deal with. The first and third equations may be put in the form $v = \frac{10\,y - c}{y - x}$; $z = \frac{50\,y - c}{y - x}$. All these symbols represent unknown quantities, and it would be impossible to find their values unless $c$ (the price paid by each) is given. Even then we will have four unknown quantities and only two equations, so the values could not be found by ordinary algebra. Suppose, then, that each spends 6s. 8d., or 80 pence, we have $v = \frac{10\,y - 80}{y - x}$; $z = \frac{50\,y - 80}{y - x}$. All we have to guide us is that all symbols must represent whole numbers (as we could not buy half or a quarter of an egg), and that they must represent positive numbers, also that $v$ must not be greater than 10, and $z$ not greater than 50. The process as given by Todhunter is to substitute for $y$ successively 1, 2, 3, &c., and then put for $x$ such a number as will make the expression a whole number, which must be positive, and not greater than the numbers given above. Put $y = 1$, and we get $v = \frac{-70}{1 - x}$ $z = \frac{-30}{1 - x}$. Now the only value of $x$ which will make $v$ and $z$ whole numbers, and positive, and less than 10 and 50 respectively, is $x = 11$; this gives $v = 7$ and $z = 3$, and these values, substituted in the equations, will be found to be correct; $w$, being the average of $v$ and $z$, will be 5. If we substitute 2, 3, 4, &c., for $y$, we get negative quantities; but another result is obtained if we make $y = 11$, when it will be found that $x = 1$, $v = 3$, $z = 47$, and $w = 25$. These are the only two results.

Bath. M.I.C.E.

[73300.]—**Coil.**—To Mr. Bottone.—Your connections are wrong. The accompanying cut shows



the proper mode of connecting up. The binding-screw A leads from one pole of the battery to one end of the primary wire, and also to one shocking terminal C. The other end of the primary coils is connected to the contact-spring pillar B¹, and also to the other shocking terminal C¹. The other pole of the battery is attached to the terminal A¹, which is connected to the screw pillar B. If your coil is furnished with a secondary coil, the two ends of the secondary are connected respectively to D and D¹.

S. Bottone.

[73278.]—**Safe Load on Beam.**—The way to do this is to find the amount of "work" in foot-pounds (the usual unit) done by the 5-ton weight in deflecting the beam two inches; then find what distance the 200lb. weight must fall in order to produce the same amount of work. Suppose the 5 tons to be applied gradually to the beam, a pound or so at the time, the deflection would increase at the same rate as the weight applied, and the weight applied would vary from nothing to 5 tons: the average weight would therefore be 2½ tons, or

5,600lb. This also represents the average resistance of the beam, from nothing to 2in., or ⅙ft.; then 5,600 × ⅙ = 933·3 represents the number of foot-pounds of work expended in bending the beam two inches. Again, if a weight W pounds falls through a distance *h* feet, the "energy" developed at the end of the fall will be W*h* foot-pounds; by "energy" is to be understood its capacity for doing work, and it will be the same as the work expended in raising W pounds to a height *h* feet. In this case W is 200lb., so we have the equation 200 *h* = 933·3, or *h* = 4·66ft. Thus a weight of 200lb. dropped on the beam from a height of about 4ft. 8in. will have the same effect in bending the beam as a weight of 5 tons resting on the beam.

Bath. M.I.C.E.

[73308.]—**Thinning Oil.**—Mix with paraffin oil, such as is used for burning in lamps. As to proportions, try a little, and then you will be able to ascertain the right fluidity. INCA.

[73309.]—**Electric Bells.**—In my reply last week to this query, the word "not" was omitted before "necessary" in the first line.

F. C. ALLSOP.

[73319.]—**Bunsen Battery Zincs.**—The edges of the zinc cylinders should be kept about ⅜in. apart, to allow free circulation of the solution. This fact is mentioned in Slingo and Brooker's "Electrical Engineering," on page 52. HY. WILSON.

[73322.]—**Banjo.**—In answer to "Jo's" query, the tone of a banjo depends on the resonant qualities of the materials used in the hoop and head; on the relative proportions of these materials to each other, and the length of string; on the maker's skill, and also on the skill of the player. The best woods for the hoop are maple, rosewood, and Riga oak, the first being unquestionably the best. The metal hoop used in connection with the wooden one sharpens the sound and increases the carrying power, and brightens the tone of the instrument, as well as adding to its appearance. In the best banjos these rims are made of German silver, though I fancy myself that phosphor bronze would be an improvement, by producing a mellower tone than the other. The wood and metal hoops should be joined together with a resonant cement somewhat similar to that used by violin makers, though I have used shellac with good results. The head should be one of Joseph Rogers' best. These are made of sheepskin, and are very carefully prepared and selected. One of medium thickness should be chosen. As to the number of straining screws, my own idea is that 24 for a 12in. diam., and 30 for a 13in. diam. hoop are sufficient. "Jo" would not be far wrong to take a banjo by one of the best English or American makers and copy it as nearly as he can; of the two I prefer the proportions of the English 13in. "Orchestral" banjo to any American model. This, of course, is only my own opinion as an amateur. I have made a good many banjos myself, all of which have turned out satisfactorily, but I have found a distinct improvement in the tone of each new one over the former, as I gained experience in manufacture. It is easy enough to get a good tone in the C or G strings of a five-string banjo; but a perfectly balanced tone over all five strings at any position is a very different matter, and one which very few of even the leading makers ever succeed in doing.

BANJOKER.

[73323.]—**Electric Bell, 5in. Gong.**—I made and fitted one that size about fifteen months since, the same. I hand you its particulars of sizes:—Length of iron cores, 2⅝in., diameter ½in.; boxwood bobbins 2in. long, heads 1⅛in. diameter, wound full, No. 26 silk-covered wire; hammer rod with spring 6in. long, weight of head, ½oz.; distance front-door press to bell in hall, 30ft.; bell to battery, 10ft., and has three cells No. 2 Leclanché battery, giving the greatest satisfaction. Can be heard to ring through the house, 14 rooms.

SOMERSET LAD.

[73329.]—**Voltmeter.**—If you read my article carefully, you will find that the resistance of the coil must bear a certain proportion to the volts to be measured, in order to get fairly accurate readings. This proportion is about 50 ohms resistance to each volt. You do not say whether your s.c. wire is copper or German silver. If the latter, it will do very well, provided the volts to be measured do not exceed 5. The glass-capped boxes are those used by mineralogists and others for preserving specimens of small minerals, &c., and may be obtained of S. Henson, in the Strand, or of Russell, or, indeed, of almost any dealer in mineralogical or small geological specimens. If you cannot procure them, I will obtain some for you. S. BOTTONE.

[73332.]—**Wood.**—"Texture" as applied to wood means, I believe, the fibre or actual make of the wood in growth. Grain of wood means the natural perpendicular growth, the way it will split. Cross-grain is cutting across the grain—that is, cutting down a tree by sawing across it. The two ends show the cross-grain.

Southampton. GUNZINE.

[73335.]—**Crystallised Fruit.**—This is a very simple preservative process, the first stage being to obtain very sound, ripe fruit, and take care that all humidity is previously removed by keeping it on shelves without touching each other, at the same time not allowing it to wrinkle or shrivel. The syrup is made by boiling the best sugar-candy "to the crack," in confectioner's language—i.e., till the syrup forms a thread on touching it with a silver spoon. This requires a charcoal fire, and some practice, to avoid burning and discoloration. I have known a house lizard to be found, thoroughly preserved and crystallised, in a jar of fruits which he had entered in pursuit of flies! Bitter fruits, such as oranges, finger citrons, and such like, require previous preparation to extract their pungent bitter oils. Boiling water in which some carbonate of soda is dissolved I found the best treatment. Immerse the fruit or peels in this for a few hours, then remove them; rinse them in pure hot water, and then slowly dry them on an inverted sieve in a warm room. The smallest known oranges, about the size of a large marble, were my favourite preparation. Making an incision, I removed the interior, then soaked them in the soda solution, dried them, and stuffed them with the soft part of orange marmalade; lastly I put them in a stoneware jar with a large mouth, pouring the hot syrup over them till the vessel was full, and tying a piece of gauze over the mouth. After some time has elapsed the fruit is carefully removed and placed to drain on a metal sieve put over a deep basin, each one apart. The final process of crystallisation consists in putting the fruit so prepared (all kinds in the same way) in long tin trays, placing these in a drying oven, and occasionally sprinkling each specimen with a little clear white sugar to give a frosty exterior. I have prepared freshly-dug green ginger in the same way as the oranges. The drainage syrup of the sieve process will serve over again if heated on a charcoal fire. Stone fruit can be carefully opened, the shell broken, and the kernel replaced in the fruit. I have used thread sewing for delicate fruits, and withdrawn it when they were finished. EOS.

[73336.]—**To "Jack of All Trades."**—The sulphuretted hydrogen gas is very pernicious stuff to deal with. It is said to be strongly narcotic, so take it out of the house, where you have a good ventilation; and if in a shed, take it into a flue. A little of it goes a great way, I can tell you. To make the compound to generate this gas, you want about 2 or 2½ parts of flowers of sulphur to 4 parts of cast-iron borings, fine—the finer the better; then get a crucible in a furnace red hot, and cover it up, except a hole, that you may put a tube into it. Having well mixed it, eject it down the tube and into the crucible. In a little time you may pour it out into a mould. This is the stuff you want—sulphide of iron. I have a notion that Spence's metal for making joints is the same material; perhaps more sulphur is used. Whether that will answer your purpose without making it, or whether you can purchase sulphide for the purpose of gas-making, I don't know. If you want much of it you will have to make an appliance. Get a large champagne bottle and drill some holes in the bottom rim. Break your sulphide up and put into the bottle. Now put a cork in the bottle with two pieces of glass tube in, and wax the cork well; put an indiarubber tube upon one tube and convey it to your chamber where you want it, and a cork to the other tube. Now stand your bottle in a jar with some water, about what you think will cover your material in the bottle. This is all ready for starting now. If you have a quantity to operate upon make a wooden trunk or flue airtight, with ledges in it to rest frames upon, covered with muslin to carry material, a cap to fit tight upon your flue, and a vent into a flue with a slide, that you may regulate it. Now, having all ready, take the cork out of glass tube, and pour a few drops of sulphuric acid in, and you will get your gas. Don't overdo it with acid. When not in use wash out, and put clean water in ready for use again. Put your lead upon your frames as fine as you can, and with a dredger like a pepper-box, and not too thick, and don't forget that it is inflammable and poisonous, so confine it as much as you can, and breathe as little of it as you can; and when you turn the liquor out of your bath and wash your jar out, have some chloride of lime, say, a pound; pour some boiling water upon it, say, half gallon; put up in a stone bottle, and label; put some of that in your liquor when turned out, and the water that you have washed out with, before you put it down the drains and sprinkle your place with it; but don't put it in your jar or generator, but charge that with clean water for the next operation.

JACK OF ALL TRADES.

[73338.]—**Hardening Bricks.**—Would not a work on Pottery meet your requirements?

INCA.

[73338.]—**Hardening Bricks.**—Make a solution of copperas, and use a little to temper your clay with, or get 2lb. of copperas and half peck of lime, dissolve your copperas in half-gallon of hot water, slake your lime, and make up into a wash, and try a portion of this with your clay.

JACK OF ALL TRADES.

[73339.]—**Hypnotism.**—Any bright surface, such as a circular looking-glass, a disc of polished steel, or a circular Japanese mirror, will do for this purpose; and from Cagliostro downwards people have deceived themselves and others into the belief of extraordinary effects to be obtained by the use of such. But I can assure you that, as far as my experience extends (and it has not been small), nothing definite, nothing tangible—nothing that could be repeated by another by following the directions of those who professed to teach—has ever been done. See also Wm. John Grey's reply 73202, and draw your own conclusions therefrom.

S. BOTTONE.

[73340.]—**Sewing-Machine Motor.**—As you exclude steam, I should advise you to try a small hot-air engine. One of Robinson's, as advertised in these pages, would give every satisfaction. The price is moderate, and as almost any rubbish can be burned up, the cost for driving a sewing-machine for a day of ten hours should not exceed 6d. at the very most. S. BOTTONE.

[73340.]—**Sewing-Machine Motor.**—I have had no experience with electric-motors, so cannot give any opinion on the working of same; but of the other motors mentioned a hot-air engine, if heated by a coke fire, would be the most economical; but most likely the trouble of attending to the fire would be objectionable. If gas is used as fuel, then a small compression gas-engine would be the best. The cost of working per annum depends on the number of hours the motor is working, and this would vary with different makes. A ¼ man-power "Seal" gas-engine, giving out 2,700ft.lb. per minute on the brake, costs about 1d. per four hours. This engine would drive two or three sewing-machines at the high speed required. If "Weyden" will write me, I will send him full particulars of the above engine. For address see Sale Column. J. SEAL.

[73341.]—**White Lead v. Lime.**—The above, or litharge with fine silica and lime, make a good cement to stand the weather, mixed with boiled paint-oil. What it will do in the shape of paint for iron vessels I don't know; but I have seen wood stand for years, and as fresh as the day it was done, upon some wood-work run as Gothic mouldings to shop fronts; turps will not improve it, and I think it would be very difficult stuff to paint with, but it may be trowelled on, and I think it worth a trial.

JACK OF ALL TRADES.

[73342.]—**Saccharimetry.**—What sugar do you wish to estimate? Cane and grape are most common; but there are others. Allen's "Commercial Analysis," Vol. I. 2nd edition, will give you full information. INCA.

[73342.]—**Saccharimetry.**—Sugar may be estimated volumetrically by means of Fehling's solution, or by that of Pavy, Knapp, and Sachsse; also gravimetrically; also by polariscope or saccharimeter. But I cannot say that a person who is ignorant of chemistry would find these processes easy. Sx.

[73342.]—**Saccharimetry.**—"H. K. L." can estimate the amount of sugar in solution by means of (1) a saccharometer. According to the kind of instrument used, the indications will be shown in degrees of specific gravity, per-centage, lbs per barrel, or, in other words, the pounds of solid matter in excess of 360 (the weight of a barrel of water of 36 gallons at 60° F.); from any of these the weight of sugar per gallon of solution can easily be estimated. (2) Special polariscopes for determining the value of saccharine solution. I do not know of any reagent that has the power of precipitating sugar from solution; but grape sugar will precipitate red sub-oxide of copper from an alkaline solution containing oxide of copper, such as "Fehling's," which is the solution generally used for testing the value of sugar. Cane sugar is easily converted into grape sugar by boiling for about 20 or 30 minutes with dilute sulphuric acid. To obtain reliable results by means of this test some little practice is necessary. J. B. B.

[73343.]—**Problem in Geometry.**—The lines bisect each other. The proof depends on the following theorem, which may be proved by Book I., but more readily by book VI.:—"The line joining the mids of two sides of a triangle is parallel to the base, and equal half the base." Assuming this, we get both E H and G F parallel to A C and equal half A C ∴ E H equal and parallel to G F ∴ EHFG is a parallelogram ∴ its diagonals bisect each other. *Q.E.D.* L.

[73343.]—**Problem in Geometry.**—Yes, the diagonals do bisect each other, and if the extremities of these diagonals are joined by lines EG, GF, FH, HE, then EGFH is a parallelogram equal in area to half of the original figure, or half of the triangle ABD + triangle BDC. If two of the lines cross each other so as to give a figure con-

# UNANSWERED QUERIES.

*The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.*

72755. G.W.R. Locos., p. 214.
72771. Nitrate of Soda, 214.
72775. Wig, 215.
72777. Flexible Metal Tubing, 215.
72783. Weights, 215.
72795. "Jenny Lind" Locos., 215.
72798. Geological, 215.
72907. Electrical, 215.
72813. Colorimeter, 215.
72814. Cropping Machine, 215.
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73032. Telegraph Line, p. 299.
73048. Pulleys, 299.
73049. Armour, 299.
73051. Magnum Bonum Pens, 299.
73052. Yorkshire Coalfields, 299.
73054. Walton's 200 c.p. Dynamo, 300.
73065. Gas Engine, 300.
73070. Musical Scales, 300.
73073. Phonograph Cylinders, 300.
73077. Fountain, 300.
73082. Engine for Dynamo, 300.
72086. Firebars, 300.

# QUERIES.

[73371.]—**Slow-Combustion Stove.**—I have one of these for heating a bedroom. Hitherto I have burnt coke in it: but have found it very dusty, and that it often goes out when you most want it to stay in. Requiring a fresh supply of fuel, I have thought of trying anthracite coal. Can anyone tell me if it is as suitable as coke for such a stove? Also whether it is cleaner, burning longer, and such coal as a woman could readily break in pieces, for I am told it is very hard? I should be glad also to know the best mode of kindling it.—E. G.

[73372.]—**Copper.**—I should feel obliged if any of our practical readers would inform me as to the effect of copper on steel in small per-centages, say from 0·005 to 0·030 per cent. "Greenwood's Metallurgy" says that $\frac{1}{2}$ per cent. induces red-shortness, and this is all I can find. —Steel.

[73373.]—**Brass Melting.**—Could any kind reader inform me how to obtain more draught for melting brass? I have a round stove ($\frac{1}{2}$ plate), 10in. over and 10in. deep, and stands on three legs 7in. from ground in middle of my shop, 12ft. square. I have two 3in. pipes, 6ft. long, and lid on hinges, grate, &c., as shown in Fig. 1. The brass becomes soft, but will not run fit to pour into moulds. I do not wish to disturb pipes, but should like to adopt a plan at bottom of stove. Would shortening the legs cause sharper draught, or would it answer to partly inclose the bottom, and leave a small opening in front, as shown in Fig. 2? If so, please say what height the grate requires to be from ground, and what size hole required in front of stove to be left?—A. B.

[73374.]—**Slade's Universal Micrometer.**—To Mr. Slade.—Would you please inform me how to illuminate the field of view, when using your micrometer? Also, would the glass reticule stand direct sunlight, i.e. without the sunglass? My telescope is a 3in. refractor.—Arcturus.

[73375.]—**Pointing Pins.**—Can any of our readers tell me how pins are pointed? I want to produce a similar, but shorter, point upon a great number of pieces of very fine wire, about $\frac{3}{4}$in. long.—F. H.

[73376.]—**Small Dynamo.**—Will Mr. Bottone kindly answer the following question on dynamo to give six volts, one ampère? Size of field magnets? Size of H-armature? Size and amount of wire to use?—C. H. C.

[73377.]—**Battery for Electric Light.**—Will some kind electrical reader tell me what c.p. lamp eight Daniell cells (quart size) will light, and how long? Also where the wires on field magnets of a dynamo lead to? A sketch would greatly oblige.—A Beginner.

[73378.]—**Blowpipe.**—I once saw a blow-pipe made with an ordinary pair of bellows and a football bladder. Can any of "ours" tell me how it is constructed, with a diagram?—W. G. B.

[73379.]—**Composition.**—Could some correspondent give information as to the component parts of some hard and durable composition? Such as dentists use for artificial teeth would do admirably, being a non-conductor of heat, and not so liable to crack as the compositions generally used.—Outlander.

[73380.]—**Oak Stains.**—Will some reader kindly tell me how to darken wainscot oak to match some old oak furniture that has not been polished, but has gone very dark from age? I have been advised to do it with pyrogallic acid and ammonia solution. Is this reliable? If so, what strength should be used?—Enquirer.

[73381.]—**Glass and China Riveting.**—Would some reader kindly answer the following questions:—1. How to drill glass and china, and what sort of drills to use? 2. How to fasten the rivets into the article to be riveted?—Novice.

[73382.]—**Schifbauer Small Arc Lamp.**—Can Mr. Bottone kindly explain the working of these? which I am given to understand are being largely used.—M. C.

[73383.]—**Hong-Kong.**—Can any reader inform me, from personal knowledge, what is the effect of the climate of Hong-Kong upon Europeans, and what precautions, if any, are necessary, especially if one possesses a *liver?* Are there any mosquitoes? Is living expensive? How does the value of money compare with that in England? Regarding outfit — what articles should be taken, and what left behind? Any hints applicable to an intending emigrant will be thankfully welcomed by—Sm.

[73384.]—**Catgut for "Weather - House."**—What kind of cat-gut is used for Weather-house? Please give thickness of gut, and a description of working parts. —Weather-house.

[73385.]—**Comets**—To "F.R.A.S."—Whilst reading up for a lecture on comets, I have met with a difficulty. In Proctor's "Mysteries of Time and Space" is the view of Biela's comet previous to its division; also the appearance of the two comets after the split. In Guillemin's "World of Comets," edited by Glaisher, I find the engraving of the first picture named as Winnecke's, June 19th, 1868; and the two views after the split according to Proctor, described as P. Henry's comet, Aug. 26th and 29th, 1873. If you would kindly inform me which of the two authorities is correct, I should be very grateful.—J. Hendry.

[73386.]—**Speeding Pulleys.**—Will any of your kind readers inform me as to the method of getting the exact revolutions of a machine from a shaft by pulley power? say, as an example, main shaft running at 60 revs. per minute, machine to run at 130.—Julius Cæsar.

[73387.]—**Pressure Gauge.**—Would any reader give me a little information as to how to construct a small pressure gauge for a model boiler, to indicate up to 40lb.? A rough sketch would oblige.—One in a Fix.

[73388.]—**Re-Gilding Frames.**—Can anyone explain the mode of burnishing the bright parts, when regilding an old picture or looking-glass frame?—E. E. Balley.

[73389.]—**Cement Floor Dusty.**—I have a room 60ft. by 40ft. with a concrete (Portland cement) floor. An almost impalpable white powder works up from this floor, and covers everything with a thin dust. Can anyone tell me of an inexpensive and easily applied solution which would harden the surface of the concrete and prevent it from cutting up?—E. L.

[73390.]—**Amateur Re-Tinning.**—I have succeeded in re-tinning copper stewpans very satisfactorily; but find the same process of no avail in re-tinning cast-iron goods. Would some of your many readers be good enough to enlighten me?—P. Kean.

[73391.]—**Straightening Drawn Steel Tubes.** — These tubes as purchased are seldom straight. Can anyone tell me of a simple method of straightening them?—Calculus.

[73392.]—**Ellipse.**—Will someone kindly show how to determine the least ellipse that can be described about any given rectangle?—Learner.

[73393.]—**L. and N.W. Engine No. 373.**—In the exhibition of 1862 the L. and N.W. Railway Company sent a fine engine, made at Wolverhampton by MacConnell. It has 7ft. 6in. wheels. Can any reader say if, and where, it is now running? And also if there were any others of the same dimensions? It was a very fine engine, some years in advance of its time, and a record of it should be preserved.—An Engineer.

[73394.]—**Clock Trains.**—What regulates sizes of quarter and hour trains? My weight - clock has for quarter-chime 120 great—80 pinion, 10—72 pinion, 8—52 pinion, 8—fly; chime barrel 40 teeth; line barrel, $1\frac{3}{4}$in. diam. How has this been calculated?—A. W. G.

[73395.]—**Compressibility of Water.**—Can some one of our scientific readers describe, with rough diagram, Amagat's "Manomètre à Pistons Libres?" There is a description in Tait's "Properties of Matter"; but without diagram one can only make a rough guess at the construction or principle.—L.

[73396.]—**Water.**—Please tell me how many gallons of water will pass in one hour, through a pipe $\frac{3}{4}$in. in bore from the main, and tapered to $\frac{1}{4}$in. at the outlet, pressure of water from main 45lb.—S. S.

[73397.]—**Melting Brass.**—Seeing in the "E.M." two or three weeks ago that brass could be melted on a coke fire in a crucible, I would wish to know if there is any ingredient put in on the brass to help it to run. Also can I temper thick pieces of spring steel to make magnets.—A Constant Reader.

[73398.]—**To Mr. Bottone.**—Would you kindly tell me what would happen if one limb of a series dynamo F.M.'s should leak whilst working? It is of your make, Siemens H-shape, $2\frac{1}{2}$ by $4\frac{1}{2}$; $1\frac{1}{4}$lb. No. 18 on armature, 3lb. No. 14 on each limb of F.M.'s, different layers being separated by silk paper and varnished. I should also like to know the rule for determining the proper slope in splitting commutator cylinders.—Robert.

[73399.]—**Lenses and Mirrors.**—Some time ago "F.R.A.S." recommended Heath's Optics. Will he kindly say if the kind of lens mentioned on page 69, 3 ($\beta$) is ever made? and if so, for what use? Perhaps "F.R.A.S." could also give pretty accurate dimensions of as many as possible of the most celebrated (new and old) mirrors and object-glasses, i.e. aperture and focal length; also in the case of the object-glasses, the curvatures and refractive indices of the component lenses; and whether separated or cemented.—L.

[73400.]—**Rot.**—Can any of your readers recommend a remedy for a spreading fungus underneath the floor, at first of a white velvety appearance and apparently leading to a dry rotten condition of the wood? The fungus has long stringy stalks, and insinuates itself two or three feet up within the casing of doorways, which it shrivels and rots. It does not seem to be affected by a dry atmosphere though it springs from a damp and confined place. —Ama.

[73401.] — **Focal Point.** — Will some optical brother contributor describe the exact point which determines the focal length of a telescope? Some state it to be at the eye-lens of eyepiece, some at the field-lens of e.p. Of a telescope mounted ready for use, astronomically or otherwise, please state what point or part of object-glass is taken; and then, what point of eyepiece, whether the eye-lens, field-lens, or between the two, or outside both, where the rays meet the eye. One time or other, all of these have been declared. Every amateur ought to know how to measure the exact focal length of his telescope; but very few do know how with certainty. Some are quite 3in. out in their statement as to focal length.—Telescope.

[73402.]—**Telescope.**—I may shortly be under orders for the West Indies, and if I go intend to take my telescope, in hopes of doing a little star-gazing under favourable conditions. The instrument is a 3·5in. refractor, and a good one of its kind. Now I rather hesitate to put it on shipboard in the long box belonging to it, which is not very strong, and is certainly very unwieldly in shape. It occurred to me that it should be possible to have the brass tube of the telescope cut in half, and a sort of screw-collar made to join the pieces. I consulted a good optician on the subject; but he did not seem to care to tackle the job, fearing that the defining power of the instrument might suffer. Would "F.R.A.S." kindly give me his opinion, or any other reader of the E.M. who may have any positive knowledge of the subject? and also advise as to packing the telescope to stand rough usage on shipboard, and yet not to take up too much room. I do not propose to take the stand, as I can easily make a serviceable one. —T. Preston Battersby, Capt. R.A., F.R.A.S.

[73403.]—**Boiler.**—Would some fellow reader inform me of the size of boiler I require for a 4 by 2 cylinder, the material to be made of, and the pressure per inch; also what power may I expect? Secondly, I have designed an improvement on a machine tool, and think it worthy of protection. Can I protect it under the Patent Act? If so, for how long; also is the charge anything reasonable?—Ignorance.

[73404.]—**Photo-Micography.**—The article on "A Handy Photo-micrographic Camera," p. 371, affords useful information on a matter of interest, but I should be glad if the writer, or any reader, would give an explanation of the following paragraph:—"The final fixing of the exact focus is done by means of a focussing-glass, used in conjunction with a disc of thin cover-glass, attached to the ground surface of the screen by means of Canada balsam." In what way are the focussing-glass and the cemented cover-glass used in conjunction? In the further paragraph:—"The eyepiece may be removed or not. ... I have almost invariably worked without it, using an amplifier where sufficient magnification could not be obtained with the objective alone." What is the amplifier, and how is it used?—Squire.

[73405.]—**Medical.**—On my return from a long residence in the Tropics, I had a severe attack of "herpes" or "shingles," for which I was skilfully treated by a local doctor, but was unable, from want of means, to retain his services till completely cured. It is now two months since I ceased taking medicine, but, though free from pain, some of the red spots remain, and the skin is generally tender. I do not sleep well, and there is a distinct loss of sensation in both hands, productive of general clumsiness. Will some medical reader please give advice?—Herpes.

[73406].—**Tasmania.**—Will any of ours who have been through the sieve say whether 40 years is too old for a temperate man to go out, who finds he has a family of youngsters growing up, and whose income is very limited? Was for many years in the wholesale cutlery, tools, and hardware, and plated trades in Sheffield, and is also a fair "Jack of Many Trades," such as rough carpentry, boat-building, lathe-work, and photography; can also drive a compound engine, and do own repairs, but knows nothing of agriculture. Have tools of all kinds—is it best to sell off or take? Sell or take photographic gear? If take, what part would be classed dangerous by shippers? Is there any chance of working passage out by giving one's time? Which is best line to go by to Launceston or to Hobart? Is the food provided steerage good enough, or advisable to take any? What sum advisable to have in hand on landing? In case of husband going first, is a female passenger liable to be annoyed by male passengers, as I have heard that saloon passengers are permitted free access to all parts of the vessel? Information on these points, with any advice that may have struck the thoughtful ones who have been, will be highly valued by—Center-Board.

[73407.]—**Snow-Shoes.**—Would our friend "Ref." (who knows everything) or some one who has had practical experience on the point, say how snow-shoes are attached to the feet by their thongs, and also the method of progression adopted by the traveller when thus shod; is it a skating movement, or merely a running one? In a sketch of a snow-shoe race I have, the rear shoe appears to be flat on the snow, and the runner's foot to bend up from the heel, as in taking a walking step, but the details of the fastenings are too small to show the manner in which the thongs are attached to the feet or ankles.—B. Harcourt.

[73408.]—**Magnetism.**—To Mr. Bottone.—Will Mr. Bottone answer the following, About how many magnetic lines of force would be induced in a bar or magnet of charcoal iron 1 square c.m. in section by a current of 10 A.? Also, would this number of lines of force be induced in each square c.m., providing it had, say, 100 square c.m. and the c. still 10 A. turns? Is the number of lines dependent on the sh pe of the magnet? If so, we will suppose the magnet to be of the same shape as that of the small dynamo in your book ("The Dynamo"). What would the difference be, supposing I use best malleable and cast iron? About what amount loss per cent. would there be? An approximate answer to the above will greatly oblige—Magnet.

[73409.]—**Model Locomotive.**—To "J. H."— now fitting the gunmetal axle bearings to the model as first described in the "E. M." by "J. H."; but I feel obliged if he will enlighten me in the following. Must I first fix the axle slides to the frame, and then bearing or step to the axle slides? Should I bolt keep and step together, and place them on a mandrel the purpose of facing the sides, and after bore the axle bearing on face plate, or must I fit to axle slides and face and bore afterwards?—T. S. H.

[73410.]—**Running Resistance of Armatu**
Some ten or twelve vols. back, in the "E. M.," Bottone told us the running resistance of an arm was less than the resistance of the wire of A., and other gentleman, I think Mr. W. H. Eaves (I write memory only, Sir). said this was not so, in fact; according to the nature of motors and dynamos, this occur. Has it ever been published? Why? And, where? Or have electricians agreed of late on sam may say that I have two dynamos in my charg

lighting, and have satisfied myself on
would like the opinion of others.—J.

**pses of the Sun.**—Will any of our
ds be kind enough to tell me the date of
ipse of the sun visible in England, and
r total eclipse of the sun will be visible
Eclipse.

**Ir. Bottone.**—Will you kindly inform
the most constant, cheapest, and efficient
nd single-fluid batteries—bichromate of
lb. or chromic acid at 1s. per lb.? If
c acid is the best, please give proportions
nd single-fluid cells. If a half-pint cell
our, will a pint cell run for two hours
for four hours? If they cannot be cal-
y, please say how they can be calculated.

**troleum Fuel.**—Under this head
appeared a reply giving a description
el burner used in Russia, the invention
Should be glad of further information,
where the burners can be seen in this
R.

**trical.**—Would some kind competent
" tell me which is better—a Siemens
cinotti ring—for a 10c.p. dynamo and
mo? Also, can I charge a Leyden jar
orous with a 2ft. roll, and how must I
h is better, a series or a shunt-wound
ndescent lighting, plating, and charging
Anxious.

**cks.**—I have constructed a lathe at
d like a little information as regards
le as possible. It is my first attempt
ool, so you may suppose it looks rather
c treadle motion once belonged to an
wing machine, and the iron stand and
where iron was cheap—at least, I suppose
odern machine. However clumsy and
no doubt, serve my purpose till I can
e one. Now, I want to know how to
rest, or something to do screw-cutting in
t a 6in. centre, also anything that will
ggling amateur, will be greatly appre-
se, Southampton.

**Ir. Allsop.**—Please give the length or
s.c.c wire I must wind a bell-magnet
nce it has to speak will be 200yds. I
instrument at each end for the present,
hen, if possible, I shall put in a carbon
w many batteries, No. 2, will it take to
t distance? I have been told I cannot
e and use it without paying royalty to
that correct?—Gratified Reader.

**n Telegraph, Etc.**—Could anyone
nd diagrams of some form of train tele-
preferably), and of the means for inter-
ments with the signal levers? Also of
des (electrical and mechanical) for in-
al shall not be lowered while a train
hich it covers?—Signal.

**h Finishers' Brush-over Ink.**—
se give me a receipt for a good brush-
and blue), suitable for fancy woollen
on an inking machine? It must be one
cotton burls, without adhering to the
B.

**kle for Brasswork.** — Will anyone
what is the best solution for dipping
e lacquering? I have used nitric acid,
or drawn brass, wire, &c.; but it turns
ark, and I want something which will
ight.—F. W. B.

**roscope and Astro. Eyepieces.**
ders of the "E. M." kindly oblige me
g? 1. I have made a microscope with
us: ½in. for object, 3in. for field, and 1in.
w, what I want to know is how I can
nifying power. Can I do this by adding
f so, what magnifying power should I
ombined. 2. I want to construct three
astro. telescope, not achromatic. The
e 30, 60, 80. What glasses should I get,
I arrange them? My object-glass is
—Nim.

**omatic Organ.**—Wishing to build a
r octaves) to play by means of paper band
ched back vols. of "E. M." in vain to
tion for working the pallets. Mr. Wen-
piano is not sufficient for pipes, as the
eld open till the lever rises from the per-
an this be done without straining paper?
." stated in a back vol. that he had over-
lty, a rough model giving satisfaction.
w the paper under the levers by means
um, driven by a weight, which will also
d mechanism for actuating pallets. A
o drum will carry an arm, which will be
hour and locked after tune is played;
a minute's duration to be on one strip.
in letter 31927 will be welcome to many.
give sketch of reliable mechanism for
ves or pipe instrument?—Accoucheur.

**dbell Casting.**—I should be glad if
d give me some information on handbell
t sand to use? I am in a small way a
t cannot get handbells to run; being so
out with parts out of the sides (large
times only the crown is cast.—H. C.

**and Snow.**—What is the cause of
erature being obtained by the admixture
ow? I have noticed a fall from 33° to
S.

**inless Teeth Extraction.**—Does
other travelled reader, know anything
of one hundred dollars, said to be offered
for the discovery of the Chinese method
th? Chinese dentists, it is said, do not
e brutal manner common to the Cau-
imply rub the affected teeth of their
patients with a powder, and, this done, the tooth falls out by itself on the least provocation. What is this wonderful powder?—K.

[73425.]—**To Mr. Bottone.**—Will you tell me kindly, please, what size spark your Wimshurst machine, as described in "Electrical Instrument Making," will give with 12in. plates? Will ordinary cardboard do for the sole of an electrophorus, instead of gum-paper, as long as it is thick enough? What size spark does the Bertch machine, as described in your book, give? And would you mind telling me how to cast a lead ball on to the end of a wire?—S. L.

[73426.]—**S. N. Telegraph.**—I should be much obliged if Mr. Bottone, or Mr. Allsop, would be kind enough to give instructions how to construct coil and attach needle for S. N. instrument (with sketch preferred), with quantity and size of wire and battery power, for distance 100yds.—E. E.

[73427.]—**Making Magic Lantern.**—Would any of our readers assist me in making a magic lantern, and say what the distance should be from light to condensers, and distance from condensers to plate or slide for 3in. condenser, and two-wick lamp?—H. B. L.

[73428.]—**Coil Boiler.**—I have been experimenting with one of the above, made of iron piping 1in. thick, and consisting of about 15ft., but the results have been so poor that I intend to discard it. I wish now to employ copper piping about ⅜in. What I want to know is—What length of piping shall I require for a cylinder 2 by 4? Is it necessary to employ a reservoir, and will it want a special form of pump? The one I have been using is single-action plunger ⅝in., the engine working by fits and starts. I shall be glad if any reader will assist me.—H. B. S.

[73429.]—**Tempering Springs.**—What is the best and quickest way of tempering flat spiral springs, 18½ gauge, 1in. long, ½in. wide, ¼in. thick steel Fox's wire. Is there a good book on tempering spiral springs, small ones?—J. B., Leeds.

[73430.]—**Scraping Surfaces.**—To "J. H."—Would this valued correspondent, who has rendered so much service by his articles on mechanical matters, give full instructions on the above, showing proper form of tools, &c.—H. H.

[73431.]—**Soldering Tin Tubes.**—What is the best method of soldering the small tubing as used for gas? I am told that in the South a blowpipe is used. Instructions as to kind of solder, size of flame, and any other particulars would oblige—Dundee.

## ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

### HINTS TO CORRESPONDENTS.

**1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.**

***** Attention is especially drawn to Hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

**The following are the initials, &c., of letters to hand up to Wednesday evening, Jan. 7, and unacknowledged elsewhere :—**

W. Russell Judd.—A. R.—Coarse Wire.—Kent.—A.D. W. J. Grey.—E.—T. Brown.—Oxygen.—E. A. A.—Anxious Mac.—Little Toc.—E. G. L.—J. Johnstone.—A. D.—Very Much an Amateur.—S. E. Peal.

P. K. (Why should you be "much astonished" because your query was not inserted? You were answered in this column on p. 386, and we can now only refer you to the usual textbooks. 2. The first work referred to is, we believe, out of print, but may be heard of, very likely, at Mr. Wesley's, Essex-street, W.C.; Lockyer and Seabrooke's "Star-gazing" is published by Macmillan, at a guinea.)—A. F. Farryer. (Perhaps Munro and Jamieson's "Pocket-book of Electrical Rules and Tables," published by Chas. Griffin and Co., Exeter-street, Strand, may suit; but it is difficult to select books when there is a limit put to size as well as to price. As to the other question, Preece and Sivewright's "Telegraphy," Longmans, may contain the information you require; or Culley's "Handbook of Practical Telegraphy," Longmans.)—Carbon. (We presume you mean the albo-carbon. Nothing injurious about that; just the contrary. If the room is "close," why not ventilate it? See Hints above.)—George Taylor. (We do not know how many locomotives there are in England, nor yet how much weight they could all pull. The railway companies make returns from which an idea of the number of locomotives in use by them could be obtained; but there are others besides. See Hints above.)—Nemo. (Depends on what is meant by a "cast in the eye." As a rule, it can be remedied. It is not contagious or infectious, if that is what you mean.)—Beginner. (Do you mean the practical work, or merely a treatise on the steam engine? Jamieson's "Steam and Steam Engines," C. Griffin and Co., may suit.)—Gamma Draconis. (*The Observatory*, Taylor and Francis, Red Lion-court, Fleet-street, price one shilling. Apply to the Assistant Secretary of the Society, Burlington House, W., about the other, but the price to non-members is 10s. for the numbers forming a volume.)—E. Malvern. (We know nothing more of the Turnbull transmitter than was given in the No. for Aug. 6, 1886. For so short a distance as 30yd. a mechanical telephone will do; but there are many described in recent numbers, and in the series of articles on telephones, commenced May 16, 1890.)—T. P. S. (Apply to the Civil Service Commission, Cannon-row, Westminster, for full particulars, or see one of the guides to the service.)—C. F. (Tricycles and other cycles propelled by power other than the muscular power of the riders are by 41 and 42 Vict. c. 77, sec. 29, limited to speeds of four miles an hour when on roads and to two miles when passing through towns and villages. It was decided in "Parkyns v. Priest" that a motor tricycle, capable of being propelled by steam, is a locomotive within the meaning of the Act.)—H. Leslie. (Simple diet is the best medicine for a disordered stomach. See the medical column of the *Weekly Times and Echo*.)—C. D. (Any bookseller can supply you with a work on Conic Sections; but see indices of back volumes.)—Denny. (Full particulars can be obtained by applying at the college, or to the Secretary, City and Guilds of London Institute, Gresham College, London, E.C. As a rule, the terms commence in October.)—Flint. (Any good glass properly annealed will stand heating to the extent mentioned. The softer kinds will stand the heating without cracking, but naturally they become soft, and bend. You should have specified the particular object if more definite information is required.)—Young Bird. (You will find some information in back volumes, but if you want a manual on the subject of bird-stuffing, there is a useful one published by L. U. Gill, at 170, Strand, W.C.)—F. H. Leslie. (Any bookseller can supply a work on Physiology, or procure the list of such publishers as Longmans, Macmillan, Crosby Lockwood and Son.)—Microbe. (Will not the Quekett Club suit? The meetings are held at 20, Hanover Square, W. We think, however, there is a society in the vicinity of Hackney or Clapton.)—William Johnson. (Rather malicious on your part, we fear. The fact that the Government analyst and Mr. Stokes disagreed no more proves the latter incompetent than the circumstance that you spell "knew," new, in your letter proves you a dunce.)—H. A. (Very good indeed; but we recommended copal varnish for the soles of shoes long since in these columns.)—Speech. (We know nothing of him or his system.)—Meteor. (We see little good likely to arise from such a discussion.)—C. T. P. (We should use Grundy's apparatus ourselves in preference to the other. You can see the system in operation at his residence, 30, Duncan-terrace, Islington, and can then judge for yourself.)—A. Bowers. (We really cannot understand sketch or description—or, if we do, we cannot see that any practical "type-writing" is ever going to be done with such a machine.)

**Is it a Rupture?**—Examine yourselves and see.—Thousands suffer from this terrible and dangerous affliction in its early stages without knowing it, whilst others who are simply troubled with local weakness think that they are ruptured. Mr Harness' washable trusses are universally admitted to be the most comfortable and healthy hernia appliances ever invented, and his world-famed combined Electropathic appliances are invaluable in all cases of local weakness. Those who are unable to call and avail themselves of a free personal consultation at the Electropathic and Zander Institute, 52, Oxford-street, London, W., should write, without delay, for descriptive pamphlet and book of testimonials.

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### PAYABLE IN ADVANCE.

5s. 6d. for Six Months and 11s. for Twelve Months, post free to any part of the United Kingdom. For the United States, 13s., or 3dol. 25c. gold; to France or Belgium, 13s., or 16f. 50c.; to India (via Brindisi), 15s. 2d.; to New Zealand, the Cape, the West Indies, Canada, Nova Scotia, Natal, or any of the Australian Colonies, 13s.

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Messrs. James W. Queen and Co., of 924, Chestnut-street, Philadelphia, are authorised to receive subscriptions for the United States for the ENGLISH MECHANIC, at the rate of 3 dols. 25c. gold, or Thirteen Shillings per annum, post free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the receipt of the subscription. If back numbers are required to complete volumes, they must be paid for at the rate of 3d. each copy, to cover extra postage.

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*** It must be borne in mind that no Displayed Advertisements can appear in the "Sixpenny Sale Column." All Advertisements must be prepaid; no reduction is made on repeated insertions, and in cases where the amount sent exceeds One Shilling, the Publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

The address is included as part of the Advertisement, and charged for.

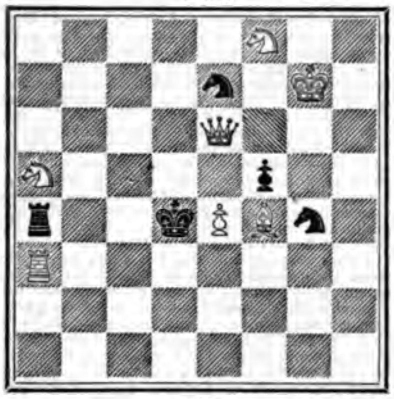
Advertisements must reach the Office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

## CHESS.

ALL communications for this department must be addressed to "J. PIERCE, Knollside, Yawl, Lyme Regis, Dorset."

### PROBLEM MCCXXXVI.

*Black.*



*White.* [7 + 5

White to play and mate in two moves.

### SOLUTION TO 1234.

| *White.* | *Black.* |
|---|---|
| 1. Q-R 8. | 1. Any. |
| 2. Q or R mates. | |

### NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1234 by Link, F. W. N. Lambert (very good, Q-K 8 a near try), J. H. Eastwood, W. Gleave, Biene, J. Kistruck, C. P. P., A. Fellows, H. Fellows, G. W. Middleton, W. A. Clark, and White Knight; to 1233 by F. W. N. Lambert, White Knight, W. A. Clark, G. W. Middleton, Lieut.-Col Ryan, and J. H. Eastwood; to 1232 by F. W. N. Lambert; to Prize Problems by White Knight (Mr. Gleave's very symmetrical and elegant, but not difficult) and Link.

**Holloway's Pills** rouse the stomach, liver, and every other organ, thereby bringing digestion to that healthy tone which fully enables it to convert all we eat and drink to the nourishment of our bodies. Hence these Pills are the surest strengtheners and the safest restoratives in nervousness, wasting, and chronic debility.

## OUR EXCHANGE COLUMN.

*The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.*

**Homing Pigeons**, the best breed out. To reduce stock will accept any reasonable exchange.—Address A. VARLEY, Wool-road, Saddleworth.

The **Chenies-street Exchange** offers the greatest choice. Fair value in cash, or instruments given by return.—CAPLATZI, Chenies-street, Tottenham Court-road.

**Static Electrical Apparatus.**—Henley's Discharger, Electric Pistols, Insulating Stands, and other apparatus. Will exchange for anything useful. Offers.—W. YOUNG, Aylesbury.

**Telescope Equatorial**, 12½in. With reflector, slow motion R.A., 2in. finder, six eyepieces, Barlow's lens, diagonal, set of stops. Photo 12 stamps.—Below.

**Transit Instrument**, 2⅝ o.g., silver circles, striding level, collimating eyepieces; photo six stamps. Photometer by Hilger, micrometer by Grubb, astronomical books and instruments.—Below.

**Barometers** two aneroid; patterns for Equatorial stands, dynamos, tricycle, Cromartie lamp, new ebonite Wimshurst machine, 9in. spark; lantern photos. List stamp.—Box 20, Liversedge.

**Bicycles** (two), nearly new. Telescope, 2¼ Wray, new books, and Scientific Apparatus, various. Wanted, Chronometer, by good maker; also small Transit.—Box 20, Liversedge.

**Small Bar Lathe, Camera and Lens wanted**, for VERTICAL ENGINE, chest cover and bolts missing; also Magneto Machine.—A. INSKIP, High-street, Shefford, Beds.

Will exchange an ancient English **Crossbow** (now in Brunner Museum, Northwich) for a good Astronomical Telescope, refractor.—W. MILLER, Greenall-terrace, Northwich.

Wanted, good **Microscope** or **Photo. Apparatus**; in exchange, really first-class DRAGOON PIGEONS from Palace Dairy Show, &c., winners.—J. SMYTH, Bury St. Edmund's.

Pair of **Telephone Receivers.** Exchange small Dynamo or offers.—J. MATTINSON, 92, Brisbane-street, Liverpool.

Brass Horizontal Slide-valve **Engine**, cylinder, 1in. by 2in., fitted, nearly finished. Must clear out. Offers. Small Water Motor new).—J. RICHARDSON, Westholme, Kettering.

**Magic Lantern**, japanned, lens 1¾in. in diameter, silvered reflector, and one dozen hand-painted slides, 2in. wide.—Below.

**Exchange above for Fret Machine, anything useful.** Incandescent Lamp with batteries. Exchange to value of 5s. 6d.—IVANHOE, 10, Brighton-road, Stoke Newington.

5in. **Screw-cutting Lathe**, 5ft. gap bed, treadle, new; for 1-horse Gas Engine, or Engine and Boiler, about 3-horse—15, Albion-place, Grantham.

Two 4in. best make **Electric Bells**, quite new, worth 10s. each. Will exchange for Cornet or Photo. requisites. Offers.—L., 4, Hartington-road, Salisbury.

**Ship Connoisseurs.**—For disposal, cheap, magnificent collection of large Models of Ironclads and Ships, under ebonised cases; made for Jubilee Exhibition; part cash, part exchange; any inspection.—19, Plymouth-street, Broughton, Manchester.

What offers for handsome wire-haired **Irish Terrier** BITCH, also five Pups; silver English Lever Watch, Cottage Piano.—81, Shepherdess-walk, City-road, N.

**Dog Collars** with name and address on, 1s. 6d. post ree.—13, Ann-street, Union-square, London, N.

Two pair **Ring Doves**, splendid birds. Exchange anything useful; must clear out; worth 6s. 6d.—WHEAR, 15, St Botolph's-street, Colchester, Essex.

Wood Turning **Lathe**, 6in. centre, 4ft. iron bed, oak frame, with drawers, Tee-rest, tools, value £3. Exchange for Violin or Engineer's Lathe. Offers.—Can be seen at CHAS. ADAMS, Beverley-road, Colchester.

**Bellows Camera** for plates 8 by 5 inches, three double slides, lens. Wanted in exchange, Lancaster's Instantograph.—FENNESSY, Pallasgreen, Limerick.

3-16in. **Spark Coil**, in exchange for Magneto Machine, or small Hand Dynamo, or Drilling Machine.—WILLIAM TAYLOR, 17, Bishop-street, Dublin.

Handsome Rippingille's **Oil Heating Stove**, good as new, 30in high, 18in. wide, fitted with double 6in. wicks.—SANFORD, Cambridge-street, Aylesbury.

**Bagatelle Skittle Board**, full size, new, and complete, with cue and skittles. Will exchange for Electric Motor or Water Motor for driving 6in. circular saw, or useful exchange.—KITTERIDGE, High-street, Walthamstow.

"**Maxwell's Heat**," "Lockwood's Dictionary Mechanical Terms," "Barber's Engineer's Sketch Book," "Meadowcroft's A B C of Electricity," "Lyell's Geology." What offers?—YOUNG, Thompson's-lane, Cambridge.

**Glazier's Plate Diamond** (Sharratt and Newth). Exchange two 20-gallon drums.—J. W. G., Watercote, Brighton-road, Redhill.

**Venetian Blinds**, one pair, new condition, for anything useful.—Apply as above.

**Wire.**—Four hundred yards d.c.c. 20 Wire, new; Induction Coil, with regulator, working order; Model Launch Engines. Exchange.—BENNETT, 30, Albion-road, Pontypool.

**Blowpipe**, Foot Bellows, 24in. Smith's Bellows, Drilling Machine, nearly new; 5in. Slide-rest, new, good make. Exchange small Lathe and Vice.—WEP, 30, Middleton-road, Kingsland-road, Dalston, N.

**Instantograph Camera**, reversible back, four dark slides, three-guinea Rectigraph lens, tripod, cloth, dishes, printing frames, &c. Exchange for good London made Microscope, English Objectives, good condition.—THOMAS, Post Office, Acton.

Hand or quarter-plate **Camera Stand**, walking-stick pattern, value 18s. Exchange accepted in photographic requisites, dishes, &c.—K., 189, Southampton-street, Reading.

One set 20c.p. **Dynamo Castings**, fitted, armature finished, value 14s. Exchange for Induction Coil or electrical offers.—C. L. FORD, Stalybridge, Lancashire.

Wanted, Hand Camera or Lancaster's ½-plate Instantograph. Exchange only. Good SILVER WATCH, excellent timist, second-hand, value 25s., and Quackenbush Air Gun, almost new, cost 48s.—Mr. E., 344, Caledonian-road, London.

Splendid **Engine and Steel Boiler**, man-power, suit small lathe. Exchange to value £4 10s.—HALMSHAW, 182 Barkerend, Bradford.

Wanted, ¾ or 1H.P. **Boiler**, with fittings. Send, dimensions and sketch with particulars. Exchange.—NOAL, 6, Winchester-terrace, Sunderland.

**Harmonium.** Sewing Machine, Safety Bicycle, Greenhouse Boiler, self-contained. Exchange for Couch and Chairs suitable for sitting-room.—W. W. E., Biscay Villa, Wath, Rotherham

Wanted, **Coleoptera.** Exchange with collectors, especially abroad; also books, papers, on subject, cartoon, and store-boxes.—D. D., 89, Elms-road, Clapham, S.E.

Exchange—part cash.—**Pictures, Furniture**, Tools, groover and gas fittings, books on music, poetry, photography, mechanics, chemistry, magnetism, fiction, &c., &c., musical instruments, and various articles, all in good condition. Can be seen at any time.—Apply by letter W. MORRIS, 10, High-street, Plaistow, Essex.

**Rudge Tandem**, good condition. Exchange for anything useful.—54, Cornwall-road, Brixton-hill.

One-horse **Portable Engine and Tubular** BOILER, just overhauled, been driving dynamo. Exchange good Screw-cutting Lathe.—HALL, Victory-road, Chertsey, Surrey.

Half-plate **Camera**, three double backs, with carriers for ¼ plates, one R.R. 8 by 5 lens, also W.A.R. and stand, forming most complete set extant, cost £15. Approval.—C. BEAUMONT, Whitehall-street, Rochdale.

**Magic Lantern**, 3½in. condensers, double front lens, Argand lamp and lime jet complete, two dozen landscape slides in box. Offers.—BEAUMONT, Whitehall-street, Rochdale.

**Binocular Microscope**, by Swift, mechanical stage and sub-stage condenser, 1-9th, 1-5th, ½, and 1½in. objectives, perfect condition. Offers to value of £12 requested.—C. BEAUMONT, Whitehall-street, Rochdale.

Wanted, ½ Camera and ¼ Detective, Round Aquarium, (R.D.) Safety. Exchange 1-1 and 12 by 10 Slides, 2¼ Telescope, Organette, and cash.—EDWARD ROUSE, 3, Hethe, Bicester.

One set of 4in. back-gear **Lathe-head Castings**, one set of 3½, one set of 2½, one set of oval Chuck Castings. Stamp envelope for reply.—Below.

Smith 18in. **Bellows**, 3½ Leg Vice, lot of Lathe Tools, 12 Slide Rest Tools, small Printing Press, set of Gas Tackle.—SEDGLEY, Witton-lane, West Bromwich.

**Induction Coil**, ¾in. spark, 4-cell battery, quarts, with lifting arrangement. Exchange.—HEYSIDE, Oldham.

Large **Medical Coil**, 8 powers, complete with battery, in polished case. Exchange.

**Bassinette Perambulator**, bicycle wheels, complete with hood and canopy; cost £7 in London. Exchange.—HEYSIDE, Oldham.

Twenty-four whole-plate **Negatives**; Great Northern, Western, Eastern, North Eastern, Midland, Brighton engines. Wanted, Tools or Castings.—147, Moselle-avenue, Wood Green.

"**London Encyclopædia**," 1836, 22 vols., perfect, illustrated by numerous and fine engravings, diagrams, &c., for a good Watch, or offers—A. ZECHBAUER, 13, Guildford-street, Farringdon-road, Clerkenwell.

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all sizes, free, 3s. 6d.; nickel-plated, 6s. 6d.—LEE.

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**Microscopic Objects**, first-class, 3,0
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: English Mechanic
WORLD OF SCIENCE AND ART.
FRIDAY, JANUARY 16, 1891.

## PHONES: THEIR CONSTRUCTION AND FITTING.—XII.

By F. C. Allsop.

of "Practical Electric Bell Fitting," Electric Bell Construction," "Practical Electric Light Fitting," &c.

### esting for and Removing Faults.

ll telegraphic, telephonic, or other sysms of electric communication, certain s will from time to time develop elves, however well the apparatus may been constructed and erected. These alled "faults," and the methods of g and removing these will form the t of this article. Communication en two telephone stations can be interl by faults arising in the "ringing" , or the "speaking" circuit, or in the common to both. Thus, in the telestations A and B, A may be able to p B, yet B may not be able to ring up ugh both can hear clearly; or the ringay be good in both directions, and the ng interrupted from one end, but in ever circuit the fault occurs the effect same—viz., to render both instruments s for practical purposes until it is ied. The rapid detection of faults in one instruments requires a thorough edge of their construction, combined o small amount of skill and experience. arious telephone companies keep men "inspectors," whose sole duty is to and remove faults as they arise on the ibers' lines or instruments, and on the nd quickness of those men depends of the efficiency of the system. A good one inspector can generally, after a e or two's testing of one of the instruwith a short length of wire, during time he momentarily connects one al or part of the instrument with r, point out almost the exact position fault.

en removing faults from a telephone he proper way is to alter or repair g till you are absolutely sure where ult is. This maxim cannot be too impressed on all telephone fitters, as nense amount of trouble will be saved ictly adhering to it. The slovenly reless fitter who jumps at conclusions, rthwith attacks a certain part of the tus because an idea strikes him that lt lies there, is one who should leave one fitting alone, as his hasty action n nine cases out of ten, lead him into lifficulties. He will pull to pieces the itter when the fault was perhaps the y run dry, report a faulty generator the trouble is a break in the line, or the receiver when the automatic was the offending part of the aps.

areful, therefore, to make a thorough tion of the whole appartus, and caretest each circuit before attemping to r repair. Adjust only a little at the and if a piece of apparatus is working e wise enough to let it alone. When ing for a fault, make first a careful tion as follows:—First examine the y, replacing any zincs that may be y eaten away, and see that each cell enty of solution in it. Scrape off any ls that may have collected on the , zinc, or glass jar. If necessary, out the jars and recharge. Try all the ting screws to see that none are loose, rape with a knife or clean with emery at may have become corroded from t with the solution. Follow up the wires from the battery to the instrument, repair them where damaged, and staple up if loose. Next inspect the switch-bell. Try all the connections to see that they are firmly screwed up, and see that the switch hook works freely. Carefully note that good contact is made when the automatic arm is up, and also when down. Inspect the bell. If of the battery form, see that the contact post is firm and the platinum contacts clean. If of the magneto form, see that the bell is not out of adjustment, and test the automatic cut-out of the generater to see that it is working well. All rubbing contacts may have the minutest drop of oil placed on them with advantage, but the quantity must be very small indeed. Then inspect the transmitter: if of the Blake type, clean the carbon contact by drawing a clean piece of note-paper between the button and platinum point. If of the Gower pattern, see that no pencils are broken, and the connections are firm. Next inspect the receiver: see there is no dirt between the pole-piece and the diaphragm, that the diaphragm is not buckled, that the bobbin is tight on the pole-piece, and that the cord is sound. See that the two ends of the telephone cord are not frayed, and thus short-circuiting, if so—double back the ends well under the terminal screws. Metal tags are now almost always employed for connecting the cords, the wire being soldered to the tags, and the point of the tags passing under the terminal; this makes the best job. If the telephone cord is suspected of being broken, it should be removed and tested for continuity with a cell and galvanometer, a slight tension being put on the cord while tested, in order to cause the broken ends to part should there be a break. A broken receiver-cord is often difficult to detect, the cord appearing intact at one moment, while the next the continuity is broken.

If, after having been carefully over the instrument as directed above, the fault is not discovered, proceed to test for the particular fault that may be on; but look well first, and do not alter the least thing till you are quite sure what you intend doing.

One of the most common faults is:

*Buzzing or Rasping Noises in the Telephone.*—This fault is generally local, and if the instrument is of the microphone class we must look in the microphone or local cell for the origin of it. A continuous humming noise is caused either—1st, by the transmitter (especially if of the Blake type) being too loosely adjusted; or, 2nd, by the local cell being too strong. To ascertain which of these is the case, touch the diaphragm with the finger, and if this stops the noise the adjustment is too loose, and screwing up the adjusting screw will cure it. Should the noise, however, continue, unless the transmitter is so tightly adjusted as to affect the transmission of speech, the local cell is too strong, and if there are more than one cell, one or two must be taken off. If there is only one cell, as is generally the case with transmitters of the Blake class, a resistance of two to three ohms should be inserted until the battery weakens. In the Blake transmitter rasping sounds are caused by the carbon buttons, where they touch the platinum points, being rough. If this is the case, the screws in the insulated block must be slackened, when the carbon button can be moved up or down a little, so as to bring the points to a new spot. Dust in between the springs of the contact in the local circuit will also often give rise to rasping sounds in the receiver, or the spring may not be pressing firmly against the contact stud. It should be remembered that when the spring only touches the contact lightly, the slightest jar or vibration causes it to act as a microphone, which could not happen if the contact is firm. If the contact has a rubbing action, as all the more modern forms have, see then that the spring makes firm contact, and put the slightest touch of sweet oil on the point. Never put oil on dotting contacts, as this will only make matters worse. Before attempting to remedy a fault of this character, it must be ascertained by testing whether the fault may not be at the distant end. To do this, join the "line" L and "earth" E terminals (see Fig. 20) with a short piece of wire, and if the noises cease, the fault is probably at the other station. The speaking of a Blake transmitter will often become impaired, owing to the rubber ring $g$, or the glove on the spring $k$, having become sticky. This can be remedied by placing a paper ring between the rubber and iron frame, or in the case of the spring $k$, between the glove and the diaphragm. In all cases of adjusting or repairing transmitters never pull springs back too far or turn adjusting screws more than a quarter of a turn at a time, as it must be borne in mind that transmitters are, in many respects, delicate instruments, and will not stand rough or clumsy handling. If the telephones are of the E.M. type, having receivers only, one of which is used as the transmitter, noises in the telephone may be caused by a partial break or disconnection in the line, or the contact springs of the automatic switch may not make firm contact.

We will now pass on to more complicated faults, and will treat of each fault in connection with both the "receiver" and "microphone" type of instruments. By "receiver type" is meant the form where there is no microphone, there being two receivers, one of which is used as a transmitter, and by a "microphone instrument" is understood the complete combination with microphone transmitter, induction coil, and switch bell. The connections of the receiver type are given in Figs. 49, 50, and 51, and of the microphone in Figs. 52 and 53. In speaking of faults we shall refer to the station at which the operator is as the "home" and the other as the "distant."

*Bell at "Home" Station does not Ring, Ringing at "Distant" Station Good, and Speaking Good in both Directions.*—It is evident that the fault may be either in the bell and its attendant apparatus at the home station, or in the ringing battery and its connections at the distant. To ascertain which of these is the case (presuming the instrument to be a microphone one with battery switch-bell), join terminals C and L with a short piece of wire, and if the bell rings then, the fault is most likely at the distant station. If your bell does not ring when terminals C and L are connected, the fault is probably in your own bell. Inspect the bell and see that the adjusting screw has not worked back; if so, screw it up, so that when the armature is held against the magnet-poles the contact spring just leaves the contact screw and no more. Should the bell appear in good order, see that the back spring of the ringing key makes firm contact with the front stop, which is connected to the bell, and if this is all right follow the wire back to see that it is not broken. Next see that the arm of the automatic switch makes proper contact with the bottom stop, and if not, adjust so that it does. If the bell rings all right where terminals C and L are connected, the fault is either caused by the battery at the distant end having got weak, or the spring of the ringing key does not make proper contact with the bottom stop when pressed. The battery may be too weak for ringing, yet the local cell for the transmitter may be strong enough to give satisfactory results on the microphone.

In the instruments having magneto switch bells the fault may be in the bell at the home station, which may be out of adjustment, or, what is more likely, in the generator at the distant end. If your bell rings when the handle of your generator is turned, the fault is in the generator of the distant station; but if not, it is probably in your own instrument.

Inspect your bell, see that the adjustment is perfect, that the hammer moves freely, and that the gongs have not worked loose. If these appear all right, see that the wires from the bobbins are not touching the frame, and so cutting out the coils. If the fault appears to be at the distant station, inspect the generator there. See that the insulation of the armature has not broken down, and that the automatic cut-out or armature shunt works properly. Probably the spindle fails to break contact with the spring when the handle is turned, or if the armature shunt is of the "Post" form, the bob may not leave the contact.

*Bell at Home Station Rings, but cannot Reply. Speaking good in both Directions.*—This is probably due to the battery at home station having got weak, or the bell at distant station is out of adjustment. Test as described for previous fault, repair any apparent bad places, and test again. If the instrument has a battery switch bell, you can ascertain whether the bell at the far end is ringing thus:—Take receiver off the hook, and hold it to your ear; then with a short piece of wire join terminals C and L, and if the bell at the far end is ringing, a loud chattering noise, corresponding to the make-and-break of the circuit by the bell, will be heard in your receiver. With instruments having a magneto switch bell, test as described for the previous fault.

*Bell at Home Station does not Ring, and no call can be sent to Distant Station. Speaking Good.*—The fact that the speaking is good in both directions proves that the line is intact. Examine and test as described for the previous faults; but fault will most likely be found in the automatic switch of the instrument at the home station. Probably the bottom contact for bell circuit does not make good contact with switch-hook. Adjust and test again, when all will probably be found right. Should no fault be found in either of the instruments at the home or distant station, it is probable there may be a partial break or disconnection somewhere in the circuit. A transmitter will often speak through a high resistance contact or partial disconnection where a battery-bell would not ring, since a very small current is required to work the receiver, and the fault might be of too high a resistance to let sufficient pass for the bell, but quite enough for the receiver, the current for which is of a higher E.M.F. If the switch-bell is of the magneto form, it is probable that the generator, if a good one, would ring through any resistance that the transmitter would speak through.

*Signalling Good in both Directions, but cannot make Distant Station hear.*—The fault here is probably in the local circuit of the home-station instrument. Examine transmitter cell and test with galvanometer (thick wire coil), to see if it is in good condition. If this is so, inspect microphone, and also local circuit-switch, which may not be making good contact. Should this be all right, the fault is probably in the primary of induction coil, which should be tested with galvanometer for continuity. Should all be found in good order at home station, inspect receiver at distant station, where iron-filings or dust may probably have got between the pole-piece and the diaphragm. Particles of dust, &c., very often remain in the receiver cases after they leave the manufacturer's hands, and these will frequently shake down between the diaphragm and pole-piece, filling up the intervening space and interfering with its action. A very simple remedy for this is to cut a disc of tissue paper ⅛in. larger than the bell part of the receiver, and having a three-quarter hole in the centre. If this is gummed at the edges and the centre, and stuck on the end of the bobbin as centrally as possible, the edges can be pushed down into the bell part so as to prevent the paper touching the receiver. This forms a kind of screen that will prevent particles of dirt, &c., passing down lower than the end of the bobbin, thus they cannot cause any trouble.

*Signalling Good in both Directions, but cannot hear at Home Station.*—This fault is similar to the one just described, and is probably due to some disarrangement in the local circuit in the instrument at distant station. Test as described for the previous fault. To ascertain whether the fault is at the home or distant station, join terminals L and E, take receiver off the hook, and holding it to your ear, tap with your finger the diaphragm of the transmitter, which should produce a loud sound in the receiver. If this is so, the fault is probably at the distant station; but if the tapping produces no noise, examine receiver, where the fault will most probably be found.

*Signalling Good in Both Directions, but Cannot Hear at Either Station.*—The fault in this case may be either in the primary or microphone circuit of both instruments, or in the primary circuit and receiver of one instrument. It would also be caused by a break in the secondary circuit of the coil and its connections at either station, or the automatic switch may be at fault. To ascertain at which station the fault is, join terminals L and E with a short length of wire, take receiver off the hook, and holding it to your ear, tap the diaphragm of the microphone. If this produces a loud sound in the receiver, the fault is at the other station; but if no noise can be heard the fault is at your own station.

Proceed to locate the fault as follows: Take the receiver off the hook, and place to your ear. Next momentarily connect terminals C and L with a short length of wire, and if you get a sound at the moment of connecting, the trouble is in the microphone or primary of induction coil and its connections. If you get no sound, inspect the automatic switch, and see that it makes good connection with the top or telephone circuit contact. If you find no fault here, take away the receiver cord and replace it with two wires, and if you get a sound now the trouble is in the cord, which must be replaced by a new one. If the receiver still appears dumb, connect across the two ends of the secondary of the coil, and then join C and L as before. If you get a sound in the receiver now, the fault is in the secondary windings of the coil. If you get no sound, the fault is in the primary of coil or microphone and its connections. Having traced the fault to the primary or local circuit, we have now to find out the exact spot. To do this first inspect the local transmitter cell to see that it is in good condition, and also inspect the local contact breaker of automatic switch, and note that it makes good connection. These being all right, take your galvanometer (using the thick wire coils and still keeping the receiver off the hook), fasten one wire on to the terminal C, and with the other touch in succession different points of the local circuit, noting the deflection. Should at one place no deflection be obtained, the fault will be found between that point and the one last touched. Presuming there is a fault found in the local or primary circuit at one instrument, there must still be another in the secondary or receiver circuit to account for the speech not being received from the other end; unless, of course, there is a fault in local circuit of both instruments. When looking for faults in the local circuit of a Blake transmitter, it should be noted that the spring carrying the carbon button and the one with the platinum point do not touch one another except at the platinum point. It is advisable also to test with a galvanometer and battery to see that the iron frame and diaphragm are insulated from one another, as contact between these would prevent the microphone working properly. While testing a piece of paper must be placed between the carbon button and platinum point.

*Partial Breakdown. Ringing an*
*in both Directions Faint.*—The mos
cause of this would be a partial
high resistance connection in tl
Join terminals L and C to test you
afterwards join terminals L and E
off receiver, tap diaphragm of t
while listening in receiver. If th
loud and your bell rings all right
is at the other station or in th
Test similarly at other station, a
instrument is in good order the lin
wires are at fault. If the bell di
when terminals C and L were jo
the instrument seemed dumb
joined terminals L and E, go care
the connections of the instrumen
more particularly to all moving
Dust or film of dirt in the contacts
matic switch may be the cause of th

*Total Breakdown—Cannot Ring*
*in either Direction.*—The most proba
of this is either a broken line or ea
It would also be caused by "full e
the line-wire—i.e., the line-wire
into direct communication with eart
terminals L and C to test the bell,
terminals L and E, as described
previous fault. If the instrument is
order disconnect the line of earth (L
terminals, and test with the batt
galvanometer both wires in su
using a temporary earth-wire for t
pose. If no deflection is obtained
earth-wire the wire is probably br
corroded at some point, and this
found and repaired. If the fault
line-wire, this must be located by
the method of doing which we shall
later on.

(*To be continued.*)

## MODEL LOCOMOTIVE-MAKI

## XIV.

I SHALL not apologise to that supe
of amateurs for whom the previou
of this series of articles has been writte
presuming to introduce a very simpl
loco. model. I think there must be
number of our readers who, though int
the other models, would not attempt t
struction, through lack of tools, leisure
For the especial benefit of these, I
describing in three or four articles
easily-made engine, with slide-valve
In this way I hope to meet the wants
readers. The engine, a portion of
shown in Fig. 69, is very much lik
those sold by the model-makers. But it
rather superior mechanical design and
ship. It is an outside-cylinder engine—
¾in. bore by 1⅜in. stroke, driving-wh
diameter, 3¼in. gauge. It will be heat
spirit lamp. It has no reversing gear.

The construction of the engine be
what is called the foot-plate, being
frame-plates, and axle-bearings—all in
casting. The plate (Fig. 69, A) is
the centre, is flanged, B, round the bo
has thickened prolongations, C, to
axles. There are no sliding-axle be
springs; nothing but plain drilled holes
the axles. All this is easy enough, b
pattern is perfectly plain and easily
$\frac{1}{16}$in. thickness all over, except at
bearings, which may be $\frac{3}{32}$in. or ⅛in. w
enough.

The wheels will require patterns; bu
be very slight in wood if the arms a
There are two ways in which such sk
wheels may be made. One is by
spaces between the arms, which is
should not adopt. The other is by m
boss, and arms separately, and uni
together. But if made in this way the
should be done immediately, before t
has time to go out of truth. Made in
a bit of perfectly seasoned mahogany
taken, and the rim turned out of i
would be turned, and the stuff for
planed up and tenoned into the bos
opposite ends of the arms fitted withi
and just held by means of a spot o
few castings could be moulded fr

PLAN

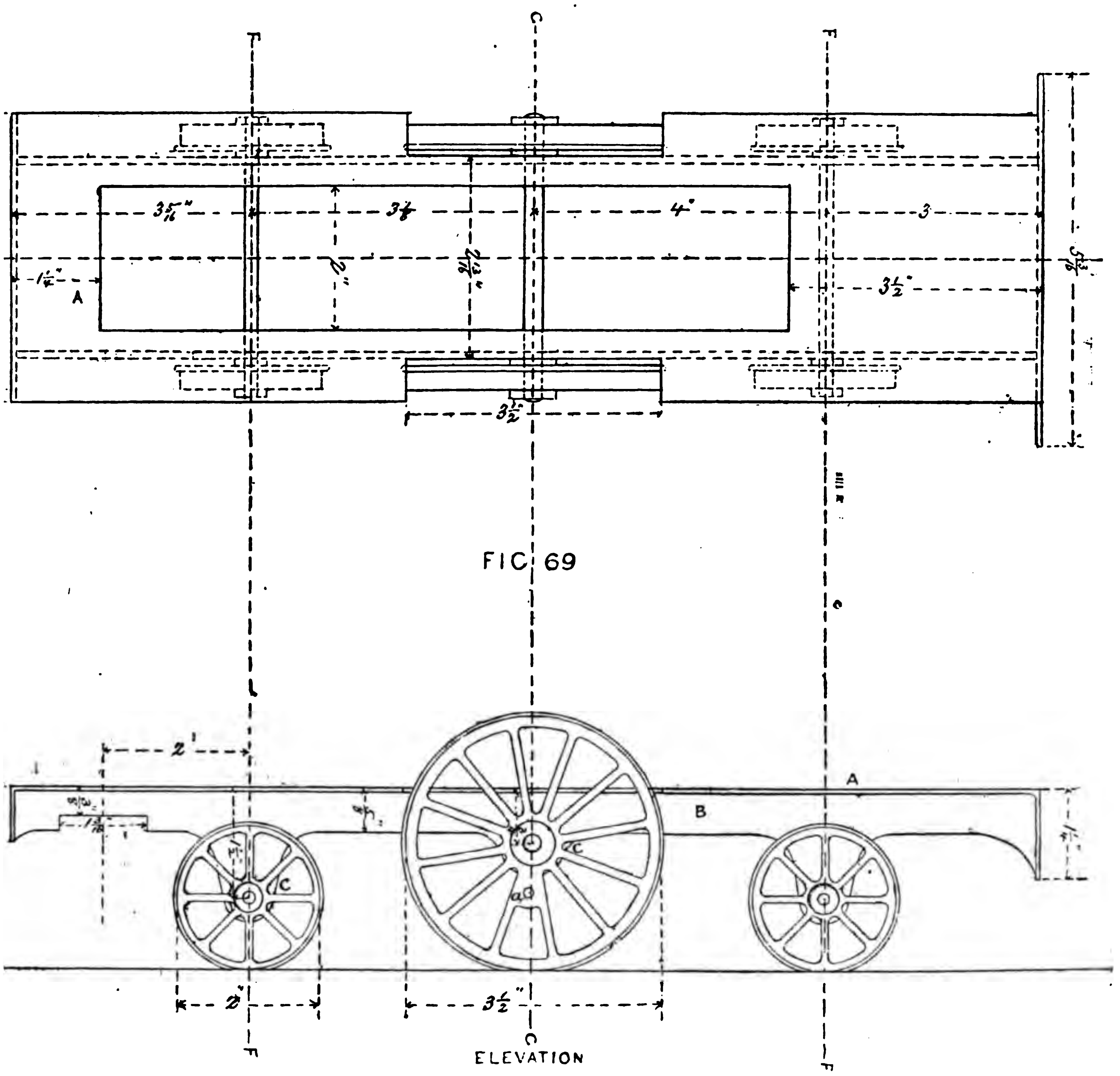
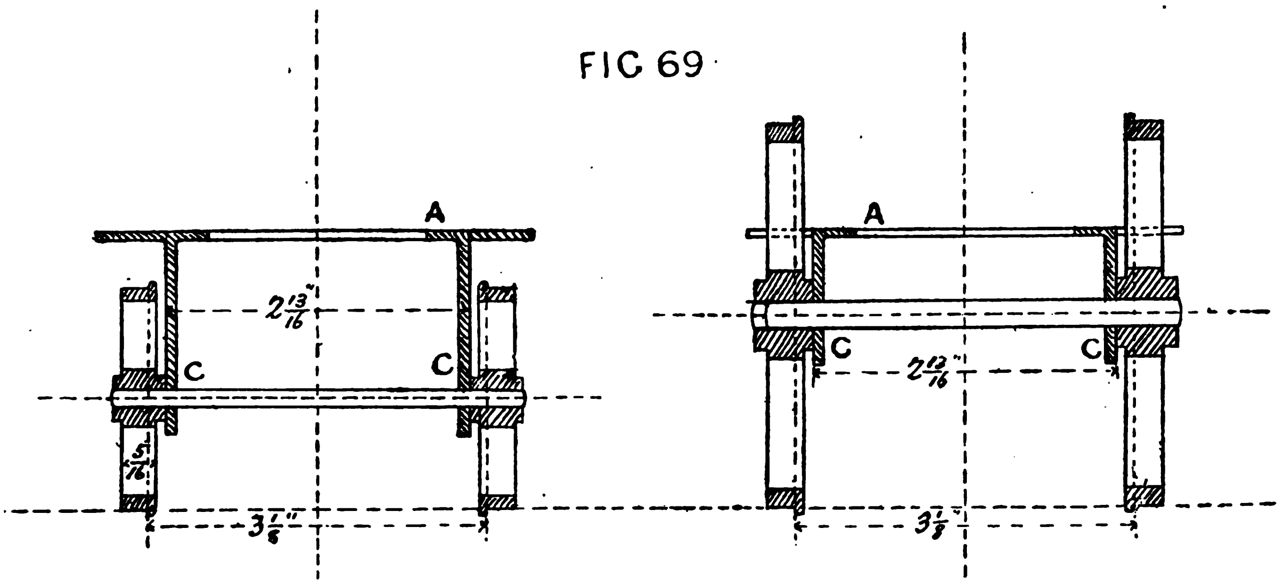


FIG 69

ELEVATION

FIG 69

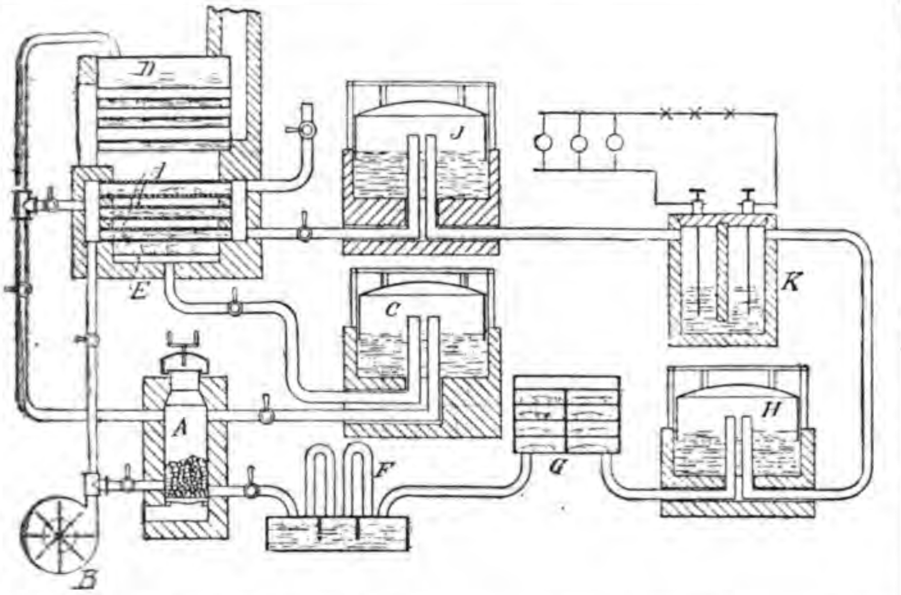


SECTION F-F

SECTION C-C

but not many, because it would soon broken or out of truth by moulding. etal pattern can be made from this, and e, and kept for permanent use.

nother way would be to cast the wheels solid—that is, as discs, mark out the arms on the dished faces, and drill and file out the inter-arm spaces. This would give a deal of trouble, and would be more suitable for making a good metal pattern than for the actual wheels to be used on the engine. As, however, the cast wheels have to be turned upon the treads, edges, and flanges, and bosses turned up, holes bored, and arms filed a little, the whole of the time spent in turning the solid wheels would not be sacrificed.



The driver-wheels will each require a boss, *a*, for the pin of the big end of the connecting-rod. The axles are simply lengths of wire cut off and straightened. The driving-axle may measure ¼in., and the leading and trailing ones $\frac{3}{16}$in. diameter. They need only be driven tightly into the drilled hubs of the wheels. If they do not make a tight fit, then they should be sweated in.

As there are no shoulders upon the axles, bosses are shown standing out from the backs of the wheels to run against the framing, and so prevent the inner edges of the wheels from coming in contact with the framing when running.

J. H.

## DAHL'S GAS BATTERY.

ALL students of electricity know how important the results would be which would follow the successful construction of an economical gas battery, and many will therefore be interesested in the device patented in this country by Mr. Olof Dahl, of Allegheny, Pennsylvania. The invention relates to a process of generating electricity from fuel—such as coke or coal—by chemical means; and its object is to produce electricity by the principle of the gas battery in a cheap and practical manner. The principle of the gas battery is well known to be that when hydrogen and oxygen, or certain other gases are brought into contact each with one of the two electrodes of a battery immersed in acidulated water, and the electrodes are the terminals of a closed circuit, a current will flow in said circuit. The same result can be obtained with a battery in which one of the active bodies is gaseous, while the other is liquid. Heretofore the gas batteries have not received much application, owing to the want of cheap and practical ways of producing the gases, especially the hydrogen. This invention contemplates an electricity-producing process which utilises a new and economical way of producing hydrogen together with ways for manufacturing oxygen or equivalent gas, gas-battery, or gas-batteries, and a working circuit or circuits. In the drawing the figure represents the apparatus in a conventional form. A is a furnace similar to those used in making water-gas, which is charged with coke, coal, or other suitable fuel. This is fired and brought to a certain temperature by the aid of an air-blast supplied by the blower B. While the fuel is rising to the required temperature a gaseous product, commonly known as "Siemens generator" or producer-gas, is generated and passes through the pipe to the gas-holder C, whence it may be conducted to other furnaces, and used as fuel or conducted to other places for sundry use. The supply of air is shut off and steam admitted to the incandescent fuel when it has reached such a temperature that the admitted steam will be decomposed and a mixture of hydrogen and carbonic acid gas formed, the liberated oxygen from the steam having been combined with carbon from the fuel to carbonic acid. This is attained at a temperature of about 500° centigrade with coke and 550° centigrade with coal. To be able to know, if the temperature of the fuel is too high, in which case part, or all, of the carbonic acid first generated would be decomposed and carbonic oxide formed—a sample of the gas mixture from the furnace is caused to pass through a solution of chloride of copper in muriatic acid, which absorbs the carbonic oxide that might be present, thereby lessening the bulk and weight of the sample, indicating too high temperature. Simultaneously or nearly simultaneously with the admitting of the steam to the incandescent fuel, the outlet to the gasholder C is cut off and the production of the decomposing steam is led off through the condenser F, wherein the steam that might have escaped undecomposed is condensed to water, and the gases washed. The gas mixture next passes to a purifier G, containing chemicals, such as hydrate of lime, or solutions of carbonate of sodium or potassium, which absorb the carbonic acid, and allow the hydrogen to pass to the gas-holder H. The drawing shows a purifier of suitable construction for hydrate of lime. When impurities are present in the gas mixture, they are caused to be absorbed by suitable substances, such as oxide of iron for sulphur compounds before the gas mixture enters the purifiers proper, thereby rendering it easier to revivify the carbonic acid absorbing chemicals. After a short time the action of the steam on the incandescent fuel in the furnace will have so lowered the temperature that the manufacture of gas cannot be successfully continued, and it becomes necessary to discontinue the current of steam, and to renew the supply of air in order to repeat the process, alternately producing producer-gas and hydrogen.

Oxygen may be produced by any well-known method. The patentee prefers to produce it by heating in earthenware tubes I, in a current of steam, sodium manganate, which then gives off free oxygen to be led off to the gas-holder J, forming caustic soda and lower oxide of manganese. These products, when again heated in air from the blower B, absorb oxygen, the manganese being reproduced, so that the same portion may be used over and over again. By repeating the process a regular production of oxygen can be obtained from a small quantity of chemicals.

The gases having been manufactured and stored in the separate holders H and J, are separately conducted to the opposite chambers of the battery K. The battery may be of any suitable construction and of any number of cells, and the cells may be joined in intensity, or in quantity, or in combinations of both. The battery shown in the drawing consists of a jar, of glass or other suitable material, closed, air-tight at the top, and having a dividing-wall with an opening at the bottom. The jar is filled with acidulated water reaching over the opening in the dividing-wall, closing off two separate chambers containing the gases. Each of the chambers also contains an electrode of platinum, or other suitable material, partly immersed in the acidulated water. The electrodes are electrically connected with each other outside the battery through the working circuit or circuits. Instead of oxygen, certain other gases, mixtures of gases or liquids such as chlorine, bromine, or nitric acid
may be used. In all the processes d
will be seen that the only thing of va
is consumed is the fuel. The charges
cals may be revivified and used over
and after the first charge need never b
It is to be understood, of course, th
ducts or pipes connect with the several
and that each is connected with a valv
thus be seen, says the patentee, that
up the fires and attending to the su
and steam electric currents may be
direct from the fuel.

## OPTICAL ILLUSIONS ADAP
## THE LANTERN.*

AN interesting illusion produced by
—preferably silver dollars—consists
the pieces in a row and removing the
from between the others at right angles
upon which they were all originally arr
the distance between the moved coin an

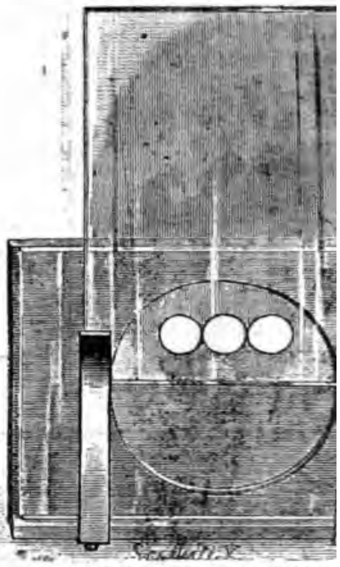


FIG. 1.—Optical Experiment with Thr

the others is adjudged to be equal to the
diameters of the three coins, then mea
distance. It is found, almost without
that the operator fails to move the coin f
by its own diameter, or more. This sim
ment, when shown in the lantern, is m
effective than when viewed directly. T
to lantern use, a spring slide-holder, like t
in Fig. 1, is fitted to the lantern front, an
the springs are placed two plates of t
Upon the inner glass, near the upper
exposed surface, are cemented two discs
$\frac{5}{16}$in. in diameter, and separated a distanc

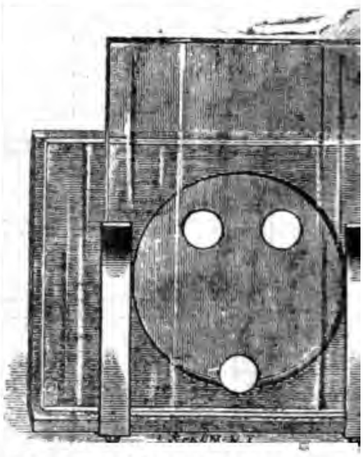


FIG. 2.—Central Disc Removed from
Three Times its Own Diamete

the diameter of one of the discs. On the
face of the second glass plate is cement
disc like the other two. This is attac
plate near its lower edge, and the plate i
so as to bring the three discs in line, as
Fig. 1.

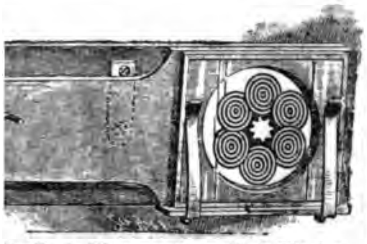
---

* By GEO. M. HOPKINS, in the *Scientific A*

ınging the three discs in a row, and pro- ıem on the screen, and taking the distance ɜ three, at the screen, with a pair of large the experiment is made ready. Now the ısc is moved down in the lantern (as in ınd, of course, the image moves upwardly creen. Let any spectator say when the between the moving disc and either of the equal to the distance taken by the dividers, ly the dividers. It will be found that the will be greatly deceived. It is not uncom- nd the best eye measurements wrong by a ıore.

obable explanation of this great error in surement is that nearly every one has almost unconsciously the expectation of e discs arranged on the apexes of an equi- 'iangle, so that what he does see in reality ıce exactly three times as great as is re- fulfil his expectations.

3 is illustrated apparatus for exhibiting ern Prof. S. P. Thompson's curious illu- ıe concentric rings. As is well known, it



3.—Prof. Thompson's Optical Illusion adapted to the Lantern.

ary to give the rings a gyratory motion required in rinsing out a pail, to give the appearance of turning. This is accom- ı the lantern by a movable holder which ded on a pendulum bar pivoted to the the holder and to the support. The end lder which receives the slide is apertured, ded with two curved springs. The oppo- s furnished with a circular hole through ojects an eccentric mounted on a stud pro- om the support. By turning the eccentric of the attached handle, the slide is swung a circular path and the desired effect is on the screen.

:uliar whirling effect is thought to be due irradiation and partly to persistence of

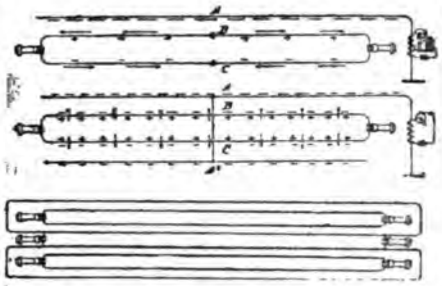
## JNGEN'S SWITCH PLUG.

ustration shows a neat spring plug for use witch-boards, devised by Mr. Lungen, of and Co., New York. The difficulty with :acts is a tendency to wear irregularly, uce in course of time badly fitting sur-

ich are hard to keep clean and give but t contacts. In the present plug the urfaces are formed by a tube slit four l with the four segments slightly sprung , so that on insertion into its proper hole ɔring contact is obtained, and the slight luring its insertion and removal is suffi- eep the surfaces bright and clean. Such a plug accommodates itself even to worn d will prove a great convenience where ıave to be made so frequently that wearing an important factor in the successful of a switchboard.

## )UCTION IN TELEPHONE CIRCUITS.

'HOD of reducing induction in telephone ɜuits has been patented by Mr. John J. New York, the principles of which will tood from the accompanying engravings g how the two sides of a round metallic C, may be electrostatically charged with of different sign by a disturbing wire, A, h an interrupted current may be passing. re A, at any given moment, be charged nus potential, then the near wire B will d directly with a plus potential, and the ire C, being charged in turn by the wire of the same sign as the original charging thus creating current in its circuit. To overcome this difficulty, Mr. Carty proposes to divide the charging circuit, and place one branch on each side of the telephone circuit, thus causing the two wires to create opposing electrostatic disturbances in each wire and preventing any flow of current due to electrostatic action in the telephone circuit. When a series of telephone circuits are arranged parallel to one another, as shown in the final diagram, a wire may be carried from the middle circuit around the outside of each of the outer circuits, this arrangement having a similar effect in destroying the electrostatic action to those described above.



## THE ELECTRO-MAGNET.—XI.*

### Other Modes of Extending Range of Action.

ANOTHER way of altering the distribution of the pull is to alter the distribution of the wire on the coil. Instead of having a coned core, use a coned coil, the winding being heaped up thicker at one end than at the other. Such a coil, wound in steps of increasing thickness, has been used for some years by Gaiffe, in his arc lamp; it has also been patented in Germany by Leupold. M. Trève has made the suggestion to employ an iron-wire coil, so to utilise the magnetism of the iron that is carrying the current. Trève declares that such coils possess, for an equal current, four times the pulling power. I doubt whether that is so; but even if it were, we must remember that to drive any given current through an iron wire, instead of a copper wire of the same bulk, implies that we must force the current through six times the resistance; and, therefore, we shall have to employ six times the horse-power to drive the same current through the iron wire coil, so that there is really no gain. Again, a suggestion has been made to inclose in an iron jacket the coil employed in this way. Iron-clad solenoids have been employed from time to time. But they do not increase the range of action. What they do is to tend to prevent the falling off of the internal pull at the region within the mouth of the coil. It equalises the internal pull at the expense of all external action. An iron-clad solenoid has practically no attraction at all on anything outside of it, not even on an iron core placed at a distance of half a diameter of the aperture: it is only when the core is inside the tube that the attraction begins; and the magnetising power is practically uniform from end to end. Last year I wished to make use of this property for some experiments on the action of magnetism on light, and for that purpose I had built, by Messrs. Paterson and Cooper, this powerful coil, which is provided with a tubular iron jacket outside, and a thick iron disc perforated by a central hole covering each end. The magnetic circuit around the exterior of the coil is practically completed with soft iron. With this coil, one may take it, there is an absolutely uniform magnetic field from one end of the tube to the other; not falling off at the ends as it would do if the magnetic circuit had simply an air return. The whole of the ampère-turns of exciting power are employed in magnetising the central space, in which therefore the actions are very powerful and uniform. The coil and its uses were described in my lecture last year at the Royal Institution on "Optical Torque."

### Intermediate Forms.

The property of the coil-and-plunger of extending the range of action has been adopted in various ways by inventors whose object was to try and make electro-magnets with a sort of intermediate range. For certain purposes it is desirable to construct an electro-magnet which, while having the powerful pull of the electro-magnet, should have over its limited range of action a more equable pull, resembling in this respect the equalising of range of the coil and plunger. Some of these intermediate forms of apparatus are shown in the following diagrams. Here (Fig. 35) is a peculiar form of electro-magnet; it combines some of the features of the ironclad electro-magnet with those of the movable plunger; it has a limited range of action, but is of great power over that range, owing to its excellent magnetic circuit. It was invented, in 1870, by Stevens and Hardy for use in an electric motor for running sewing machines. A very similar form is used in Weston's arc lamp.

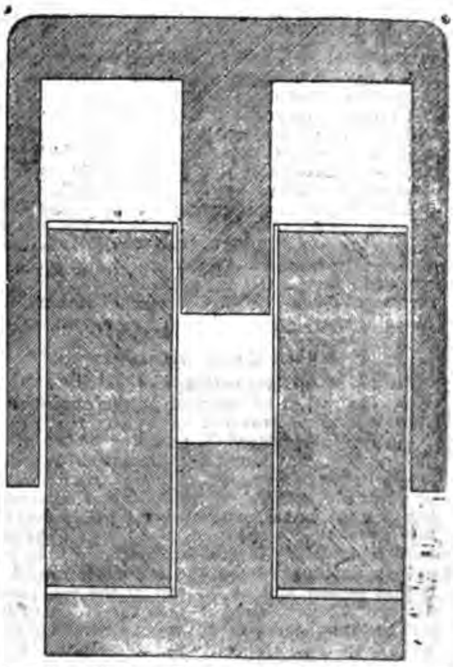


FIG. 35.—Plunger Electro-magnet of Stevens and Hardy.

Here (Fig. 36) is one form of tubular ironclad electro-magnet that deserves a little more attention, being the one used by Messrs. Ayrton and Perry in 1882; a coil has an iron jacket round it, and also an annular iron disc across the top, and an annular iron disc across the bottom, there being also a short internal tube of iron extending a little way down from the top, almost meeting another short internal tube of iron coming up from the bottom. The magnetic effect of the inclosed copper coil is concentrated within an extremely short space, between the ends of the internal tubes, where there is a wonderfully strong uniform field. The range of action you can alter just as you please in the construction by shortening or lengthening the internal tubes. An iron rod inserted below is drawn with great power and equality of pull over the range from one end to the other of these internal tubes.

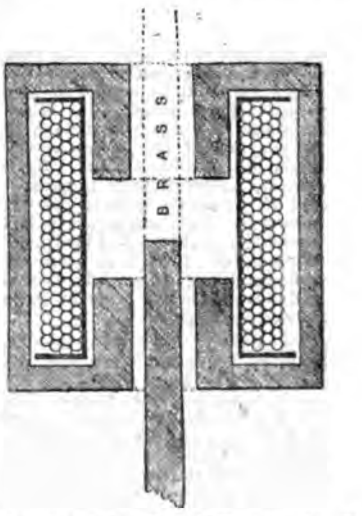


FIG. 36.—Ayrton and Perry's Tubular Ironclad Electro-Magnet.

### Action of Magnetic Field on Small Iron Sphere.

In dealing with the action of tubular coils upon iron cores, I showed how, when a very short core is placed in a uniform magnetic field, it is not drawn in either direction. The most extreme case is where a small sphere of soft iron is employed.

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* Extracted from the Cantor Lectures delivered by Prof. SILVANUS P. THOMPSON, B.Sc., before the Society of Arts.

Such a sphere, if placed in even the most powerful magnetic field, does not tend to move in any direction if the field is truly uniform. If the field is not uniform, then the iron sphere always tends to move from the place where the field is weak to a place where the field is stronger. A ball of bismuth or one of copper, tends, on the contrary, to move from a place where the field is strong to a place where the field is weaker. This is the explanation of the actions called "dia-magnetic," which were at one time erroneously attributed to a supposed dia-magnetic polarity opposite in kind to the ordinary magnetic polarity. A simple way of stating the facts is to say that a small sphere of iron tends to move up the *slope* of a magnetic field, with a force proportional to that slope; whilst (in air) a sphere of bismuth or one of copper tends, with a feeble force, to move down that slope. Any small piece of soft iron—a short cylinder, for example—shows the same kind of behaviour as a small sphere. In some of Ayrton and Perry's coiled-ribbon ampère-meters and voltmeters, and in some of Sir William Thomson's current-meters, this principle is applied.

### Sectioned Coils, with Plunger.

An important suggestion was made by Page, about 1850, when he designed a form of coil-and-plunger having a travel of indefinitely long range. The coiled tube, instead of consisting merely of one coil, excited simultaneously throughout its whole length by the current, was constructed in a number of separate sections or short tubes, associated together end to end, and furnished with means for turning on the electric current into any of the sections separately. Suppose an iron core to be just entering into any section, the current is turned on in that section, and as the end of the core passes through it, the current is then turned on in the section next ahead. In this way an attraction may be kept up along a tube of indefinite length. Page constructed an electric motor on this plan, which was later revived by Du Moncel, and again by Marcel Deprez in his electric "hammer."

### Winding of Tubular Coils and Electro-magnets.

The mention of this mode of winding in sections leads me to say a few final words about winding in general. All ordinary coils, whether tubular or provided with fixed cores, are wound in layers of alternate right-handed and left-handed spirals. In a preceding lecture I mentioned the mistaken notion, now disproved, that there is any gain in making all the spirals right-handed or all left-handed. For one particular case there is an advantage in winding a coil in sections; that is to say, in placing partitions or *cloisons* at intervals along the bobbin, and winding the wire so as to fill up each of the successive spaces between the partitions before passing on from one space to the next. The case in which this construction is advantageous is the unusual case of coils that are to be used with currents supplied at very high potentials. For when currents are supplied at very high potentials there is a very great tension exerted on the insulating material, tending to pierce it with a spark. By winding a coil in *cloisons*, however, there is never so great a difference of potentials between the windings on two adjacent layers as there would be if the layers were wound from end to end of the whole length of coil. Consequently, there is never so great a tension on the insulating material between the layers, and a coil so wound is less likely to be injured by the occurrence of a spark.

Another variety of winding has been suggested—namely, to employ in the coils a wire of graduated thickness. It has been shown by Sir William Thomson to be advantageous in the construction of the coils of galvanometers to use for the inner coils of small diameter a thin wire; then, as the diameters of the windings increase, a thicker wire, the thickest wire being used on the outermost layers, the gauge being thus proportioned to the diameter of the windings. But it by no means follows that the plan of using *graded wire*, which is satisfactory for galvanometer coils, is necessarily good for electro-magnets. In designing electro-magnets it is necessary to consider the means of getting rid of heat; and it is obvious that the outer layers are those which are in the most favourable position for getting rid of this heat. Experience shows that the under layers of coils of electro-magnets always attain a higher temperature than those at the surface. If, therefore, the inner layers were to be wound with finer wire, offering higher resistance, and generating more heat than the outer layers, this tendency to overheating would be still more accentuated. Indeed, it would seem wise rather to reverse the galvanometer plan, and wind electro-magnets with wires that are stouter on the inner layers and finer on the outer layers.

Yet another mode of winding is to employ several wires united in parallel, a separate wire being used for each layer, their anterior extremities being all soldered together at one end of the coil, and their posterior extremities being all soldered together at the other. Magnetically, this mode of winding presents not the slightest advantage over winding with a single stout wire of equivalent section. But it has lately been discovered that this mode of winding with *multiple wire* possesses one incidental advantage—namely, that its use diminishes the tendency to sparking which occurs at break of circuit.

### Extension of Range by Oblique Approach.

I now pass to the means which have been suggested for extending the range of motion, or of modifying its amount at different parts of the range, so as to equalise the very unequable pull. There are several such devices, some electrical, others purely mechanical, others electro-mecanical. First, there is an electrical method. André proposed that as soon as the armature has begun to move nearer, and comes to the place where it is attracted more strongly, it is automatically to make a contact, which will shunt off part of the current and make the magnetism less powerful. Burnett proposed another means: a number of separate electro-magnets acting on one armature, but as the latter approached these electro-magnets were one after the other cut out of the circuit. I need not say the advantages of that method are very hypothetical. Then there is another method which has been used many times with very great success, the method of allowing the motion of the armature to occur obliquely, it being mechanically constrained so as to move past, instead of towards, the pole. When the armature is pulled thus obliquely, the pull will be distributed over a definite wider range. Here is a little motor made on that very plan. A number of pieces of iron set on the periphery of a wheel are successfully attracted up sideways. An automatic device breaks the circuit as every piece of iron comes near, just at the moment when it gets over the poles, and the current being cut off, it flies on beyond and another piece comes up, is also attracted in the same way, and then allowed to pass. A large number of toy motors have been made from time to time on this plan. I believe Wheatstone was the first to devise the method of oblique approach about the year 1841. He made many little electro-magnetic motors, the armatures of which were in some cases solid rims of iron arranged as a sort of wheel, with two or more zigzag internal teeth, offering oblique surfaces to the attraction of an electro-magnet. Such little motors are often now used for spinning Geissler's vacuum tubes. In these motors the iron rim is fixed, and the electro-magnet rotates. The pole of the electro-magnet finds itself a certain distance away from the iron ring: it tries to get nearer. The only way it can get nearer is by swinging round, and so it gradually approaches, and as it approaches the place where it is nearest to the internal projection of the rim the current is cut off, and it swings further. This mode may be likened to a cam in a mechanical movement. It is, in fact, nothing else than an electro-magnetic cam. There are other devices, too, which are more like electro-magnetic linkages. If you curve the poles or shape them out you may obtain actions which are like that of a wedge on an inclined plane. There is an electro-magnet in one of Paterson and Cooper's arc lamps, wherein the pole-piece, coming out below the magnet, has a very peculiar shape, and the armature is so pivoted with respect to the magnet that, as the armature approaches the core as a whole, its surface recedes from that of the pole-piece, the effect being that the pull is equalised over a considerable range of motion. There is a somewhat similar device in De Puydt's pattern of arc lamp.

Here is another device for oblique approach, made by Froment. In the gap in the circuit of the magnet a sort of iron wedge is put in, which is not attracted squarely to either face, but comes in laterally between guides. Another of Froment's equalisers, or distributors, consists of a parallel-motion attachment for the armature (A), so that oblique approach may take place without actual contact. Here (Fig. 37) is another mechanical method of equalising devised by Froment, and used by Le Roux. You know the Stanhope lever, the object of which is to transform a weak force along a considerable range into a powerful force of short range. Here we use it backwards. The armature itself, which is attracted with a powerful force of short range, is attached to the lower end of the Stanhope lever, and the arm attached to the knee of the lever will deliver a distributed force over quite a different range. One way, not of equalising the actual motion over the range, but of counterbalancing the variable attractive force, is to employ a spring instead of gravity to control the armature. So far back as 1838, Edward Davy, in one of his telegraphic patents, described the use of a spring to hold back the armature. Davy preceded Morse in the use of a spring to pull back the armature. There is a way of making a spring act against an armature more stiffly as the pull gets greater. In this method there is a spring with various set-screws set up against it, and which come into action at different ranges, so as to alter the stiffness of the spring, making it virtually stiffer as th approaches the poles. Yet another n employ, as the famous conjurer Rob did, a rocking lever. Fig. 38 depicts on Houdin's equalisers. The pull of t magnet on the armature acts on a c which works against a second one; t application of force between the one an altering with their position. When the a far away from the pole, the leverage o lever on the second lever is great. armature gets near, the leverage of the on the second is comparatively small. ployment of the rocking lever was ado Houdin by Duboscq, and put into the D lamp, where the regulating mechani bottom of the lamp contains a rocking lev

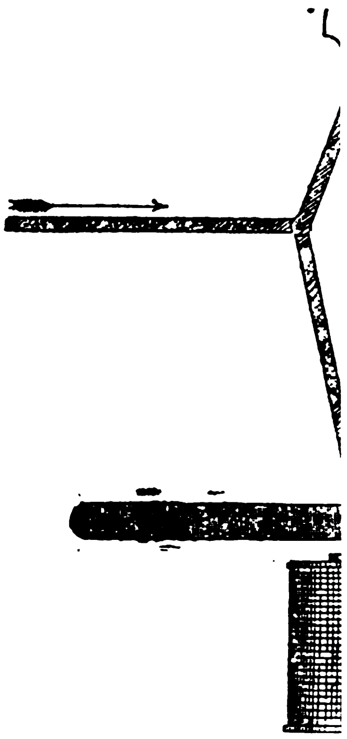


Fig. 37.—Froment's Equaliser with Lever.

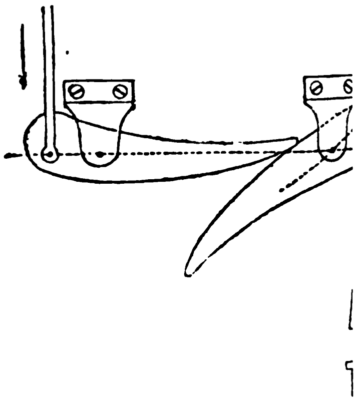


Fig. 38.—Robert Houdin's Equali

Another device for equalising the pull by Wheatstone in his step-by-step te 1840. A hole is pierced in the armatu end of the core is formed into a proje which passes through the aperture of the thereby securing a more equable force an range. The same device has reappeared years in the form of electro-magnet u Thomson-Houston arc lamp, and in the regulator of the same firm.

## A NEW SENSATION

THE *Weekly Times and Echo* quote lowing extract from *Le Petit* 29th December, 1890:—"Monsieur Grenoble engineer, has invented a mac will be the delight of the lovers of emotions. The inventor has thought of around the chuck proper. So we use a cutter like Fig. 18, and find it very good indeed. This is simply a round shank that fits a screw-chuck, and the cutting end flattened to width required; the points are worth attention, and it will be seen the centre is ground hollow, so as to let the points project ahead, and this is the secret of good work with all cutters of this kind. The points do the work, and the centre wants to be kept out of the way, and, like the other cutter, wants only enough rounded to produce a smooth surface.

Most milling machines are equipped with cutters like Fig. 19, which shows the front end of one in section—the centre is usually drilled out and four cutting wings milled in the face. When new and square, these do nice work, but how long will they remain so? Not long, as everyone knows who has seen them, and to grind them all square and even takes more than average steady man; in fact, I doubt if anyone can get them perfect by hand—and, if not perfect, only one or possibly two of the wings cut; so the advantage of a number of teeth disappears when the difficulty of maintaining them is considered.

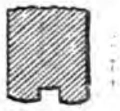


Fig. 19.

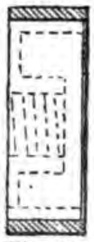


Fig. 20.

In the average case they assume the shape shown in Fig. 19, in an exaggerated form, and the work they then produce is a sight to behold. While from an artistic point of view the "snowflake" and "bas relief" effects these produce may be very fine—a mechanic knows that the nearer a perfectly smooth surface he can get, without scratch or mark of any kind, the better the milling and the better the tools used. A few of the chucks are shown in Figs. 17, 20, 21 and 22, and it will be noticed that Fig. 17 is made to fit a female spindle of the machine, which interchanges without any difficulty, and for small work, or work that must be brought low on the index plate, it is of great advantage.

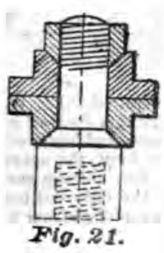


Fig. 21.

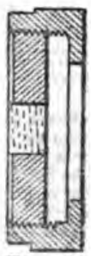


Fig. 22.

It will be seen that, except in Fig. 21, all the chucks are supplied with loose collars that bind between the work and plate as the chuck proper, and work is drawn down by the spindle, as explained before.

We have tried the chucks where the work is screwed on or in, until it jams tight enough to hold, but they are not satisfactory, and should not recommend their use. Fig. 21 is a spindle chuck, and a coned nut locks the work against a coned base—centring it and holding it firmly enough for such small work as shown, and of the thin work shown, two or more may be milled at once. Fig. 20 is for inside work, as shown by dotted lines, and needs no explanation, save the fact that it draws down on the loose collar in a manner similar to the rest.

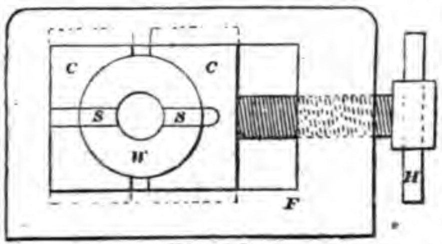


Fig. 23.

It is sometimes required to slot the ends of piping, tubes, or similar articles, and Fig. 23 shows an attachment we have used for that purpose.

The construction of the frame F can be readily understood from the two cuts, and fastens to the moving carriage shown in the body of the milling machine, and, of course, moves with it.

The work W, which we will suppose to be a brass tube that must be turned with a flat wrench or screwdriver. The jaws C C are of brass, and bored to fit the work, whether threaded or otherwise, the outside fitting the frame, and being held by a steel strap not shown in the cuts.

Insert the work, and the screw shown will give the required friction, the handle H being an iron pin driven through a square-headed bolt. But we have been doing this without a cutter in place, so we will choose one from the next cut, Fig. 25; *b*, *c* and *d* show end views of different forms, while *a* is a side view of one that does fairly well, but has been abandoned for the others. It is a single point, ground so as to give all the clearance possible, but it has given way to a better one. The one shown at *b* is now used to some extent, being a round piece of steel, turned to fit holder, and the end turned the required size for slot and three grooves ground, filed or milled in, as the case may be; but *c* is now the most used, as it is cheaper, more easily ground, and does just as good work. The last one, *d*, needs no description, being, as shown, a triangular end view, and, while doing fairly good work, has given way to *c*, as have the rest of them—a case of "the survival of the fittest."

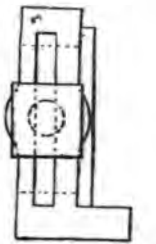


Fig. 24.

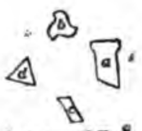


Fig. 25.

Many object to a single-point cutter, as shown in Fig. 15, and prefer the two-point one shown in Fig. 18; but it may be interesting to state that I have seen one of these two-point cutters break one point completely off, and produce work exactly as good as before, the main requirement being that it shall be held as firmly as possible in the chuck, and no shake in the lathe spindle either. With a cutter like Fig. 18 I have milled fifty hexagon nuts, whose sides were about one-half a square inch each, with one grinding of the cutter, which seems to be a good record for the cutter, especially as the nuts were all milled to size, and milled smooth too, and feel safe in saying that I can show as good work from this little machine as anyone can produce on any milling machine made.

For speed, a "double header" may excel it, though, where exact size is required, the extra time required to set two heads may reduce the speed attained more than its advocates will admit.

This seems to me an open question, a "double-headed" question, and I hardly know which side to favour—on general principles should favour anything that promised to increase the work produced, and as brass work as a rule—milling, I mean—usually consists in "taking off the rough," regardless of exact size—for this work the double machine is undoubtedly an advantage, while for exact work it seems that the single head would give less trouble. It will be noticed that the attachment shown has no means of vertical adjustment, which is, of course, a disadvantage, which can be overcome to a limited extent, by blocking up as required, with brass strips underneath, between lathe bed and bottom of machine.

HORSESHOES of compressed paper have been introduced into the artillery and cavalry of the German army. The shoe is made of sheets of parchment paper cemented with a preparation of turpentine, Spanish white, lac, and boiled linseed-oil. The separate layers are stamped out, cemented, and consolidated by a hydraulic press. When dry, the shoe is rasped to fit.

HERR AGERSKOV, of Copenhagen, has invented a flashlight fire-alarm, which is called the "admonitor." It consists of a small cartridge, filled with a Bengal light composition, and provided with a fuse made from potassium chlorate and sugar. On the fuse is a capsule containing sulphuric acid. When the temperature of the room rises above the melting point of paraffin the sulphuric acid is liberated and ignites the mixture of chlorate, which in turn sets fire to the Bengal light. The device can be supplemented by a piece of fusible metal, which in melting will establish an electric current and ring a bell.

# SCIENTIFIC SOCIET

## ROYAL ASTRONOMICAL S

THE January meeting was held on
9th inst., General Tennant, Presid
chair.

Mr. Knobel read a paper by Mr. Bu
"The Proper Motion of H. 1968." Ac
Argeländer, the proper motion of this s
After an examination of the observati
John Herschel, Struve, and Argeländ
pared with his own, Mr. Burnham cor
conclusion that the assumed proper motic
rect, or that the smaller star with which i
has been compared has a proper motion

Mr. Knobel read a paper by Prof. H.
of the Potsdam Observatory, Berlin,
Alleged Discovery of Spectroscopic Evide
Duplicity of $\alpha$ Lyræ, made by Mr. Fow
Observatory of the Royal College of Scien
Kensington," recently communicated to
nomical Society by Prof. Lockyer. P
said that Messrs. Fowler and Lockyer wo
deserve to be congratulated if, at the
their work in this difficult branch of spe
research, they had succeeded in making a
of such magnitude and importance. But he
to say that photographic evidence in the
of the Potsdam Observatory seemed e
negative the possibility of such motions a
attributed to this star. According to th
assumed by Messrs. Fowler and Lock
would only be a period of about twenty
during which the motion of the compone
not give rise to a duplicity of the lines t
not be recognised with the dispersion used
dam. In eleven photographs of the spe
$\alpha$ Lyræ taken since 1888, the lines
perfectly sharp. The chance agai
all having been taken at times w
two components of the star were m
right angles to the line of sight was o
ingly great, and the distribution in
such that the period, a little over
deduced by Messrs. Fowler and Lock
evidently inconsistent with their Potsdam
But some of the photographs had been
during a period of 40 minutes and more, a
South Kensington observations and the de
made from them were reliable, the changing
tion of the lines during the period of the e
ought to have caused them to appear blur
confused, whereas the lines in the Potsdam
graphs were perfectly sharp.

Mr. Ranyard said: When I went home f
meeting at which the discovery was anno
examined a photograph of the spectrum of
which had been given me by the Brothers
and found that the lines were perfectly s
have since written to them on the subject, a
inform me that they have taken three othe
graphs of the spectrum of this star, and
lines are perfectly sharp in all of them. Th
together with Prof. Vogel's observations,
shows that some mistake has been made.
would like to know how the mistake aro
are frequently near to making a fresh discove
we discover something that we cannot unde
should like to ask Mr. Fowler whether the
South Kensington, which, I understand,
in front of the object-glass, is clamped
screws, which might occasionally cause
under pressure, and to be in such a con
strain as to give a double image.

Mr. Fowler said: In the face of the fact
forward by Prof. Vogel, and the informati
received from Prof. Pickering, I feel
acknowledge that $\alpha$ Lyræ cannot be a d
as I suggested. Still, the photographs I
at the meeting remain, and we have no e
to offer of the occasional duplicity of
They look very much like the double lin
Pickering's photographs, and I got perfe
lines in the spectra of many other s
prisms are supported in a brass frame at
cap which fits over the object-glass, and
think that there can be any possibility c
sufficient to cause a double image, su
Ranyard suggests.

Capt. Noble said: I think that th
would like to be informed how the curve
Messrs. Fowler and Lockyer was calculat
paper published in the *Monthly Notice*
an elaborate curve of sines, and the four
vations which had been obtained were sa
that the separation of the lines followed
of sines. I should like to know how the c
were made.

Mr. Fowler said that the curve was o
Bunsen's method, and that the paper
intended as a preliminary one. It w
a "Preliminary Note." He was anxiou
work should be carried on elsewhere.

Mr. Gregory suggested that one of
Kensington students might have com
observatory and slightly shifted the ph
plates or the telescope during the exposu

# SCIENTIFIC NEWS.

THE shortness of the period of Spitaler's Comet has already been noticed; but it appears from a communication by Dr. Spitaler to *Astronomische Nachrichten* that the present orbit has been acquired only since 1887, when the comet, near its descending node, made a close approach to Jupiter.

Dr. Holetschek, in a previous number of *Ast. Nach.* refers to the apparent connection between the heliocentric longitudes of comet perihelia and the heliocentric longitude of the earth at the times of perihelion passage. He shows that the majority of the known comets have the longitude of their perihelion at a small angular distance from the earth.

The Lalande Prize of the French Academy of Sciences for last year has been awarded to Prof. Schiaparelli, of Milan, chiefly for his observations tending to prove that the planets Mercury and Venus rotate on their axes in about the same periods of time as those in which they revolve round the sun. The Valz Prize has been adjudged to Prof. S. de Glasenapp, Director of the Observatory of the University of St. Petersburg, for his investigations of the orbits of the double stars which are contained in the Pulkowa Catalogue; and the Janssen Prize to Prof. C. A. Young, Assoc.R.A.S., Director of the Princeton Observatory, New Jersey, for his spectroscopic discoveries, especially that of the infra-chromospheric layer, called by his name and first noticed during the total eclipse of December 22nd, 1870, in which the rays of the solar spectrum appear as short bright lines, forming what is sometimes called the "spectrum of the flash."

The death of Mr. George Wareing Ormerod, at the age of 80 years, removes from us one of those quiet workers who do so much to make science. As a student of local geology, Mr. Ormerod did excellent work, and his papers on the granite of Dartmoor are recognised sources of trustworthy information.

The Cav. Abate Antonio Stoppani, the distinguished Italian geologist, Professor of Geology in the R. Istituto Tecnico Superiore, Milan, died on New Year's Day in his sixty-sixth year. He was president of the Society of Natural Science of Milan.

Mr. Edward Bellamy, a distinguised surgeon, lecturer on Artistic Anatomy at South Kensington School, died the other day in the prime of life from an attack of acute pneumonia. Surpassed by none in surgical skill, he had also much artistic power, and a professional work from his pen, and illustrated by his pencil, awaits completion and publication.

Our readers will regret to see the announcement of the death of Mr. Adolf Paul Schulze, F.R.S.E. and F.R.M.S., a frequent contributor to our pages on optical and microscopical subjects. Mr. Schulze was a yarn merchant in Glasgow, and made the study of micro-photography, microscopy, and optics the special pleasure of his spare time. Born in 1840 at Crimmitschau, Saxony, he was "educated" at the Polytechnic of Chemnitz, where he studied engineering, and came to England in 1864, ultimately settling in Glasgow in 1869. He made the subjects above named his special study, and was known from his scientific work to the leading men in all that is comprised in the term "Optics," Prof. Abbe, of Jena, being in regular correspondence with him. Perhaps it would be too much to say that Adolf Schulze's life was lived in the wrong place; but for a busy man, in the commercial sense, he did much in the interests of science—so much as to give an idea of what he might have done had it been possible for him to have devoted himself to research.

The death is announced of Mr. Thomas Plantagenet Bigg-Wither, F.R.G.S., at the early age of 45. He was an engineer and surveyor by profession, but his name will be long remembered as one of the pioneers in Brazil.

The general meeting of the Association for the Improvement of Geometrical Teaching is to be held at University College, on the 17th inst. In the morning the reports of the council and the committees will be read, the new officers will be elected, and Miss Wood will read a paper "On the Use of the Term 'Abstract' in Arithmetic." At the afternoon sitting papers will be read by Prof. Minchin on "Another Voyage to Laputa"; by Mr. E. T. Dixon on "The Foundations of Geometry"; and by Mr. E. M. Langley on "Some Notes on Statics and Geometry."

The American National Educational Association will meet in Toronto in July next, and animated discussions are expected, for elementary education systems have been found not altogether satisfactory.

There are a few free admissions to the evening work in the Metallurgical Laboratory, King's College, available from the 23rd inst., for those who would find a difficulty in providing the funds for the ordinary fees. Applications should be sent to Prof. Huntington, at the College.

At the meeting of the Chemists' Association yesterday, Mr. Frederick Davis, B.Sc., read a paper on "Acarus Lini," so named because it has been found in some samples of crushed linseed. Mr. Davis has examined fifty-eight samples of crushed linseed, but found only two infested with specimens of the Acarus Lini, which, he says, is both oviparous and viviparous. It is, comparatively, much larger than the Acarus farinæ, and has fewer and smaller pinnate setæ than the latter. It revels in crushed linseed, and infested samples show that a portion of the natural oil has been extracted.

A photo-micrographic laboratory has been opened at Rimini by Count R. Sernagiotto, for the preparation and publication of photographic reproductions. Among the micro-photographs already issued, *Notarisia* mentions, as of remarkable clearness and beauty, one of *Pleurosigma angulatum*, 5000 diams., of *Bacillus radiciformis*, 1000 diams., and a tangential section of the stem of the vine, 75 diams.

The number of patents applied for continues to increase, last year's list showing 21,303 applications, against 20,993 for 1889. Although many of them may refer to utterly useless devices, there can be no doubt that the reduction on the cost of a patent has been a great stimulus to invention.

We are informed that at the Stanley Show of Cycles there will be exhibited the Zimer Double Hand-Lever Mechanism, which has been patented in this country and abroad, and is stated to be "beautifully simple and light, and yet enabling the cyclist, when in need of it, to produce the power of a giant." We understand that the invention consists in "attaching a clutch to the driving-spindle, and connecting same by one or two rods to the handle-bar, which is used as a double hand-lever."

Accounts as to the weather are being compiled, and it seems certain that taking the mean, December last was the coldest December on record; but the records are not trustworthy for more than half a century.

A Special Commission has been for some years established at Trieste by the Austrian Government for the oceanographic investigation of the Ionian and Adriatic Seas. During the past year the transport *Pola* has been set apart for the study of the sea-bottom, currents, temperature, &c., of the Adriatic, and has obtained important results. At a depth of 2,000 mètres abundance of a green alga (*Halosphæria viridis*) was found.

Although the use of the electric light is spreading, the consumption of gas continues to increase, the figures of the Gas-Light and Coke Co., subject to correction, showing an increase of 4·63 per cent. for the last half-year, as compared with the same period in 1889.

The approaching completion of the Paris-London telephone line is giving rise to a discussion as to the possibility of talking with New York under the Atlantic. No one would say that such a thing is impossible, while those best acquainted with the difficulties would probably say the idea is feasible, although our present experience points to its impracticability. The results of the experiment between Paris and London will be watched for with much interest.

The City and South London Railway Co. intend, if they can obtain permission from Parliament, to extend their line from its present terminus to the northern end of the City-road, making the connection at the King William-street end by means of a subway. It is probable that before long we may see several electric underground railways tapping suburbs which are now not easily reached.

In Boston, Mass., it is calculated there are more than 5,000 miles of overhead wire, Boston is not a very large place.

There are now 15,000 telephones in use Berlin, an increase of 50 per cent. in two year

Telephonic communication with ships is to tried at Bordeaux. The extreme distance is miles.

# LETTERS TO THE EDITOR

*[We do not hold ourselves responsible for the opinions our correspondents. The Editor respectfully requests that communications should be drawn up as briefly as possible.]*

*All communications should be addressed to the* Editor *the* English Mechanic, 332, *Strand, W.C.*

*All Cheques and Post-office Orders to be made payable* J. Passmore Edwards.

*** *In order to facilitate reference, Correspondents, speaking of any letter previously inserted, will oblige mentioning the number of the Letter, as well as the page which it appears.*

"I would have everyone write what he knows, and much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

## THE HEIGHT OF THE MOON'S ATMOSPHERE.

[31968.]—"Ja. Ha.," and some of the other writers on this subject have spoken of the height of the moon's atmosphere as if it was quite indeterminate, and depended upon the amount of atmosphere or gas surrounding the moon. "Ja. Ha." goes even further, and seems to imagine that if the pressure of the atmosphere were below a certain limit, aqueous vapour evaporated from lunar ice would flow off into space.

If the lunar atmosphere is like our own, or if it is composed of a gas which obeys, or only approximately obeys, Boyle's law, connecting the density of the gas with the pressure upon it, the lunar atmosphere must be about six times the height of our own atmosphere; for, neglecting differences of temperature, the height or thickness of any stratum of the atmosphere will be inversely proportional to the weight of the atmosphere resting upon it. In our own atmosphere the pressure is reduced by one half at a height of about 3½ miles above the sea-level. Let us suppose that the amount of the air around the earth was doubled, the height of the lower half of the atmosphere would still remain about 3½ miles, for the weight of the upper half of the atmosphere would be doubled, and consequently the lower half would be subjected to double the original pressure. If the quantity of air in the lower half of the atmosphere had not been increased, the double pressure would compress it into half its original volume; but as the amount of air in the lower half of the atmosphere would also be doubled, it would occupy the same volume which half the quantity originally occupied when under half the pressure. Similarly, if the amount of air were multiplied by three, or any other number, the height of the lower half of the air would not be altered. But if, instead of doubling the quantity of air in the atmosphere, the mass of the earth were doubled, so that the weight of each element of the atmosphere were doubled, the lower half of the atmosphere would be under double the pressure which it was previously under, and its volume, and consequently the height, of the atmosphere would be reduced by one-half. If the force of gravity were reduced to one-sixth of its present amount, the height of the lower half of the atmosphere would be multiplied by six: that is, if the earth's atmosphere were transported to the moon the height of its lower half would be about 21 miles, instead of 3½ miles, as upon the earth.

With a gas which approximately obeys Boyle's law, the lower half of the upper half of the atmosphere will, neglecting differences of temperature, occupy a stratum equal in thickness to the lower half of the atmosphere. For this quarter of the atmosphere is only compressed by the weight of the upper or fourth quarter, and each stratum is under just one half the pressure of the corresponding stratum of the lower half of the atmosphere; consequently, the density of each stratum will be one half of the density of the corresponding stratum in the lower half of the atmosphere, and the third quarter of the atmosphere will occupy the same thickness as the lower half of the atmosphere upon the earth; consequently the atmospheric pressure will be reduced to one fourth of the pressure at sea-level at a height of about seven miles.

Similarly, the lower half of the uppermost quarter of the atmosphere will occupy the same thickness, neglecting differences of temperature as the lower half of the atmosphere, and the lower half of the uppermost eighth will also occupy a stratum of

s, and so on; and the pressure of
rill be reduced to one-eighth the
sea-level at a height of about
sixteenth at 14 miles, to about a
ressure at sea-level at a height of
d to a millionth of a millionth of
he sea-level at a height of about

nally become visible at a height of
miles in the earth's atmosphere;
jority of the meteors we see are
descent by the resistance offered
y reach an altitude of 80 to 70
a level. On a fine night there is
tion of the horizon or appearance
till the sun has sunk about 18°
; a fact which indicates that the
rsed by the air, or particles float-
atmosphere, up to an elevation of
bove the sea-level. At greater
either too rare or too free from
cles to disperse any perceptible
's light.

e successive steps at which the
rth's atmosphere is halved will
temperature of the air at the
If the height of the lower half
, at a temperature of 32° Fahr.,
exactly 3½ miles, its height, at a
grees, would be $\frac{T}{273} \times 3{\cdot}5$ miles,
solute temperature measured in
. Thus, if the temperature of
only − 91° Cent., the height of
the series above referred to would
-thirds of the height of the lower
here when at a temperature of
e above supposition, to 2⅓ miles.

her element to consider: if the
lunar atmosphere has a different
the gas composing our own atmo-
t of the steps will be increased
$\frac{w}{W}$ where $w$ is the relative weight
ng the lunar atmosphere and W
ht of our own atmosphere. Thus,
phere were composed of as light a
he height of all the steps of the
ltiplied by 14·45.

ry satisfactory evidence of the
ht upon the moon. The shadows
ns appear perfectly black and
is no generally-recognised evi-
umination extending beyond the
n illuminated by direct sunlight.
, the Rev. T. W. Webb was in-
at there was some evidence of
ination occasionally to be seen
the lunar cusps. In his "Celes-
ommon Telescopes," he quotes
ter and the Brothers Henry as
ch a faint illumination, and he
f his own testimony as having
ined to be evidence of lunar twi-
of June, 1855. M. Thollon and
bserved with bisulphide of carbon
rge dispersion during the eclipse
at they detected evidence of the
e B group in the neighbourhood
when seen projected upon the
bsorption of light in a lunar atmo-
he absorption which takes place in
*mptes Rendus* for June 19, 1882).
l, Prof. C. A. Young, using a
maller dispersion during the
s unable to detect any alteration
m in the immediate neighbour-
's limb; and Mr. Stone, with a
smaller dispersion, was unable
ation in the appearance of the
the solar spectrum near to the
g the partial phases of the
4. There is no observable dis-
's limb where the moon cuts it
r eclipse, and no line of light is
ong the edge of the moon, such
cles the disc of Venus just before
sun's disc. But this is quite
existence of a lunar atmosphere
g a ray which grazes the lunar
gle of one or two seconds of arc.

which a star would be hidden
uld be decreased by the presence
re giving any sensible refraction,
served duration of the occulta-
computed from the measured
on and its known rate of motion.
(see his "Textbook of Astro-
f opinion that reliable observa-
rence between observed and cal-
occultations amounting to about
This he thinks may possibly be
e action of an exceedingly rare
aving a density of about $\frac{1}{2000}$
ut it may also be accounted for
the measured diameter of the
*tion*; the diameter of a bright object always appearing a little larger than it really is.

The foregoing observations, if they do not prove the existance of a lunar atmosphere, may be taken as evidence that there is not a lunar atmosphere denser than that to be found at a height of about 35 miles above the earth's surface. On the other hand, the existence of steep cliffs and many lofty pinnacles upon the moon may, I think, be taken as evidence that the moon has an atmosphere denser than that which exists at a height of 100 miles above the earth's surface; for if there were only as much atmosphere at the summit of the lunar mountains as exists at the height of 100 miles above the earth's surface, the weathering action caused by the bombardment of meteors would be very considerable, for the force of a blow struck by a projectile varies as the square of its velocity, and even small particles moving with a velocity of 20 to 40 miles a second, would soon break up and bring down large portions of lofty cliffs and pinnacles. The majority of the meteors we see become visible at a height of less than 100 miles, and are extinguished before they reach a height of 50 miles above the sea-level. We may feel very sure that the moon encounters about as many meteors, area for area, as the earth does, and we are probably safe in assuming that the density of the moon's atmosphere at the summit of the mountains, which, when seen in projection, form the lunar limb, is greater than the density of the earth's atmosphere at a height of 100 miles above the sea-level. The presence of ice and snow upon the moon, which I think has been shown to be highly probable, also implies the existence of a lunar atmosphere with a pressure at least equivalent to the pressure of aqueous vapour at a corresponding temperature.

A. Cowper Ranyard.

## GLACIATION OF THE MOON.

[31969.]—MR. DIXON, in reply to me, says that solar rays do not do much to melt the ice on the moon; if he will refer to "Heat, a Mode of Motion," Tyndall, 4th ed., p. 447, he will read: "The total amount of solar heat received by the earth in a year, if distributed uniformly over the earth's surface, would be sufficient to liquefy a layer of ice 100ft. thick, and covering the whole earth." Now, without an atmosphere, the solar rays must be more powerful on the moon than on the earth, and therefore melt more ice there relatively than on the earth. It must also be remembered that the obliquity of the rays on Polar mountains on the earth are vastly less effective than direct rays around the moon's equator. I quite agree that the cold of the moon in shadow must be intense, not because of its smaller size, but because of the absence of aqueous vapour, which on the earth acts so effectively both to absorb the solar rays and to prevent radiation of heat into space. If, then, Tyndall is right, there would be on the moon intense heat and cold, supposing there is no ice and no atmosphere; but if there is ice there would be less heat and less cold, but still ample heat to liquefy sufficient ice to produce aqueous vapour, cloud, and snow in enormous masses.

But further, if there is ice on the moon, it must collect in masses on the poles, and we should not see, as we do, the same volcanic surface at the poles as at the equator. But supposing the temperature on the moon's surface is only 32°, there would still be enough evaporation to produce an aqueous atmosphere dense enough to be noticed at eclipses and at occultations; for ice will evaporate without melting, as "Ja. Ha." has stated.

The interest of this question, however, does not end with ice or not ice. With the powerful appliances now brought to bear on the moon's surface, surely we shall make progress. What is the surface? I confess, not being able to use a power above 800, that the surface appears to me to have cooled from a plastic state, and the masses of mountains and craters to have been here ejected and there thrown up while in a plastic state. I can trace no action of water in any form, nor can I trace denudation nor weathering of peaks; but there is abundant evidence of falling-in of cliffs from contraction or expansion, or volcanic action. I trace no appearance of seas in the so-called *maria*: they are comparatively smooth surfaces of slag, pumice, or lava, and, like the cliffs, unalterable by alternations of intense heat and cold, in the absence of moisture.

I wait for discussion and light on this question by abler intellects than mine. That hydrogen and oxygen exist on the moon appears to me certain; it does not follow that they exist in that wonderful and beautiful combination, water, without which, in combination with heat (so-called), no life, as we know it, could exist. But if water does exist, may it not, as I have suggested, have retreated to the interior of our satellite, there to remain in a frozen state so long as this world lasts?

Stroud, Jan. 10. W. J. S.

## WATER ON THE MOON.

[31970.]—MY thanks are due to "F.R.A.S." (31938) for his prompt courtesy in supplying me with the information I required, and I must acknowledge that I have myself to blame for its inadequacy. I did not set forth sufficiently the conditions of the problem, because I hoped that the experts in the mathematics of gravitation would enter into the investigation more thoroughly if I refrained from attempting to point out the line of research they should pursue. Certainly I have no reason to complain of having received a reply which just covers the simple question I asked; but I feel that I am in the position of the tramp who has petitioned for a crust of bread in the hope of having a bit of cheese thrown in. I have got the crust, and it may not be too late to hint that I am still hungry.

The objections which I perceive to the determination arrived at are these:—(1) the calculation has been based, apparently, on the average distance of the moon from the earth, whereas I think that the minimum distance should have been taken, as it matters not whether the moon has been stripped of its atmosphere intermittently or continuously; (2) the calculations are made from centre to centre of the two globes, whereas the atmospheres rest on their surfaces, and it appears to me that the semi-diameter of the moon should be deducted from the figure set down as the height of the moon's atmosphere. If the extent of the earth's atmosphere were calculated in the same way, its height from the earth's centre would be found to be more than 4,000 miles, and that amount multiplied by the difference of gravity at the surfaces of the two globes would go a long way towards equalising their atmospheres. (3) I spoke only of the pull of the earth's gravity, although I was aware that there are other forces of a like kind which have to be taken into account, notably that of the sun, which is greater than that of the earth, and sometimes acts with the latter, and sometimes against it. At full moon, when the earth is between the moon and the sun, it is obvious that the masses of the sun and earth combine to strip the moon of its atmosphere, drawing it towards the earth. At new moon the mass of the sun, diminished by that of the earth, is advantageously situated for drawing the moon's atmosphere towards the centre of the Solar system, although the force is very much less than the combination of forces at the full moon. Even though the sun should get a share of the spoil, my main argument will remain unaffected.

I am asked if I seriously conceive that the moon's atmosphere ever has, or ever can have, extended 23,884 miles from the moon's centre. Well, the magnitude of the figure does not appal me, and I fancy that further investigation will materially reduce it, perhaps to something less than 10,000. When I look, on the other hand, at the exceedingly indefinite theory of the limitation of atmospheric extension, I feel encouraged rather than dismayed. I do not dispute the theory of limitation; but I look in vain for any data from which a definite limit can be deduced. I am told that there must be a point where the elastic force (not set forth) and the gravity of the constituent atmospheric particles (not ascertained) must balance, and that there (where?) will be the surface of the atmosphere. I do not see anything in this theory, as thus stated, to warrant anyone in definitely fixing an atmospheric limit. The diminution of the elastic force is dwelt upon; but nothing is said about the diminution of gravity with elevation, although in the case of the moon this is an important item. I am not aware that the weight of a molecule at the earth's surface has been ascertained; but if we call it 1, its weight at the moon's surface will be only 0·167, and at the height of a thousand miles above that surface—what? It will not do to tell me that the calculation is a simple one, because as the moon's attraction becomes less and less, other attractions acquire increased force, and I really do not see the necessity of supposing that the moon's atmosphere should have any limit at all due to the operation of the theory referred to—at all events, within the sphere of the moon's attraction.

To Mr. Cowper Ranyard (39139) also my thanks are due for the pains he has taken to set me right on points respecting which he thinks I am in the wrong; but I find some difficulty in dealing with his arguments, because they seem to me to be irreconcilable one with another. Thus, he admits the correctness of my estimate of the evaporation of water and ice on the moon in the absence of an atmosphere, but denies that the molecules of aqueous vapour can possibly leave the moon, because they would form an atmosphere which would hinder the dispersion of subsequently evaporated molecules. He then goes on to show, as I understand, that no such atmosphere exists, and he afterwards says that he thinks it probable that there is ice upon the moon. He seeks to minimise the density of a lunar atmosphere in a way which I am prepared to controvert. This density, he says, is only one-sixth of the corresponding density of the terrestrial atmosphere. On the contrary, I contend that the density of the lunar atmosphere required to produce a pressure corresponding to an equal terrestrial pressure (which is really the matter in question) must be six times as dense as the earth's atmosphere at equal pressure, or 36 times the density assumed by him. This, to me, is obvious, because the pressure of an atmosphere is really equivalent to the gravity of its molecules, and one molecule of the earth's atmosphere exerts a pressure equal to that of six molecules of the lunar atmosphere. The density of an atmosphere depends on the number of molecules in a given space, whereas their pressure depends on their aggregate gravity. It was for this reason that I estimated the density of a lunar atmosphere which would give a pressure of 0·17 of a mercurial inch at one-thirtieth of the density of the terrestrial atmosphere. As there is no such lunar atmosphere, it follows that there can be no water or ice on the moon, which was what I sought to demonstrate. The conclusion must be the same even if the calculations be made at the lower temperature for which Mr. Ranyard contends.

I have already answered "W. J. S." (31940) by anticipation. To state the matter more plainly, water is retained on the earth because the pressure on it is enormously greater than any pressure that can be exerted on water on the moon. The gravity of the molecules of vapour on the earth is so much greater than it can be on the moon, that the earth's atmosphere may have a limit, while that of the moon, as I have already contended, may have none.

"C. M. C. B." (31942) dwells chiefly on the extremely low temperature of the moon, relying on the reported opinion of Prof. Langley, which brings it to 100° Centigrade below zero. I have seen other accounts, however, which call in question the suitability of the instrument he employed, and I can appeal to Mr. Cowper Ranyard, who says that "Profs. Langley and Verey think that they have satisfactory evidence that the lunar temperature rises in the neighbourhood of the lunar equator a little above the freezing point during the lunar day," although he thinks that the average temperature of the lunar surface may be below Fahrenheit's zero. I am quite content with these latter determinations. I give no opinion of my own, having made my calculations for the freezing point merely for the convenience of reference. I think, however, that the experimental observations of Prof. Forbes, Signor Melloni, Prof. Piazzi Smyth, M. Marié-Davy, and the Earl of Rosse are still worthy of reliance, and they all show that the temperature of the full moon is higher than that of the earth where the observations were made; while Sir John Herschel was of opinion that the surface of the full moon must be heated to a degree possibly much exceeding that of boiling water. The determination of the Earl of Rosse was that the actual temperature of the illuminated lunar surface is as high as 500° Fahr. With these facts before me, I do not at present see that I need complicate the discussion by further reference to them. "G. M. C. B." also calls my attention to the fact that a diminution of pressure raises the freezing point of water. This amounts to a small fraction of a degree, and he is welcome to all he can make of it. He says that the consequence is that the ice must pass into vapour without melting. Well, that is precisely what I have been endeavouring to show.

Having thus far acted defensively against the objectors to my hypothesis, I may now be allowed to make a forward move on my own account. It is one that will commend itself to the legal mind rather than to the mathematical, the case being this: The earth and the moon had a common origin, and commenced their career with, it may be supposed, a fair division, proportionate to their respective sizes, of their common patrimony. The moon had a share of the materials of which the earth is constituted. Out of these the earth has developed or retained an atmosphere, and the moon has none, although it should have one. The probability is that the course of events on the moon was similar to that of the earth—the same reactions producing the same results, and so on. The moon's volcanoes, for instance, may be supposed to have belched forth gaseous products, of which not a trace remains. The separation between the earth and the moon was not complete, as the big brother retained a pull on the little one, trying with all his might to get possession of the little one's loosely-held outlying possessions. Does not the very fact that the moon has none of these left amount to presumptive evidence that it has been despoiled of them? If these possessions have not been filched from the moon, what has become of them? What would a Scotland-yard detective say to such a clue? It seems to me that the mere fact that the moon has no atmosphere is a proof that it must have been stripped of it. What do the gentlemen of the jury think? There is another familiar way of putting the case: Two neighbours sit down to a friendly game at cards, sixpenny points, payable in any sort of transferable property. They are both moderately well off, but the capital of one is eighty times that of the other. The result is that the poorer one has his pockets cleaned out, and all his convertible property is passed over to the richer. What do the bookmakers say to such a case? The earth and the moon have been playing at "beggar my neighbour" for a handful of thousands or millions of years, and the moon is stripped naked. What else could have been expected?

It is amazing to contemplate the number of people who manifest a deep interest in the maintenance of ice on the moon, while not one of them seems to care a straw about what has become of the nitrogen, oxygen, and carbonic acid with which the aqueous vapour should have been associated. It surely seems exceedingly probable that, wherever the gases may have gone, they have taken the water with them. That the truth of this will soon be seen I have no doubt.

Jan. 12. **Ja. Ha.**

## WATER ON THE MOON.

[31971.]—YOUR correspondent, "Ja. Ha.," has got so many opponents to deal with, that I shall be brief.

1. I do not know the density of the lunar atmosphere (if any); but I see no reason why it should not amount to $\frac{1}{5}$in. of mercury, corresponding to a boiling point of about $34\frac{1}{2}$° Fahr. At the same time, the usual instantaneous disappearance of occulted stars, with the occasional exceptions to the rule, lead me to think that the lunar atmosphere consists mainly of vapour, and that the density at any point varies according as the vapour is being generated or condensed. (It does not follow, however, that this vapour is aqueous vapour, though that may be most probable.)

2. I have not much faith in any determinations of lunar temperature hitherto made; still less in inferences drawn from the condition of a planet surrounded by an atmosphere to one which is almost destitute of it.

3. This last remark applies to terrestrial distillation. However, as the area becomes narrowed as the terrestrial vapour-stream moves from the equator towards the poles, a new condition is imported, which is inapplicable to the bright and dark sides of the moon. The great terrestrial collection of clouds and consequent rain-fall, or snow-fall, would probably take place at the poles but for the narrowing of the area.

4. I think it certain that water is not deprived of the absorbed air by the mere action of an air-pump. I leave this question, however, to more skilled physicists than myself.

5. I do not possess the means of ascertaining the effect of a reduced gravity on the physical properties of water, and I doubt if the variations of terrestrial gravity at different places are sufficiently large to justify any conclusion.

If I were disposed to offer conjectures on the subject, I might suggest that the lunar streaks, visible when the moon is not far from the full, are streaks of fog or vapour; but I know nothing in favour of such a conjecture at present.

Dublin, Jan. 10. **W. H. S. Monck.**

## RE GREAT METEOR OF DEC. 14.—A CORRECTION.

[31972.]—IN reply to letters 31946 and 31947, I regret that an error occurred in my account of this fireball in your issue of Dec. 26, wherein it is stated to have appeared at first in the "south-east." This is either my mistake or the printer's, and should be *south-west*, as I have it in my notes. This naturally affects seriously the determination of its path.

It could not have fallen near Ipswich, for Mr. Chas. May, of Hadleigh, Suffolk, a town some eleven miles W.S.W. of Ipswich, saw if fall about vertically near the south-west. Had its path been as given by Mr. Wood, it should have appeared to Mr. May in the east, passing to north-east. From a collation of the best accounts, it probably fell near Brentwood in Essex, travelling from the south.

I hope Messrs. Spencer and Paramor will forgive me for saying that I cannot understand how the *noise* of its motion should be heard at the instant—and especially *before*—that motion was perceptible to the eye, and by an observer placed at some distance from its path.

Woodbridge, Jan. 10. **Wm. London.**

## TELESCOPE FOCUS.

[31973.]—IN the first edition of Webb's "Celestial Objects," dated 1859, page 12, the following sentence occurs:—

"Do not spare trouble in adjusting the focus. *It is well known that it must be altered for the different distances of objects; but it would hardly have been supposed that rays proceeding from a body a quarter of a million miles off would require a different adjustment from those sensibly parallel. Yet such is the case, the focus for the moon being perceptibly longer than for the stars.*"

Now, Mr. Webb has evidently had some doubt about the accuracy of the above statement, for that portion of it which is quoted in italics is omitted in the fourth and last edition of the book, dated 1881.

My attention has been drawn to this by the fact that, in the *British Journal of Photography Almanac* for 1890, the editor, in an article on "Focussing," makes the following statement:—

"Five miles is a fairly long distance away, and so, for that matter, is one mile; but let an object at the greater distance be examined through a large telescope, the focus of which has been set for looking at something only one mile off, and it will be seen quite indistinctly, until refocussing has been had recourse to; and when the five-mile object is made sharp, a more distant object still will be blurry and indistinct until it, in turn, has been sharpened by refocussing. *Even the difference between the moon and the stars is readily appreciable, from the focussing point of view.*"

It will be seen that the sentence quoted in italics is very much a repetition of Webb's statement in the first edition of his book, which he did not care to repeat in subsequent editions.

Now is it, or is it not, the fact that the focus of a telescope requires to be altered when it is focussed upon the moon and then on a star? Personally, I have never found that any such alteration was necessary. The instrument I use is a 4in. five-foot focus achromatic by Barstow. It is an exceptionally good one, and when correctly focussed the least movement puts it out. I may say that I am no inexperienced user of the instrument. I have been accustomed to the use of the telescope and the microscope for the last 40 years, but the above statements rather staggered me. I should like very much to have the views of some of your able correspondents on this point, and, if they can give it, a reference to any other authorities where such a statement may either be made or contradicted. I have a considerable number of standard works on astronomy and optics, but I have been unable in any of them to find anything bearing on the question. If "F.R.A.S." is not, as is sometimes the case, miles away from his library, perhaps he may be able to refer me to some authority on the point.

**Wega.**

## PRACTICAL WORK WITH THE TELESCOPE—LIVERPOOL ASTRONOMICAL SOCIETY.

[31974.]—IN answer to "Sparling, B.A." (letter 31949, p. 421), I shall be very pleased to forward to the Editor my copy of "Practical Work with the Telescope," if he thinks it worth while to publish it in "Ours." I have had a good many applications for copies, and very much regretted that I could not forward any more, my limited number having soon disappeared.

The suggestion of "Asteroid" (letter 31948, p. 421) is not a new one. I personally tried very hard some months ago to bring about some understanding between the two societies, but, unfortunately, without success, and I believe others tried to do so as well. I think, perhaps, it would be better to let them work harmoniously side by side for the present, and not attempt any such scheme of amalgamation. **T. E. Espin.**

## BRITISH ASTRONOMICAL ASSOCIATION.

[31975.]—IN order to meet the needs of members of the Association who may require information on astronomical subjects, or practical advice and direction, a committee has been appointed to answer inquiries. Letters from members asking for advice and help of this kind, may be addressed to Mr. William Schooling, F.R.A.S., of Brechin House, Rivercourt-road, Hammersmith. All letters and queries must be duly signed by the members writing. At the ordinary meetings a Query Box will be provided, and into this unsigned query papers may be placed on the night of the meeting. In the case of inquiries of general interest, replies will be given in the *Journal*, or at the ordinary meetings; but in no case will the name of the inquirer be published without the express authority of the member who sent the inquiry. **Philip F. Duke,**

Secretary for General Purposes.

Hendon, Jan. 12.

## SHARPENING ANGLE TOOLS FOR ECCENTRIC CUTTER.

[31976.]—"F. A. M." (letter 31950) speaks of the difficulty of properly centring tools for this instrument. My drilling-spindle obviates the difficulty occasioned either by the re-sharpening of the tool, or the insertion of another tool, as in either case I can re-sharpen and get the exact centre in, say, four or five minutes.

On the end of my drilling-spindle is screwed a very small double eccentric chuck, which also carries the drill in a short nose, the tool being fixed with a binding-screw; one slide of the eccentric chuck gives the desired eccentricity, while the vertical slide raises or lowers the tool to the exact centre. Of course this operation is quite independent of the raising and lowering screw of the rest itself.

I suggest that "F. A. M." should add the vertical slide to his eccentric cutting-frame (it must be a neat job), and I feel sure that he will never regret it, for he will then be able to sharpen his drills without caring much about his centres, when he knows that a quarter-turn of one of the little screws will put him right, and also save him—and I hope others—a large waste of time and patience.

The above remarks apply equally to the elliptical, rose, and epicycloidal cutting-frames. Some objections may be urged that the tools stand out too far, with the liability to cause spring or vibration; but I think our lathemakers are clever enough to get over this difficulty. Without measuring, the little eccentric chuck is 1in. in diameter, and including tool-box, ½in. deep, and the nose which screws on the spindle about ⅜in. **N. Maclean.**

### LATHE MATTERS.

[31977.]—The interest shown in above proves that a large number of our readers are ornamental turners, and I gladly take "Earlswood Park" (31958) at his word, and beg for more from his pen, though I would suggest that he might add a few hints on the manipulation of the various chucks, cutting-frames, &c., that he describes for the benefit of those already supplied with these.

The Rev. C. E. Ellison, in the Replies column, mentions having sent you, Mr. Editor, a soda-water stand made from yew. Now it occurs to me that someone might give a list of neat and usful nick-nacks to make, as with many the trouble is not how to make, but what to make. There would be no need to go over the stereotyped articles which are found in books on turning, beginning with boxes, needle-cases, spill-cases, and such like, but I mean novelties. For instance, this soda-water stand strikes me as somewhat novel, and it never occurred to me to make such a thing. I presume it consists of a base, possibly clover-leaf shaped, and a similar-shaped disc a few inches higher up a turned stem, three large holes turned out probably with the eccentric chuck, and large enough to admit the soda bottle. If merely a rough idea is given, the rest might be left to the skill and taste of the turners.

On materials also someone might be found willing to give a few remarks. Would someone give me the best way to preserve apple and pear-trees from "shaking"? The logs have been cut a year, and are now sawn into short lengths, and I am afraid of their cracking. Is painting the ends and keeping in a not too dry place sufficient?

Have any of you tried a wood called Madagascar redwood? I fell in with a log more than a year ago, and was told at the time that it was the only log that had ever reached this country; but since then I fancy I saw it offered for sale in your columns. It is undoubtedly a grand wood, quite equal to African blackwood, and, I should say, a sounder timber. It is reddish coloured, but turns all but jet black with exposure, and the polish is simply magnificent.

If anyone will go into these matters, these suggestions would keep us going for some time and keep up the interest. **Phederick.**

[31978.]—In reply to "Earlswood Park" (31953) I did not condemn the taper-stem fitting (I consider it the best); but the omission of the "set" screw, which completes it, and for this reason that when using Holtzapffel's drills and spindle (which cannot be fairly called either "badly made or low class") the drills *frequently*, when doing *intermittent* cutting, *come loose and spoil the work*. This never happens when a set screw is used, therefore I repeat, "Use them." Holtzapffel and Evans put "set" screws to their larger size ornamental drill-spindles, and I should very much like to see "the better class appliances which do not have them." I know that they are used by some of the very best tool makers of Manchester for their finest drills.

Though it is many years since I connected my spherical rest with the spiral apparatus, I know that it was not a very easy job, and I shall be very much obliged to "Earlswood Park" if he will describe a simple way of doing so with such a lathe as is usually turned out by Holtzapffel or Evans.

In reply to "F. A. M." (31950), the necessary length of the drill (if there were no other prohibitive reasons) precludes you from using them in the ecc. cutting-frame.

It is a scandal to the trade that, considering the price charged for small cutters, 24s., and for universal 36s., that they should not be made to size, and that the various slots to receive them should also vary, that both are not made to a Whitworth gauge, so that in the midst of a piece of work it shall never again be necessary to go to a grindstone before you can get a tool into its slot. However well the cutters may be fitted, it will always be necessary, for the best results, to press one side of cutter (that which does the least cutting) against the side of the slot when tightening it up.

Drills, in my opinion (with very rare exceptions), should never be so sharpened as to produce a groove angular at the bottom. The drill should have a slight thickness at the point, and that should be sharp and polished, and it will leave a minute flat at the bottom, which, reflecting the light, adds life and lustre to the pattern. **C. C. Ellison.**

### ANEMOMETER.

[31979.]—Although I can give "F.R.A.S." no information as to the reading of his instrument, perhaps the following may be of interest:—About 10 years ago I was through Sir Howard Grubb's works while the lenses of the Vienna refractor were being ground. Mr. Romney Robinson, the inventor of the anemometer in question, was there (in his 90th year) superintending a series of experiments on his invention. The apparatus was similar to the ordinary instrument, but the arms were, say, 15ft. long, revolved by manual power. Above them were two very light arms carrying each an india-rubber balloon, suspended by strings a few inches above the hemispherical cups. As each cup passed under a balloon, the current of air produced by it dragged the balloon forward a foot or so, and thus kept the upper arms continually in slow motion. Of course this velocity had to be subtracted from that of the cups. The centres of both systems were in electric communication with one of the neighbouring rooms. The instruments there I did not see, but I asked afterwards, what was the result? and I was told that it was not satisfactory, the constants could not be determined.

I had heard before that the instrument was not reliable. There is (or was) one on the east pier, Kingstown, Co. Dublin, and I remember one day being in it while the attendant was changing the paper, and I looked at the registered velocity and found it differed greatly from my experience a few hours before while cruising in a small yacht within a quarter of a mile of the instrument, although the breeze was fairly steady.

Would "F.R.A.S." kindly inform me where I can get the Appendix I. to the "Washington Observations for 1885," containing Mr. Winterhalter's descriptions of the European observatories, referred to in letter 31778, and the probable cost? **J. A. F.**

### ASBESTOS WATER-TAP.

[31980.]—A few weeks ago the "E. M." had an account of a valve for steam with an asbestos seating—a perfect kind of thing, as far as it goes; but there is a larger field open for common water taps, if asbestos could be used, or anything to supersede the old rubber valve which is now used screwed down on a sharp jagged brass edge, and becomes cut in a few hours. Again, the four little screws, which always strip their threads, are a mistake in these taps. Day after day these water-taps call for the plumber, and who does not know something of this calamity? Asbestos, assert thyself! **Wm. Hosken.**

### SPEECH OF LOWER ANIMALS, &c.—AUTOMATIC ORGANS.

[31981.]—I am sorry to inform S. B. Kincaid (letter 31964) that my phonograph is only a tinfoil one, and not sufficiently delicate to make the experiment he suggests. I too am very desirous of trying the effect of super-posing two or more separate records (such as the successive notes of a full chord) in order to hear what would be the effect of the combined vibrations. Again, if a note was sounded for say one second, would the impression show the number of "dots" that a string would give vibrations, or any definite multiple of this number?

As regards "Accoucheur's" request, I have sent the Editor the first instalment of my promised letters and sketches, and I hope before they are completed to give the querist full details, such as he requires. **A. S. L.**

[31982.]—In reply to letter 31964, I would say that I read with interest Mr. Sidney Bolton Kincaid's letter on the above subject. The principle he would adopt is, of course, theoretically correct, though I doubt the practicability of the method, as I fear the necessarily resulting delicate impressions and the roughness of the recording substance, together with other obstacles, such as noises caused by other motions of the body, would quite disguise the desired result. I think there can be little doubt but that many animals utter sounds unheard by the human ear, and in the case of small insects, it would be anticipated that the sounds would be of high pitch, from the fact that the organs producing and receiving them must be small.

"A. S. L.," who writes on this subject, cannot have experimented with a phonograph, otherwise he would know from experience what he ought to see from theory, that the rate of vibration of the diaphragm—that is, the pitch of the sound—will depend on the rate at which the cylinder is turned, and that, therefore, the means proposed by "S. B. K." are, theoretically, quite correct, and that the sounds originally imprinting the cylinder will be exactly reproduced, differing only in pitch and duration. I may add that I made a phonograph twelve years ago, and one of the earliest experiences was this change of pitch, due to change of velocity of cylinder. The idea of "S. B. K." has occurred to myself; but I have not had sufficient hopes of a good result to induce me to give it a trial. **A. R. Molison.**

### STUDENT'S MICROSCOPE.—TO "ORDERIC VITAL."

[31983.]—When I have found the originals, or can find time to make fresh ones, I shall be pleased to send figured details of the student's microscope that has already appeared, also of a modified pattern. If I could only do for the *brass-work* what "Orderic Vital" has done for *glass-work*, I should hope the information might prove as useful. **A. S. Lukin.**

### IODINE.

[31984.]—Perhaps it would be right to add to what has already been mentioned in letter 31925 that the preparation of iodide of nitrogen is not unattended with danger. It explodes with great violence even when damp or wet; but when dry a slight shock will bring about the explosion. Unfortunately, the kelp industry has been in a great measure ruined by the enormous shipments of iodine from the Atacama Desert in Chili; the gatherers of the seaweed and burners only being able to make anything because the price is kept up by a "ring." Already there are signs that the said ring may break down again and the price of iodine fall to one-half. The supply of iodine from Chili is beyond the demand at the present time. After the iodine has been removed, then the bromine is set free and distilled off. Here, again, the kelp-burner meets with an opponent in the supply of bromine from North America. The supply of potash salts from Strassfurt has been another blow to the kelp-burners, whose calling appears likely to shortly become a matter of history. **Inca.**

### ETHER AND ELECRICITY—TO PROF. H. A. ROWLAND.

[31985.]—The following is an extract from a lecture delivered by Prof. H. A. Rowland on May 22, 1889, before the American Institute of Electrical Engineers:

"I have recently solved the mathematical problem of the electric oscillation along a *perfectly* conducting wire joining two *infinite* and *perfectly* conducting planes parallel to each other, and find that there is no definite time of oscillation, but that the system is capable of vibrating in any time in which it was originally started."

I came across the above in your issue of June 28, 1889, and have been looking through back numbers for further information, but without success.

If this should meet the eye of Prof. Rowland, would it be asking too much of him to give your readers the process by which this problem was solved? I have been very much interested in the ether discussion, and (in case you, Mr. Editor, may feel somewhat tired of giving the subject more space) wish I had come across the report of Prof. Rowland's lecture before. **E. P.**

### THE ETHER AND "SIGMA."

[31986.]—I have read with much interest the letters of "Sigma" on the Ether—the more especially as electricians are now beginning to adopt the "Ether Theory of Electricity" I published in 1839. "Sigma" is right in much that he has written against some modern fanciful notions about the ether; but I am sorry to see that he has prefaced his own intended remarks on it by an attack on the Westminster Standards and God's creation works. "Sigma" writes: "The writers of the Westminster Confession chose to state, as a fact, what they had no possible means of knowing anything at all about: they asserted that 'it pleased God to create, or make out of nothing, all things.' St. Paul, or whoever wrote the Epistle to the Hebrews, only said that 'things which are seen were not made of things which do appear.'"

In this paragraph both the Westminster Standards and the text quoted are misused. The proof texts to the passage of the Standards above quoted direct the reader's attention to the whole of the first chapter of Genesis in corroboration of the fact that the word of God is the authority for the statement, and not an opinion of the writers of the Standards, as asserted by "Sigma." The words, "it pleased God to make, or create of nothing, all things," are a mere commonplace explanation of the word "created," as used in the first verse of Genesis—"In the beginning God created the heaven and the earth." The word "created" here used by God means to make out of nothing; but "Sigma" does not see this, for his expressed opinion is to the effect that God made matter out of something which had existed before, which is an opinion that the Almighty is no more than an ordinary mechanic making things out of things that existed before. The writers of the "Westminster Standards" give another text which "Sigma" has not quoted—namely, "By the word of the Lord were the heavens made; and all the host of them by the breath of his mouth" (Psalms xxxiii. 6). And when translated as it stands in the Hebrew, it is:—"By the word of Jehovah the heavens were made, and, by the spirit of his mouth, all their host." The text is a Hebraism—that is to say, it is an assertion made twice in slightly different words. The two assertions, put together, mean that the heavens were made by the power of God's voice, which is just an act of creation. It is remarkable that the text which "Sigma" did partially quote contains the above declaration. The full text is, "Through faith we understand that the worlds were framed by the word of God, so that things which are seen were not made of things which do appear" (Heb. xi. 3). It is this faith in the power of God's word or voice as a creating power which "Sigma" does not wish to exercise.

James Johnstone.

8, Merchiston-park, Edinburgh, Jan. 5.

## TO MR. BLACKBURN, M. CH. RABACHE, AND "EOS."

[31987.]—On page 379, M. Charles Rabache addresses to me a series of ten questions, not in order to gain information, but merely because he wants to turn any reply I may make into paradox. The only question of the set which really raises any interesting point is No. 5. It is certainly curious that two gases which have so great an affinity for each other as oxygen and hydrogen may be kept mixed for an indefinite period without combining, and if M. Rabache has any resonable theory on this point, I will be glad to consider it. No. 7, in which he compares a large number of slightly different values obtained by different experimenters as to the heat of combustion of hydrogen gas, is a good example of the dodges of a paradoxist. Apparently M. Rabache has never heard of such a thing as experimental error. Is he aware that such a simple thing as the solubility of a salt cannot be determined with sufficient accuracy to meet the requirements of the calculus of finite differences? Why did he never reply to my criticism of his colour theory a few weeks ago?

There have been very few truer statements made in the "E. M." than that on page 382 by Mr. D. Blackburn as to the rarity of an accurate observer. He is, indeed, one of the rarest animals in existence, and thus general lack of the power of observing correctly is a great aid to the professors of mesmerism, clairvoyance, hypnotism, and other quackery. I am rather surprised to find "Eos," page 402, giving a description of the method of preparing the so-called tri-iodide of nitrogen, which substance he terms an "amusing curiosity." It is a very dangerous substance, so dangerous in fact that its real formula is unknown, as chemists are shy of dealing with it. In all probability it contains hydrogen, and is a partially substituted derivative of ammonia. On no account should its preparation be attempted by inexperienced persons.

Wm. John Grey, F.C.S.,

Newcastle-on-Tyne. Analytical Chemist.

## REMEDY FOR IN-GROWING TOE-NAILS.

[31988.]—If "Nun. Dor." (letter 31932) will try the following remedy I think he will find it very beneficial, viz.:—Cut the nails straight across, and not round, as you would your finger-nails. At the sides, where they grow into the flesh, do not pare them thin; but, if possible, get under them and cut them straight out to the end, and they will very soon grow strong, and cease growing into the flesh.

Little Toe.

## A CURIOSITY.

[31989.]—Perhaps the following note may be of interest:—About ten days ago, whilst some men were sawing into planks a large log of beech, at Messrs. R. Bealey and Co.'s bleach and chemical works, Radcliffe, the said beech-tree having been grown in Shropshire, they cut across a circular hole 5½in. long and 1in. diameter. One end of the hole was 3½in. distant from the outside of the tree, the other end of the hole being about 4in. from the centre of the log. Whilst turning over the cut pieces of log, a brown-coloured powder fell out of these holes, and, wonderful to say, two live insects. In size and appearance they were very much like wasps, though, from the shape of their head, very narrow wings, and thick body, I am inclined to think they are altogether different. A most careful and minute examination was made round the hole to discover an inlet or outlet, but to no purpose—not even an air-hole. All round was sound, solid wood, and evidently they must have been in this tree many years. Although alive, they appear to be in a kind of sleep. If brought near to a fire, after a while they begin to crawl about; they cannot fly.

I may also mention that an iron bolt, 3in. long by ½in. diameter, was discovered in the centre of the same tree, and lying parallel to the tree's length.

Perhaps some reader may have met with similar phenomena, or could account for same. I am inclined to think the bolt has been shot into the tree when quite young, and then the wood grown round and inclosed it; the same with the insects.

John J. Barlow, Analyst.

Whitefield, Jan. 10.

## THE VIOLET-COLOURED FLAME PRODUCED BY THROWING SALT INTO THE FIRE.

[31990.]—I cannot think that Mr. A. Percy Smith (letter 31955, p. 422) has so completely settled this question as he seems to imagine. Although the effect may be produced by sprinkling salt upon glowing coals, most persons are aware that it is best shown when a clear glowing cinder or coke fire is used. This contains no hydrogen, and cannot, therefore, supply the necessary component for the production of HCl by combination with the disassociated chlorine, as your correspondent states. It may be quite true that his experiments gave him the characteristic flame; but the conclusion at which he has himself arrived, that they prove the spectrum to be due to HCl will not, I think, be so convincing to most minds. He acknowledges that this spectrum does not agree with that of a spark in hydrochloric acid gas, which one would expect it should do, if both were identical. These are difficulties which present themselves to my mind in accepting Mr. A. P. Smith's conclusions; but surely with the aid of such an efficient instrument as the spectroscope, what seems to be so simple a matter might be speedily set at rest.

W. T. N.

## ORGANETTES.

[31991.]—In compliance with the courteous request of the Editor, I propose to describe the construction of some of the many varieties of automatic musical instruments that may be classed under the general name of "Organettes," though the name itself has been applied to instruments of many different kinds. I only include, however, those which employ perforated bands (or discs) of paper or other material to the exclusion of barrel organs, "roller organs," &c., where the action is produced by pins or raised projections.

It will save time if I refer first to general principles of construction applicable, more or less, to all the varieties, and then give the special details in connection with the separate instruments described.

There are two classes of these organettes, one on the harmonium principle with pressure wind, and the other made like American organs on the suction principle (if I may use the term), and these are again divided into those with pallet-valves to control the admission of air to the reeds, and those in which the perforated band acts as the valve.

In certain cases both these latter may be said to be combined, as in some of the varieties (especially large instruments) the "tune-band" merely controls the wind that actuates a "pneumatic" arrangement, which latter works the actual pallets in the wind-chest.

The first instrument (and the only one of its kind) made was a pipe organ, which had a perforated band acting as the valve, but it proved a failure owing to the disagreeable droning effect produced by the want of promptness in the admission and cut-off of the wind from the pipes. How this can be avoided will be described later on. This was in 1849 or 1850, and some years later I myself repeated the experiment, but used reeds (those of a concertina) in lieu of pipes. The experiment succeeded, but it was not till the Mathews patents were commercially worked that anything further was done.

Now the child's toy has developed into larger instruments producing remarkably good musical effects, considering the mechanical method by which they are produced. I may add here that in those made also with keys, the air may be played automatically and accompanied by a performer on the keyboard.

Coming now to constructive details, the first question is as to the scale to be employed, as this is independent of the mode of playing to be adopted. Taking a moderate-sized instrument of the smaller kind, we may take, say, three octaves as the compass, and consider how best to arrange it. If we used the diatonic scale we should only require 25 notes; if the chromatic scale, 37 would be needed. In all the smaller instruments (and in some of the larger ones) a compromise is made, usually by substituting one or two semitones for naturals, so as to obtain greater variety without increasing the actual number of notes. It is also found better to introduce a few notes of a lower octave in order to strengthen the bass and the chords of the tunes.

Every maker seems to employ a different scale, and I therefore give a few that I have met with for the intending constructor to choose from. I should suppose that the diatonic scale with the F sharps and B flats inserted would be as good as any other non-chromatic arrangement.

As regards actual number of notes, the fewest I have seen has been 13, with 4½ octaves as the other extreme. Scales:

For 17 notes—
Bfl. C D Efl. E F Fsh. G Afl. A Bfl. C D Efl. F
Fsh. G.

For 20 notes—
D Fsh. G A B C Csh. D E Fsh. G Gsh. A B C Csh.
D E Fsh. G.

For 24 notes—
Ash. Csh. Dsh. F Ash. C D Dsh. E F G Gsh. A Ash.
C D Dsh. E F Gsh. Csh. A Ash. C.

For 28 notes—
A B D E Fsh. G Gsh. A B C Csh. D Dsh. E Fsh.
G Gsh. A B C Csh. D Dsh. E Fsh. G Gsh. A.

For 35 notes—
The scale resembles that for 24 notes, but carried
an octave lower.

For the 4 to 4½ octaves the arrangement is chromatic in the main, with the introduction of extra notes from lower or higher octaves (or both) to increase the compass. Any portion of the bass or treble notes can of course be used, but in small instruments (in which the wind is supplied by turning a handle) it will be found advisable not to extend the scale far downwards, as big reeds require big bellows to supply them.

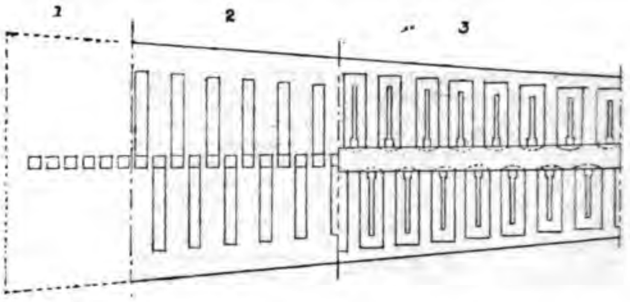
The next point is, What should be the width of the tune-band?—and as to this there is a practical difficulty with wide bands, owing to their tendency to run unevenly, and to then hitch and get torn. The widest I have myself tried has been about 14in.; but 9in. or 10in. is preferable. If, on the other hand, we try to crowd in too many reeds (and therefore perforations), we cannot make the perforations large enough for the reeds to sound properly when the band is used as the valve. The perforations are also apt to tear into each other.

The best way is to put the reeds zigzag in two rows, and this is the arrangement shown (see Figs. 1, 2, and 3, where 1 shows perforations only, 2 shows in addition the channels over which the reeds are fixed, 3 shows the reeds in place). In this instance the holes are about ¼in. wide, with ⅛in. between them; the channels are also ¼in. wide, and the reeds (frames) are bare ½in. This would make the width of the tune-band for the proposed 25 notes about 9½in. wide, or allowing a small margin at the edges, say 10in. I have, however, seen 32 reeds in only about 7in. width; but the arrangement would be a difficult one for an amateur. The intermediate spaces were only $\frac{1}{20}$in. wide, and the reed tubes (or cells) were only $\frac{2}{10}$in. wide, the perforated portion being made of polished brass.

In other arrangements to be described it will be shown how best to reduce the width of the tune-band by altering the interior mechanism.

To traverse the tune-band I have seen three arrangements. In one the motion was by a small toothed wheel working in a line of small holes up the middle of the band, and acting intermittently only. In all others the band has been moved forward by either a pair of gripping rollers, or by being wound off one reel on to another. In some French instruments the band is folded up "zigzag," and the instrument always leaves it neatly folded up into a kind of book, ready for use again.

When wound on to a roller it is obviously necessary to unwind the band before the tune can be repeated. Provisions for doing this is made in the instrument itself, which re-rolls it also on the first



Vith gripping rollers the band may be, if , an endless one, allowing the tune to be without the band being removed and

For long bands made of thin paper the on a roller is the best, but for short thick e gripping rollers (with or without the rrangement) answer well.

organette with tune *discs*, repetition in- f course nothing but to continue the of the disc, but as hitherto constructed, the xtremely monotonous. Perhaps if a suc- f discs could be connected up into a kind rkscrew, this might be remedied and longer ayed.

we must decide on the size of the bellows

At first one would think "the bigger the but it is not so, for if too large it will be at when only a few reeds are sounding they ver-blown, and more or less out of tune. e contrary, the supply is insufficient, the eeds and chords become unsteady and s. The difficulty can't be altogether met, other details) we must compromise, and way is to use moderate-size "feeders," but arge reservoir. Actual sizes will be given ifferent patterns to be described in detail.

A. S. L.

(*To be continued.*)

## DRY BATTERIES.

.]—These batteries (letter 31934), seem to good point about them—namely, a good . All the difference between Mr. Alf. E. inion of them and my own can be summed e very little word "if." If these batteries, linary care, act and endure as he states, certainly preferable to the Leclanché, even ost a little more, because they have several ted points in their favour, as I pointed out I have never yet met with a perfect battery kind, though I have probably handled a variety of them than any reader of this note. ries are simply a compromise of good and lities, arrived at in a hundred different The most appreciated on the whole is that ves the least trouble. They have all proved ry useful servants—Volta's children brought fferent nurses.

A. Caplatzi.

## TS FOR EXPERIMENTALISTS.

3.]—The writer proposes to communicate, ies of short letters, some ideas that were y noted by him with a view to private ation. Circumstances now render it unlikely will be at leisure to pursue such inquiries iments, and it is hoped that others may find something novel and suggestive.

has been written and attempted in the colour photography, two distinct lines rch having been followed. One of these investigation directed to the discovery of a surface, such that rays of light of any alling upon it may induce permanent local ns, involving the reflection of similar rays nd the other to the productions of surface , by ordinary polychromic printing pro- o yield pictures in pigments of the colours amera image.

ess to say that success has not been attained, ect of this letter being merely to explain e may call a temporary expedient, and one d applicability, by which, however, certain istic results can be obtained.

are various modes by which this process e carried out, but it will be enough at the to describe one which was used by the n 1886.

dscape negative (foliage, water, rocks, &c.) ratched at one corner with "register ' and a succession of prints were made from surfaces of bichromatised gum-arabic, as d by Abury ("Ins. in Phot." p. 178). The this series of transfer prints was fully , the next less so, and so on to the last, eceived very short exposure, and they were sferred to stone. There was no stopping hand, but suitable colours were selected for impressions.

irst, or that which had resulted from the exposure, was rolled up in a very light green, and first printed; the next of the showing less of the picture, was printed de darker, and yellower green; and so on, a very dark brown, appearing only in the shadows. Now in this chromolithograph ms that there was more or less imitation of colours, but that is not a necessary condi- securing richly artistic effects: by thus ng with a conventional scheme of colours ate accuracy of a photographic print.

ose that we operate with the photo-negative ple sphere—say of a billiard ball. Let some f good taste be used in the regulation of the , and afterwards in the solution of printing d we shall obtain very pleasing results.

n modify the process by multiplication of s, and we can differentiate them, not merely by regulation of the exposures, but by the use of artificial lights of different colours, or by directing a white light upon the objects to be photographed from a different position in taking each negative.

Those familiar with the effects of Southern latitudes need not be told that the sun, in its daily travels, furnishes conditions of light and shadow, by means of which series of slightly different landscape negatives can be made, each negative adapted to emphasise, under proper conditions of printing, particular parts of the picture that are adapted to special colouring.

In clear climates also it is possible, at sunrise or sunset, almost any day, to produce within ten minutes' time a series of cloud, or even of landscape negatives, adapted to render, by simple printing processes, a most attractive coloured picture. In this case the negatives are varied so as to fulfil their special functions in printing, because of those rapid changes of colour which occur while the clouds, &c., remain sufficiently stationary.

Of course, with other transfer process more suited to bring out detail, better results would be attainable, and it need not be remarked that such methods are adapted also to the production of transparencies and lantern slides.

Some other modifications, which might be experimented upon, must be reserved for another communication.

A. D.

## PRE-MARRIAGE COMMUNISM.

[31994.]—As I am pretty nigh the end of my tether in regard to the seeing of lunar detail with my little 3·5in. telescope, power 100, and as I am not likely to be able to get a larger one, I think of turning my attention, during odd hours of an evening, to the investigation of an important anthropological matter, for which this locality offers exceptional opportunities. I write this in the hope that anthropological readers of the "E.M." can assist me.

On looking over Dr. E. B. Tyler's address to the Anthropological Society for January 1881, I see at p. 13 that he refers to the work done by M'Lennan, Lubbock, and Morgan, as to how primitive society was developed, and refers to the unsettled state of the question *in re* the transition from communal marriage to the stage where the man has a private right in one woman (say due to capture). Now out here most of the savage and semi-savage races have a peculiar institution, which, it seems to me, if studied, may yield a clue. It is, that the lads and unmarried young men are, as a rule, not allowed to sleep at home, but live more or less in barracks, which among "head-hunters" are often guard-houses at the entrances to their perched villages. Among many tribes the single girls also sleep away from home in similar barracks, and, like the young men, are under old and peculiar laws. Asamese call these houses "Morongs." Among all races having this institution, there is unrestrained liberty between the sexes until marriage, after which they are very strict, and infidelity is rare. On looking over my Royal Geographical Society *Journals* for the last twelve years, I see that this peculiar custom ranges from Central India (Chota Nagpur), among the savage tribes around Asam, down the Malay peninsula, viâ Sumatra, Borneo, New Guinea, and the islands as far east as Formosa. It is seen among races either now or till lately head-hunters, and who, as a rule, whether on plains or hills, build their houses, often 300ft. long, on piles, and containing associated families who tattoo (for heads), and who, I find, have ten or twelve customs and arts in common. For some sixteen or twenty years I have felt almost certain that our savage head-hunting Nogas, inhabiting the hills S. and S.E. of Asam, are almost identical with Dyaks (of Borneo), and latterly I see that the idea is gaining ground that the races of the Archipelago are related to the Dravidian and Somali, the Mincopies being a sub-branch. If I mistake not, the stock is what Prof. Huxley calls the "Austro-Mongoloid."

What I want to know is, how far this question has been worked out, and where I shall find the results, if possible in one work, and not an expensive one. In the library of the Asiatic Society of Bengal, to which I belong, I find few books which will help me, and am thus on my beam-ends.

The peculiar institution of "barracks for the unmarried," is one of the many proofs that all these head-hunting, pile-building, tattooing, and fuming races are from a common stock. The custom must be very old, one which preceded their dispersion; it is also one which seems to have preceded the institution of "marriage" among them all. In some cases the evidence is clear that the last stage is the endogamous marriage, and that it was preceded by exogamy, or marriage (presumably by capture) out of the tribe, and that the oldest stage is represented by the "Morongs," where, within the tribe, there was regulated sexual communism.

In one tribe of Nogas, whom I have known well for the last twenty years, we see all the three stages at once in operation. The common folk are endogamous; but the chiefs, who are great at etiquette and "custom," are strictly exogamous, and go through a a mimic "capture," on their little frontier during the marriage ceremony.

But the "Morong" steadily underlies them both, and the laws relating thereto are like those of the Medes and Persians. Unfortunately, travellers in New Guinea, Borneo, and elsewhere, allude quite casually to the unmarried barracks, and do not seem to have realised the importance of this feature as giving a clue to the past social stages. D'Albertis, in the 2nd vol. "New Guinea," refers to them but once, where a headless corpse having been recovered, was taken to the house of the young unmarried men." Mr. W. H. P. Driver alludes to them more directly —*in re* Chota Nagpur—as "the bachelors' halls," before which the unmarried girls dance of an evening, but dare not enter, being, as among other races, *tabu to women* (of their tribe). Most travellers, as far as I can yet see, refer to it as simply "a peculiar custom."

In one large Noga village east of me, there are eleven Morougs for the young men, and three for the girls. Asamese call them "Morougs," which is their Miri name. The Abors call them Mosup; Nogas' call them Pak, Arizu, and other names, the "Dupus" of New Guinea. They generally contain the long canoe-shaped war drums, and are the council houses. The skulls of enemies, or those surprised, are placed in them in rows—men, women, and children. I have counted 300 in one house, which had three fresh heads stuck on stakes out-side, the hands tied below like a pair of gloves—a ghastly sight. Among the more civilised of the aboriginal races, the houses of the married people seem in the ascendant, and the barracks on the decline, as among Miris, &c., where at times they are (now) not found in some village. Among Nogas and head-hunters they are of more importance, being generally guard-houses. In other cases, as in New Guinea, on the Fly river, they are the main buildings, the married quarters being a series of semi-detached houses, all alongside the "Dupee," and joined thereto by bridges. In other cases again, we see but one long house, with a long central partition dividing the young men's public, or common hall, from the series of rooms sacred to the different married couples, all related.

Again a still more primitive form is the one large room divided by a light screen, all the males being on one side, and *all* the women on the other.

The subject needs careful systematic study *in situ*, and hence my desire to resume it; but I am sadly in want of books, and don't know how far it has been worked out. If any reader of "ours" can in any way assist me, I shall be very much obliged.

For the last ten or twelve years the moon has quite collapsed my anthropology, and now I hope to begin on it anew. Whether the readers of "Ours" would care for any notes on this question I cannot say; we get very little as a rule.

December 10th, 1890.

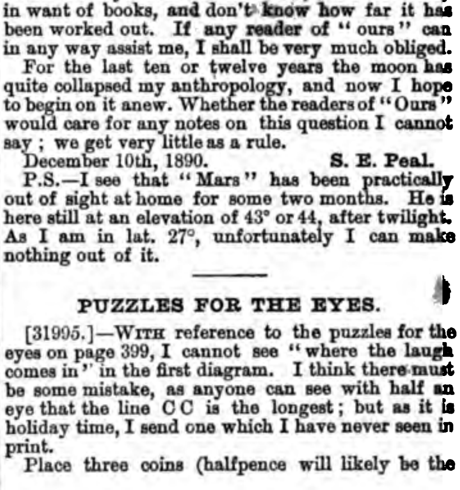
S. E. Peal.

P.S.—I see that "Mars" has been practically out of sight at home for some two months. He is here still at an elevation of 43° or 44, after twilight. As I am in lat. 27°, unfortunately I can make nothing out of it.

## PUZZLES FOR THE EYES.

[31995.]—With reference to the puzzles for the eyes on page 399, I cannot see "where the laugh comes in" in the first diagram. I think there must be some mistake, as anyone can see with half an eye that the line C C is the longest; but as it is holiday time, I send one which I have never seen in print.

Place three coins (halfpence will likely be the most plentiful—they are with me at any rate), A B C, in a straight line close together; then move B up perpendicularly until you judge the distance D D to be equal to E E; then measure, and see how far you are wrong. Nineteen out of twenty will only put it about half or two-thirds the right distance. Query: Wherein does the deception lie?



The deception is not so apparent in a diagram unless you make solid black A and C and the upper B, which makes me think it is because two-thirds of the distance E E is covered up.

Wishing our inestimable "E. M." and yourself personally, and all its readers, a Happy and Prosperous New Year.

Jarrow-on-Tyne. H. B.

### CONTRACTION BY DAMP.

[31996.]—It should be remembered that a string on a violin is under great tension. When it is damped it becomes soft, and therefore is more easily stretched. There is no connection between this circumstance and the shortening of a hempen string by absorption of moisture. The paradox exists only in "Caldemone's" imagination.

Sm.

## REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[72685.]—**Yew.**—I can quite endorse what Mr. Ellison says about the beauty of this wood. We cut a tree down at Stamford-hill, where there was a row concealing the approach to a structure in the corner of the garden of the house, with an alarm bell on the top, standing, as now, on the top of the said hill. In the year 1841 I used a portion of the wood to make the sides of the original fishing-winch, with revolving plate in lieu of a crank, and with a conical instead of a knobbed handle, which was designed by my father, and by him submitted to Alfred, the tackle-maker, then of Coleman-street, City; and he, I believe, sent it off to Scotland, and had some made to it in brass. I subsequently, on going to King's College in 1841, made a brass one for my father, and when I lost his old one that he had given me in exchange, I made another, which I have now, with date 1845 stamped on it. All the world uses them now. As to yew bows, I do not know much; but my belief is, that "self" bows are made of the long, slender branches, with a portion of the sapwood, which looks like lancewood or box, left along the back of the bow, imitated, in less expensive goods, by a strip of lancewood glued to a belly of yew or other wood, the kind of which does not appear to be very material. J. K. P.

[72951.]—**Pidgeon English.**—I cannot quite agree with Mr. N. Edwards-Robson as to the spelling of "Pigeon English." Certainly my experience in the East inclines me to give "Pidjin" as the more correct method. I cannot imagine the common term "Joss-pidjin" being spelt otherwise by a Chinaman or Japanese, or, I think, by an Englishman out in the Eastern seaports. Pidjin English is the nearest approach to a universal language that we have. It is used by nearly all nations in all the ports of the "East." I have heard Chinamen and Japanese and Malays use it amongst themselves, and I have been told that Chinamen from different parts of the "Celestial" Empire use it in preference to Chinese when their respective dialects differ too greatly. The number of English words are far in excess to those of Portuguese or Chinese origin, though a certain amount of all three go to make up a sentence as a rule. For instance, if you wished to say to your boy, "Now look sharp, do you hear?" you would say, "Makee walkee chop chop, savvy?" Of grammar I should say there was none. One might describe it as baby-English, with a number of Portuguese and Chinese words thrown in.

Acir.

[72960.]—**Equation.**—To "Assoc.N.S.S."—Let us try again. Take a mixture of

$$\begin{array}{lll} KCl = & \cdot 7471 & \\ NaCl = & \cdot 5836 & \text{Convert into sulphates} \\ & \overline{1\cdot 3307} & \\ = K_2SO_4 & \cdot 8695 & \\ \phantom{=} Na_2SO_4 & \cdot 7090 & \text{Work by your equation.} \\ & \overline{1\cdot 5785} & \end{array}$$

$$x = \frac{3\cdot 084 \times 1\cdot 3307 - 2\cdot 538 \times 1\cdot 5785}{\cdot 225} = 43\cdot 42$$

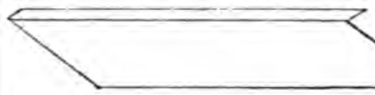
$$y = -\frac{2\cdot 227 \times 1\cdot 3307 - 1\cdot 906 \times 1\cdot 5785}{\cdot 225} = 20\cdot 04$$

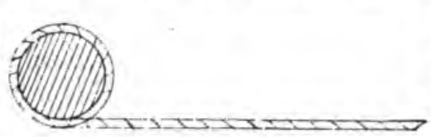
whereas K taken = 39·04, and Na 22·99. How do you account for this? Q.

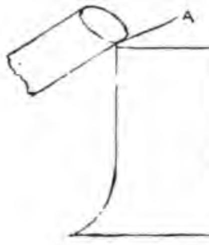
[73032.]—**Telegraph Line.**—It is rather difficult to give a direct answer to this question, as so much depends upon the conditions under which the tests are taken. Say they are taken on a wet day, the "earths" will make good contact, offering no appreciable resistance, and the insulation resistance will be lower; therefore, the total resistance of the line will read lower than when tested before erection. If on a fine, dry day, the "earths" will offer a slightly higher resistance, and the insulation resistance being higher—i.e., less leakage at the poles—the line will show a higher resistance than it did on the wet day; but, I should say, a trifle less than when tested in factory. Theoretically, with perfect "earths" and insulation, the resistance should be the same before and after erection; but, practically, this is impossible. Perhaps Mr. Allsop or Mr. Bottone will give an explanation.

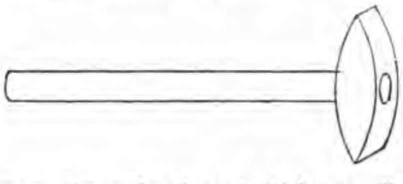
Hy. Wilson.

[73021.]—**Tin and Steel Iron-work, to Flange.**—Such work as "T.H." wishes to perform can only be done properly by an experienced sheet-metal worker; but if he wishes to persevere with it, I shall be happy to give him what assistance I can. To "wire" a pan with ½in. rod he must first edge sheet over in the flat as shown; of course taking care to get the edge sufficiently large to wrap around the rod. Now place the rod in, and knock edge down with mallet, and tuck with hammer as shown. It now remains to be bent round; this is best done by running it through tinman's rolls; but if you haven't access to a set, it is easily bent over a stout piece of wood, taking care you do not crack the "wiring." To flange a pipe elbow you require a "stretching" hammer and an anvil, or other iron block. As the distance round the outside of flange is greater than round the inside, you will readily see it is necessary that the outside should be hammered or stretched. Place your pipe on anvil as shown; hammer at A, revolving gradually as you hit it. In flanging bright work you must always use an anvil, or block, with a bright face. I inclose sketch of "stretching" hammer. With a little care, practice, and patience, I think you will get over the difficulty. E. A. A.









[73037.]—**Wood, to Slice.**—I know all about the ordinary microtomes. I want to make very thin and perfect slices of different woods across the grain about 1in. in diameter. Those I have seen are beautifully done. If "M. P." or any other reader can tell me how to do it, I shall be obliged.

Xylem.

[73097.]—**Greenhouse Construction.**—In the little manual on "Greenhouses" there is an illustration of a small house such as is required by "Glasshouse." It was built by an amateur who could handle tools. Full particulars of measurements, materials, and cost are given, besides several intelligible plates and diagrams—all for sixpence! There is an account also of the flowers grown therein, besides a calendar of operations for the whole year. The sooner "Glasshouse" gets this guide, the better it will be for his time and his purse.

Eos.

[73099.]—**Wheel-Grease.**—Cannot "Works Manager" experiment himself with his dirty oil? He seems rather helpless for a "manager," as he must know better than those who have not "felt" the oil what it can be used for. Let him filter it through canvas or calico, or something that will retain the more dirty particles, and then, if necessary, wash it with steam. Then, if boiled with a little potash and quicklime, he may obtain a grease which will do well enough for spur-wheels or coarse bearings. Oil that drips from heavy bearings is, as a rule, full of dust and particles of metal, which it is desirable to remove before using it as "grease." Nun. Dor.

[73106.]—**Mechanical Similitude.**—On line 9, "a speed of 0·4 knot, or 40ft. a minute," should be, of course, altered to "a speed of 0·8 knot, or 80ft. a minute." This does not affect the subsequent figures, which are given in round numbers.

A. G. Greenhill.

[73109.]—**Horse of the Future.**—This is a misleading title. There are plenty of machines of the kind described so indefinitely to be found (on paper) in the "E.M.," the old *Mechanics' Magazine*, and other papers. There are very few which have run 100 miles on ordinary roads, either in this country or in America. There is no secret about petroleum engines: the difficulty is to get them to work well when you have succeeded in starting them. If I were a sporting man, I would back Hutchens to run against any petro-cycle or steam-cycle yet devised for any distance, both starting on same line. Nun. Dor.

[73113.]—**Electric Ignition.**—Electric ignition is accomplished by passing a spark through the mixture of gases or vapours; but how it is to be arranged depends mainly on the design of the petroleum-engine. Surely we should have some idea of the arrangements in question before being asked to fit it with what is only a detail. If I recollect, Lebon and Lenoir's gas-engines were "fired" by an electric spark, and I think in back volumes I have seen other devices for utilising the "spark" as the firing medium; but some little "invention" is required, and the querist may get inspiration on the subject from Robinson's "Gas and Petroleum Engines," published by Spon; or from Clark's "Gas-Engine," published by Longmans.

Nun. Dor.

[73118.]—**Blackening Zinc Surface.**—I have just examined a large salver of 78in. diameter in Biddery ware, which has been in daily use for ten years. Not one particle of the black ground has worn off, though boiling water, hot tea and coffee, milk, beer, and spirituous liquors have been frequently spilled on it; add to this the daily rubbing by servants. The elaborate gold and silver raised Arabesque designs are bright as ever. It is the highest class of that metallic art, and was very expensive. The common kind of this work is cheap, and perishable by use. Eos.

[73122.]—**Composition of Gas.**—I think the information required might be found; but it would need much laborious research. In Newbigging's "Gas Manager's Handbook" there is a table of the analysis of various coal-gases, which will rather surprise some, for carbon dioxide varies from ·23 to 20·86, and cubic centimètres of gas from 100 grammes of coal from 24·4 to 238—those figures from the gas obtained by treating samples of different coals in the laboratory. They will serve to show the querist that it is not easy to answer his question. Letheby's table, published in 1866, will give the average composition of London gas; and in Crew's "Treatise on Petroleum" (Sampson Low) much information will be found, as also in some of the works on gas-engines. Nun. Dor.

[73130.]—**Steam Launch.**—If the launch cannot be got out of the water, how is the bottom to be repaired? Probably sheathing with zinc would suffice, but it should be done all over the immersed hull—"felted and sheathed," in fact.

Mortlake.

[73137.]—**Portable Mineral-Oil Stove.**—There are several of these in the market; but whether there is one which answers to all the requirements of the querist may be doubted. For instance, the flame is to be adjustable, and yet the stove is to be "absolutely free from all smell and smoke." Anyone who can construct such a stove as "R. H. P." wants, will surely protect it by letters patent.

Petros.

[73139.]—**Canoe.**—The centre-board is usually fitted in a frame about the centre of the length of the canoe or boat. There are several designs in back volumes—one in May 31, 1878—and no doubt many others; but the best place to look, I fancy, would be Kemp's book, published, I believe, at the *Field* office. W. Man.

[73140.]—**Wires for Mechanical Telephones.**—Certainly bronze wire or the silicon bronze will do for mechanical telephones; but as to its durability in any position, that is a matter for practical testing.

S. P.

[73160.]—**Gas-Engine.**—The method of tube-firing is described fully in the textbooks and in specifications of patents. The principles will be found in Clerk's "Gas-Engine," with several illustrations; but briefly, it consists in a gas-jet burning in a tube, which ignites the explosive mixture as the valve moves, so as to admit of a connection. There is nothing very special about it.

Nun. Dor.

2.] — **Indian Jugglery.** — I can assure . G." that no occult forces are required to ı the feat of raising a heavy man on the of the forefinger, as mentioned by D. ırn. I have frequently assisted in per- ; it myself; only as we were not able to n Oriental fashion, one of the performers lie on his back across three chairs in such a ı that two could put their forefingers on the ıf his shoulder-blades, the other two about ddle of the thighs, when all taking a deep the prostrate one is raised most easily to the of the shoulder. Although we frequently we found that the fore-finger of the right ʼas the only one with which we could accom- . Another feat we used to perform. A man his back across three chairs so placed that e back of his head rested on the edge of one, heels on the other. On taking a very deep he could raise his body so that the middle ould be removed, and he could then sustain ight of a moderate-sized man sitting on his h for a few seconds, or as long as he could s breath. A. D.

2.] — **Frightening Birds.** — "Remo" ake my word for it the wind-clapper is of at all for the job. I have made many ı, and seen birds at the bottom of the pole . Now old Jack Hodge's boy will serve the e better than a cartload of windmills; but if ll think of going on with one, I will send a J. VINICOMBE.

54.]—**Electric Railway.**—To MR. BOTTONE SKEW."—Yes, you could make the engine 3in. on the same lines; but, of course, the trac- ower would be proportionally less. The t can be suppled by a battery, or batteries, h the rails (which must be insulated from one r), and picked up by brushes on the engine. S. BOTTONE.

54.]—**Electric Railway.**—If you wish to ı model so small as you state, I should advise make a motor on the Froment principle. A has a model made in the following manner, works admirably. He purchased two of heap motor sets, as advertised at a shilling , and in these you can find a pair of arma- ust suitable for our purpose. The wire will ı for connection. You had better buy about s.c. wire, No. 24 gauge. You will have a magnets with the sets; but you had better another pair, as you will need four. You have no difficulty to make these, as you will he bought ones for a pattern. Soften the fore you make them. Put about an ounce on each bobbin. Next mount the armatures indle made from brass rod, and turned and to take the same. Now screw the bearings to the base, and mount the armatures and therein. Having got so far, we can fix the ts down on the board, and so arrange the ıres that when one pair of magnets are active ier's magnetism is practically nil. Now fix ontact breaker and springs, and your motor plete after the connections are made. There eed for further description, as full directions en with the sets aforesaid. The current can ; along one rail and back by the other. The will have to be insulated from each other, as rrent will be picked up by the wheels, This will be larger than you wish, but not too o run on a 12ft. length of rail. I shall be hear of your success. F. A.

72.] — **Electric Lighting by Water-** r.—I am at present working on such a job as opose. The floating arrangement is launched e wheels are being got in. What the power remains to be seen. My employer thinks it le for many purposes and places, but I am liberty to give any details.

J. VINICOMBE.

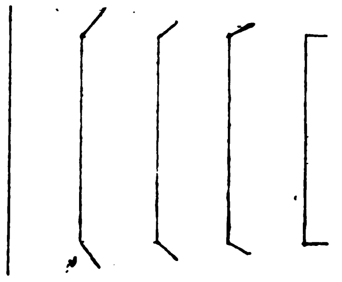
02.] — **Occult Forces and Indian** lery.—"A. W. G.," p. 425, asks for my When I was in Madras Roads, a good many ago, the three furious rollers of serf were l for passengers and goods by Massoolah worked by ten or twelve men, and by cata- s consisting of a log of wood, in which the ıt saddle-wise, and came through the water e sharks in some fashion. On such an affair came off to us two or three Indian jugglers. costume was a string round the waist, and yard of calico stretched from it between their their appliances consisted of a nest of light o baskets like wash-hand basins, some balls, , etc.; they had no great apparatus or tors. After the usual contortions, ball- ing, etc., they proceeded to some incantations, utting a basket mouth down on the deck (of passing it round first), they soon produced that basket a strong and lively cobra di ), who uncoiled himself and proceeded to to their piping. I do not know what else night have done, because our chief officer ently believing in occult forces) exclaimed, de'il is in it" (he was a Scotchman), and, in of fear and wrath, drove the poor conjurers out of the ship. For my part, neither then nor now did I think the de'il could create even a snake; and if he could, I fancy he could find more work in his line than helping two or three naked Hindoos to extract a possible sixpence or so from us. As to the other occult forces, now making some noise in the world under the name of hypnotism, I do not at all believe we were under that influence, and I know enough about it to enable me to form an opinion. When I see anyone throw a cord in the air and climb up it, I shall believe—well, I shall believe I am hypnotised; but I shall not believe what I see. Meanwhile, I have always considered that the snake was concealed somehow or other, and was a regular member of the jugglers' party.

SIGMA.

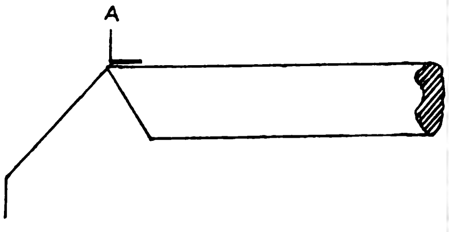
[73342.]—**Saccharimetry.** — In my reply (p. 426), for "loss" per barrel, read pounds per barrel. J. B. E.

[73343.]—**Problem in Geometry—Errata.** —In my answer on p. 426 there are several mistakes. In lines 2 and 3, for "diagonals," read *lines*. On p. 427, first line, for *their* sides, read *the lines*, meaning, the sides of the quadrilateral, not those of the triangles. J. K. P.

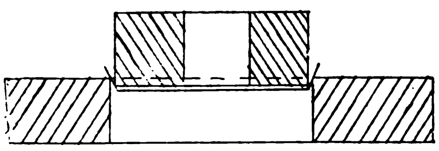
[73350.]—**Sheet-metal Work.**—I expect the cause of your failure is want of sufficient care in turning the edge, combined with the hardness of the plates. Your best plan will be to go through several successive operations thus, hammering them



all round the root A of the edge with a flat-faced hammer, having them on a round bar of iron, as shown in sketch. The top of the edge must be



knocked down with a mallet. After each operation anneal them by heating to blood-red, and plunging into water. If you have many to do, you may edge them by the aid of two rings, driving the top ring down by the aid of a heavy hammer or press. In



this last cut sections across rings and cover are shown. E. A. A.

[73353.]—**Expansion in Series.**—I would like to add the following to my reply printed on p. 427, Jan. 9th. I have now found what the expression in the original query was intended for (p. 408, Jan. 2nd), it should be

$$R^2 = A^2 \left\{ \frac{1 + (1-n)^4 \tan.^2 l}{1 + (1-n)^2 \tan.^2 l} \right\}$$

I have found this by means of the conic sections, and a very elegant problem it is. Referring to my reply, it will be seen that I have used the symbol $\theta$ instead of $l$, the two are not quite the same, as $\theta$ would denote the latitude as taken by observation at the centre of the earth, which, of course, could not be done, whereas $l$ is the latitude found in the ordinary way by "taking" the sun or one of the stars; the first method would give the degrees of latitude near the Pole *shorter* than the degrees near the Equator, and the second method gives the degrees *longer* than those at the Equator. The latter method being the correct one, I should have worked by it, but there is little difference in the length of the radius found by either method. Now, we have to expand the above expression in powers of $n$, and reduce the trigonometrical expressions to sines of $l$, $2l$, etc., for facility of calculation. Again, as $n$ is a very small fraction (I find it is ·0033), it would be useless to carry the series beyond the term involving $n^2$, as the terms following would only affect the result to the extent of a few inches, which would be absurd in a calculation for the radius of the earth. Now, in the above expression, put $\tan.^2 l = \frac{\sin.^2 l}{1 - \sin.^2 l}$, which is its equivalent in sines, then clear of fractions, then expand $(1-n)^4$ and $(1-n)^2$, and as we do not require any powers of $n$ beyond the second, we get

$$R^2 = A^2 \left\{ \frac{1 - (4n - 6n^2) \sin.^2 l}{1 - (2n - n^2) \sin.^2 l} \right\}$$

This is to be divided out by ordinary division, and the square root taken. This looks rather formidable, but as we are to omit all powers of $n$ beyond its square, the work is not great. In this way we get the series—

$$R = A \left[1 - n \sin.^2 l + \tfrac{5}{2} n^2 (\sin.^2 l - \sin.^4 l) + \&c.\right]$$

The term involving $n^2$ is the same as $\frac{5}{8} n^2 \sin.^2 2l$, and thus the series agrees with that which was correctly given in the original query. On comparing this series with the one given in my last reply, it will be found that the two first terms agree, and I find that the length of radius calculated by either method will differ very little; at 45° latitude, for instance, the difference is only about 180ft. As regards the last clause of the query, take the logs. of the expression for $R^2$, and develop by the formula $\log. (1 - x) = - x - \frac{x^2}{2} - \frac{x^3}{3} - \&c.$, these are hyp. logs.

Bath. M.I.C.E.

[73353.]—**Expansion in Series.**—Many thanks to "M.I.C.E." for his reply on p. 427, although he does not touch the real question, but assumes I have made a mistake. If he will refer to Souchon's very beautiful "Astronomie Pratique," ed. 1883, p. 43, "M.I.C.E." will find that my query is correct as it stands—viz., given—

$$R^2 = \frac{A^2}{1 + (1 - u)^2 \tan.^2 l} [1 + (1 - u)^4 \tan.^2 l]$$

show that—

$$R = A \left(1 - u \sin.^2 l + \tfrac{5}{8} u^2 \sin.^2 2l + \ldots\ldots\ldots\right)$$

I can obtain the above value of $R^2$ easily enough; but how to take the next step is a mystery to me.

ESNE CARALITA.

[73359.]—**Telephone Patents.** — The Blake transmitter patent (No. 229, 1879) expires on January 20, 1893; Hunning's patent (No. 3647, 1878) expires September 16, 1892; the first Edison patent (No. 2909, 1877) expires July 30, 1891.

MAGNETO.

[73362.]—**Closed Circuits.**—In my hurry, I wrote multiple "arc" instead of multiple "series" in my idea to use a high-resistance bell with Leclanché large cells instead of Daniell's gravity. Will Mr. Bottone or others kindly give me a few details as to size of fine wire and bobbins for constructing an electro-magnet capable of attracting a light armature, so that I can switch the circuit "on" for, say, 12 hours daily without unduly straining a Leclanché battery, composed of, say, 18 largest cells coupled 3 in multiple arc, the above E. magnet to act only as a magnet in the circuit, which, when broken, will release a lever, and thereupon close another circuit with an ordinary resistance bell? Does Mr. Bottone or Mr. Allsop's book give any such information? Also, what is a Daniell gravity charged with? I have read of crystals sulph. copper, and water only, whereas others quote sulphuric acid solution in addition. Which is correct? FITTER.

[73369.]—**Lacquering for Bedsteads.**—Heat the articles by passing steam through them. If you cannot do that, well clean off with some air-slaked lime, then give them a coat of transparent French polish, as that will dry brighter than lacquer without heat. JACK OF ALL TRADES.

[73370.]—**The "Missing" Link.**—In attempting to answer the rather narrow questions of "E. P. J."—namely, "What position does the 'Missing' Link hold in the Darwinian hypothesis?" and "Is it only an invention of the opponents of evolution?"—I must first of all point out that we must not confuse the Darwinian theory with that of evolution. It is a part of that larger whole. The evolutionist regards all the phenomena of the universe as natural, and does not believe in the intervention of the supernatural. The Darwinian hypothesis, however, is very different: it has nothing to do with the universe, but of our little planet; and then not with the origin of life, but of the origin of species of animals, and of man. When Charles Darwin wrote his "Descent of Man," he had collected sufficient evidence as to convince himself that man is the offshoot of the old-world Simian stem. His then limited knowledge, however, led him to believe in a great gap intermediate between the lowest type of man and the highest ape —the gorilla—and, so as to fill up this imagined gap, established the idea of a "missing link," from which, he argued, sprang both man and the now existing anthropoid race; and save that it had a tail, Darwin never made known what form his missing link may have taken. The more recent researches in the fields of biology and anthropology, however, are believed by many to-day to have done much in filling up the imagined gap of Darwin's, thus weakening the position of the "missing link" to-day, which once held a very high position in the Darwinian theory respecting the origin of man. And it is safe to say that, unless some Darwinian is able to explain away the great "difficulty" which is brought about by the idea of a "missing link," and which was made obvious in par. 3 of my letter (31892), appearing December 19, p. 356, the position of the "missing" link must now and for evermore remain insignificant in our idea of the evolution of man from lower vertebrata. The second question may be answered by the fact that, Darwin himself being the inventor of the phrase "missing link," it can hardly be said to be the invention of the opponents of evolution, by which I understand "E. P. J.," in this case, to mean "special-creationists."

Walworth. THOMAS SHONFELD.

[73371.]—**Slow-Combustion Stove.**—Anthracite coal and cinders, broken a little smaller than walnuts, will do well. R. H. J.

[73371.]—**Slow - Combustion Stove.** — Try anthracite by all means. It is cleaner and burns longer, and a woman can readily break it if you provide her with a big enough hammer. I don't know of any other mode of kindling than the usual one of paper and sticks.

Plymouth. B.Sc.

[73371.]—**Slow-Combustion Stove.**—Anthracite coal is better for slow-combustion stove than coke, but more expensive at present prices in London (28s. per ton). If of good quality, is much cleaner burning, more durable, and is free from any sulphurous fumes. Would be best to obtain "anthacite nuts," to avoid breaking, as the coal is very hard; is difficult to light, but not more so than coke. Best start fire with ordinary coal.

A. W.

[73371.]—**Slow-Combustion Stove.**—Coke is the most suitable fuel in every way for slow-combustion stoves. They should be fixed so as to have a powerful draught attainable at pleasure, to be reduced by the valve below the bars when the fire is well alight. The best way to obtain this is to have a few feet of upright pipe where the draught leaves the stove, and to have as little horizontal pipe as possible. Those made with the bottom bars to slide out are much more easy to keep clean, which is an essential to their satisfactory use. I have had two in use for several years, one of which is kept burning night and day. R. R. N.

[73376.]—**Small Dynamo to give 1 Ampere 6 Volts.**—To MR. BOTTONE.—I have already described and given sketches for dynamo of this size in previous numbers; but for the sake of those who may not have read the articles, I repeat the chief details in the construction of one of my 15s. 9d. dynamos, constructed for the above output. Size of armature, 1in. diameter, 1¾in. long, wound with 2oz. No. 24 silk-covered wire. Field-magnets, 4in. high, 1⅝in. wide, ⅜in. thick, wound with 12oz. No. 24 silk-covered copper wire, connected in shunt with brushes. Speed, from 2,000 to 3,500 revs. per minute, according to output desired; at the former about 1 ampère 6 volts, at the latter as much as 4 ampères and 15 to 18 volts. S. BOTTONE.

[73377.]—**Battery for Electric Light.**—The Daniell cell is not adapted for electric lighting, owing to the great internal resistance. Your eight quart cells, if freshly mounted, would barely light one 4-volt lamp. This would exhaust the battery in about 12 hours. You ask where the wires or the field magnets of the dynamo lead to. In the series form one wire is connected to one brush, and the other to a terminal of the outer circuit; in the shunt form the ends of the wires are connected respectively to the two brushes. See my book "The Dynamo" for fuller explanation and engravings.

S. BOTTONE.

[73378.]—**Blowpipe.**—You will find a note, with description and woodcut, of a foot-working blowpipe in the current number of *Science Gossip*, which will suit your requirements. It is made with an ordinary pair of bellows and a football bladder, as you desire.

Plymouth. B.Sc.

[73379.]—**Composition.** — Artificial teeth are made of the ground alumina of felspar, with a little kaolin clay. The alumina of felspar is fused, which takes place at a high temperature. It is then hardened with more heat to vitrify it by the addition of a little kaolin. If "Outlander" would give more details of what the composition is required for, I might be able to give more help.

J. KEENE.

[73380.]—**Oak Stains.**—I have matched old oak by using solution of bichromate of potash in water, exposing to light when dry. HORO.

[73380.]—**Oak Stains.**—Stephens' wood stains are sold of all kinds—you can see specimens of work. Some years ago a lady wood-carver asked me how she could make her performances look ancient. I recommended strong "Condy's fluid," applied with a soft brush, rubbed on the surface. I was told afterwards that it was suitable. Green shells of walnuts, boiled in rain-water, give a fine old nut-brown tint. Cold-drawn linseed-oil is rubbed in for a finish. Oak varnish (sold by druggists) is also used for a shiny surface. EOS.

[73381.]—**Glass and China Riveting.**—This is an art not to be self-acquired, and needs apprenticeship. Diamond points, drills, and highly-finished steel tools are used in considerable numbers. The rivets are made of soft brass or silver, as required. No book instruction can teach a "Novice"; he must see and practise this difficult manipulation, or he will certainly smash valuable materials. An expert workman in this line travels annually over the North of England, and having been trained as a mechanical engineer in America, possesses the great advantage of making his own appliances. He charges rather highly for his job work of restoring fractured porcelain. I have frequently watched his delicate operations—very far beyond my imitation. EOS.

[73382.]—**Schifbauer Small Arc Lamp.**—To MR. BOTTONE.—I regret to say that the fame of these lamps has not yet reached my ears.

S. BOTTONE.

[73383.]—**Hong-Kong.**—Paradise and Purgatory are the best terms I can find for the two divisions of the year into good and bad seasons. Reside in the most elevated position you can obtain; avoid Chinese neighbours, eat and drink moderately, shun the sunshine of hot months, keep your feet dry and your head cool, and never sleep in the open air, so tempting and so dangerous to health; wear a broad belt of flannel over your stomach next to the skin at all times; be very particular as regards your water supply. The more elevated is your abode the fewer will be the mosquitoes; but you must have gauze curtains everywhere: cheap and obtainable in the place. The expense of living will depend on your taste; the flesh of the native swine is a source of sickness. The coinage of all nations is current at Hong-Kong, being an open port. Good English boots should be taken (three or four pairs), with clothing suited to very hot and rather cold weather. No outdoor work can be accomplished for a long period by any European. Moreover, exertion at times is most exhausting and depressing, even under a roof. The rainfall is immense; sometimes by many feet. I have known the foundations of public works to be washed away; hence the necessity of living on an elevated, well-drained site. It is a most undesirable colony for men of small means, in case of illness. EOS.

[73383.]—**Hong-Kong.**—It is believed that all Tropical countries, from their heat *per se*, without reckoning other causes, have a tendency to produce or aggravate diseases of the liver. Situated between 22° 1′ and 22° 9′ N. lat., Hong-Kong is just within the northern boundary of the Tropics, and is certainly no exception to the rule; while, being also an island of but small extent—say 11 miles long by 2 to 4 broad,—the air is perpetually loaded with moisture, on account of the near neighbourhood of the sea, and this is another factor tending to the same result. Fever is prevalent during the rainy season, but nothing now to what it was in the early days of the colony, improved sanitation having, to a great extent, minimised both its frequency and its virulence. Cholera is not uncommon, but is chiefly, though not altogether, confined to the native races; dysentery, too, numbers many victims, and is, perhaps, more to be dreaded than any other disease. Generally, the climate is enervating, and unsuited to Europeon women and children, or men in delicate health. People of robust constitutions may, and in fact do, reside there for many years without feeling much the worse,—especially if they are able to afford an occasional trip home; but I should certainly advise no one to go to Hong-Kong who is already conscious that he has a liver. As to precautions, it is not very easy to give advice. The ordinary rules of hygiene, if carefully carried out, will tend to prolong life, either in Hong-Kong or anywhere else. Absolute cleanliness, both of body and surroundings; regular and strictly temperate habits; frequent open-air exercise, avoiding, at the same time, the exposure of head and neck to the sun; boiling and filtering of all water used for drinking—these are all I need name. Mosquitoes very largely outnumber the human population, and will pay special attention to "Sm." on landing. Living is, of course, very much more expensive, taken all in all, than in England, and chiefly because of the necessity of keeping servants. Hotel charges are about 4 dols. per day—3s. 6d. being about the average value of the dollar. As to outfit, "Sm." may take all his clothes that are in good condition, if only a moderate quantity: they will be useful in the brief winter season. Boots, all he has got, and it would be advisable to leave his measure with a friend, or shoemaker, or dealer, with a view to further supplies by parcel post. It may, indeed, be wise, also, to get his tailor to book his measure, though the most of his outer garments can be procured better, and more in accordance with the fashion of the place, in Hong-Kong itself.

J. A.

[73384.]—**Weather House.**—A cigar-box makes a good house. Cut two holes in bottom of box about 1½in. between, coming down to near the bottom; twist a piece of copper or brass wire sufficient to be above the height of figures, man and woman; turn ends up on which to place figures. To end of twisted part attach the catgut, which must be long enough to fasten to wires, leaving 1½in. to operate the figures. Another piece of wire will go from top of catgut to the outside top of box, to set it by. The catgut is ordinary fiddle string—medium size. All the above, I presume, may be had for asking; the whole affair need not cost a penny. Decorate the front in any way to fancy; two windows above the two doors give a nice finish. Another way is to stretch a piece of whipcord at the top of entrance-hall (to be out of the way) with a few feet of cord to come down to level of the eye. If steeped in a weak solution of salt will assist it. A piece of sheet-lead is attached to bottom; this, if properly done, will rise, or rather deviate, 6 or 7in. between extremes of damp and dry atmosphere. Of course, there must not be a fire near either. Another very handy form is: procure a chip-box from any chemist's shop. Fasten to inside of lid the catgut, with a drop of sealing-wax; make a hole in bottom of box for it to go through; fasten on the end a paste-board pointer. Any one of above ways will tell when the atmosphere is damp or dry. To forecast probable weather with any degree of certainty, the pressure of the atmosphere and the point the wind is in must be taken into account, not forgetting that the weather-glass (pressure of the atmosphere) stands, say, ½in. higher when the wind is from the north or east than when it is south or south-west for the same class of weather.

Sunderland. WM. GRIMSHAW.

[73386.]—**Speeding Pulleys.** — The size of driving and driven pulleys must bear the same proportions to each other as the speed of the driving and driven shafts. Thus, as 60 : 130 : : driven : driver. For example, say the driven pulley is 2ft. diameter, as 60 : 130 : : 2 : 4⅓, which is diameter of driving pulley. R. R. N.

[73386.]—**Speeding Pulleys.**—Let $r$ = radius of pulley on shaft, $r_1$ = radius of that on machine, $b$ = thickness of belt, $v$ = number of revolutions per min. of shaft, $v_1$ number of revs. of machine; then if $r_1$ $b_1$ $v + v_1$ be selected, I think $r_1$ may be found by formula—

$$r_1 = \frac{v r + (v - v_1)\frac{b}{2}}{v_1}$$

ATKIS.

[73386.]—**Speeding Pulleys.**—"Julius" must find the ratio of speed of the engine shaft, and the speed of the machine shaft, $\frac{130}{60} = 2{\cdot}16$; then he can assume the size of the machine sheave, say 12in., 12in. × 2·16 = 26in. nearly. Sheave on machine shaft 12in., sheave on engine shaft 26in., will give revolutions 130, which is required. If he looks up his back numbers of this paper, he will find a book advertised on pulleys.

Newcastle. J. B.

[73393.]—**L. and N.W. Engines, No. 373.**—There were only three engines of the class to which No. 373, Delamere (in the Exhibition of 1862) belonged, the other two being Caithness, and No. 975 Maberley. They were built in 1862, and used to work on the northern section of the line, and I believe were grand engines, and greatly liked by the men. On Mr. Ramsbottom becoming superintendent of the whole line he numbered them 1198 Delamere, 1199 Caithness, and 1200 Maberley, and they then ran on different parts of the line. Caithness was still running in the year 1885—the others having been scrapped—although only doing piloting and branch-line work, and I believe she has also been scrapped, as I never see her now. It is a remarkable fact—as mentioned in the *Engineer* a few weeks back—that although drawings of all the other different classes of engines that have run on the North-Western are in existence, there seems to have been none kept of these three celebrated engines. NORTH-WESTERN.

[73394.]—**Clock Trains.**—If I understand this query aright, your great wheel is 120, second wheel 80, pinion 10; pallet-wheel 72, pinion 8; warning-wheel 52, pinion 8; chime-wheel 40. The numbering of striking and quarter trains is, to a great extent, a matter of fancy. The only points which must be observed are as follows:—1st. The number of teeth in pallet-wheel must be a multiple of the pinion of warning-wheel, *i.e.* in your clock, pallet-wheel (72) is nine times warning-wheel pinion (8). This insures the warning-wheel always being in the same position when pallet-wheel stops. 2nd. The pin-wheel must contain as many more teeth than the pallet-wheel pinion, as it has pins. Thus, if pin-wheel has eight pins and 64 teeth, pallet-wheel pinion must have eight leaves. In the quarter side the pallet-wheel must make five revolutions to one of the chiming-wheel. In your clock it revolves ten times to one of the second wheel, and the chime-wheel twice to one of the second wheel, which comes to the same thing. The numbers of great wheel and second wheel depend very much on the available "drop" for the weights. If the drop is short they must be high numbered. See No. 1334, present vol., on "Quarter Chiming Clock." F. J. GARRARD.

[73394.]—**Clock Trains.**—The reason your quarter-train has the number of wheels and pinions it has is somewhat complex. In the first place, notice that your weight barrel has sixteen grooves upon it. The line has to run off these grooves in eight days, it being an eight-day clock. That is to say, the barrel rotates once in twelve hours. Now, on the small chiming-barrel you will notice five rows of pins; each row of pins is for one quarter. There are *ten* quarters chimed every hour, thus:—at the quarter 1, at the half 2, at the three-quarters 3, at the hour 4, and $1 + 2 + 3 + 4 = 10$; so that this small barrel must rotate twice in one hour. It has on its arbor a wheel of 40,—clockmakers call this the "half-wheel," because it is one half of the wheel of 80, which drives it. This wheel of 80, then, must rotate *once* in an hour. It has on its arbor a pinion of 10; in twelve hours this pinion will have gone round twelve times, and the weight-line barrel-wheel once, and therefore the weight-barrel rotates only once in twelve hours. Now, this wheel of 80 also drives a pinion of 8, which rotates *once* for every quarter-chime, thus using up eight of the half-wheel teeth, and allowing one of the five rows of pins to lift the hammers, and you will notice that the chiming-barrel will make a complete revolution when five quarters have been chimed for, $\frac{40}{8} = 5$. The remaining wheels and pinions are given numbers, determined by the slowness at which the quarters are to be struck. Your train would be a *slow* train, suitable for quarters struck on gongs. Wheels of 56 and 48 would be a *fast* train, suitable for bells. But the last pinion but one must be contained an equal number of times in the wheel that drives it, if it is to "warn"; thus, in your case, $72 \div 8 = 9$, but 70 would not do. The last two wheels are numbered to suit the size of fly used also. As to the diameters of the wheels, that is determined by the clockmaker's own experience of the size of frames and massiveness of movement required. C. A. JONES.

[73396.]—**Water.**—One of the most important elements in calculating the discharge of a pipe is its length. If this is given, I will try and assist.
HALL.

[73397.]—**Melting Brass.**—The skilful brass-founders of India, after charging a crucible with brass in lumps, shake the pot and cover the contents with coarsely pulverised borax; when this substance is not procurable they use a rather larger quantity of common table-salt. Their work is very clean and free from flaws and air-holes. EOS.

[73398.]—**Leaking Dynamo.**—To MR. BOTTONE.—Great loss of current would ensue, because the current would certainly not circulate round the coil to magnetise the magnets if it could by any means make a short circuit in the iron. The rule for the angle of the slit on the commutator is simple enough: it should not be greater than is just sufficient to allow the brushes to reach one section of the ring before they are off the other.
S. BOTTONE.

[73400.]—**Rot.**—The wood which is attacked by the fungus must be removed and replaced by wood which is well seasoned. Free ventilation must be given by gratings or air-bricks beneath the floor.
SM.

[73400.]—**Rot.**—Corrosive sublimate (Kyan's patent) or sulphate of copper are great fungus killers. A solution of either in boiling water is very effective, if you can reach the seat of the disease. The sublimate is a most dangerous poison to the human skin; hence be careful. EOS.

[73400.]—**Rot.**—This cannot take place in a dry atmosphere. Secure thorough ventilation, and apply a wash of corrosive sublimate in methylated spirits to the damp and affected portion. Painting the affected parts with tar, or carbolic acid, or even sulphate of copper solution, are also effective means. But the only preventive is plenty of ventilation.
S. BOTTONE.

[73400.] — **Rot.** — The closing sentence in "Ama's" query suggests the remedy—"it springs from a damp and confined space." This fungus is an old acquaintance of mine. Admit air under floor, and not only so, but provide for air circulation. Remove as far as possible all affected wood, and replace with wood free from sap. Cover floor in future with cocoa-fibre matting, not oilcloth or kamptulicon. H. T.

[73401.]—**Focal Point.**—A telescope, properly speaking, has no focal point. According to the markings on lenses in my possession, the focus of a telescope is rated after the focus of its object-glass—i.e., an o.g. of 30in. focus is said to make a 30in. telescope. The foci of the eyepiece and erector lenses in a properly made telescope are governed by the focus of the o.g., and as their position constantly varies, they cannot well determine the focal length of the telescope. A. CAPLATZI.

[73401.]—**Focal Point.**—The focus of a telescope, or, more properly speaking, the focus of the object-glass, is that point where parallel rays impinging on the surface of the lens are brought to a point, each point being measured from the surface of the lens nearest the focus. SM.

[73401.] — **Focal Point.** — "Telescope" can ascertain the focal length of an object-glass or speculum in more than one way. If we expose it to the sun, an image of the sun will be formed at the solar focus; that is, the rays are refracted or reflected to some point where the diameter is smallest and the image of the smallest size clearest in definition and sharpest in outline. If we take a Huyghenian eyepiece and focus the telescope sharply upon a celestial object, then measure the distance between the o.g. and the metal stop or diaphragm between the two lenses of the eyepiece, we shall have the solar focus of the o.g. Or we may use a Ramsden (or positive) eyepiece; but in this case it will be needful to know the focus of the eye-lens, because the eyepiece is used so that the image formed by the o.g. may be viewed in the focus of the eye-lens. The solar focus of a speculum is reckoned from its centre, and, in an achromatic o.g., I should imagine from the back of the inner lens.
Ramsgate. J. C. LINSCOTT.

[73402.]—**Telescope.**—If the tube is too long to carry as it is, you might cut it in half and affix two flanges to be bolted together. I would not trust to a screw coupling, and I would not cut the tube unless it is absolutely necessary. Of course, you will remove the lens and carry it separately. SM.

[73402.]—**Telescope.** — I may assure Captain Battersby that I have seen more than one fairly large telescope, the tube of which has been made to screw together in the middle of its length. It is not a difficult task, but is one requiring great care and nicety, and the operator must be an expert hand with the chaser to be able to cut the screw-threads properly. If the tube is of wood, many a man might fight shy of the job, but if of true and mandrel-drawn brass tube, there is no particular difficulty about it, if the cut ends are trued up properly and made to butt close together when screwed up. J. C. LINSCOTT.

[73402.]—**Telescope.**—Optically there can be no objection to making a telescope tube in two or more parts, seeing that most small telescopes are made in this way, and that the leading makers of the past adopted this form of astronomical tube for customers who had often to shift quarters. I myself have had 5ft., 6ft., and 7ft. tubes by Dollond, Tulley, and Harris, which screwed in halves or in three parts, without the least detriment to their performance. All that is required is that the rejoined tube should be perfectly straight. In Captain Battersby's case, the best and simplest way of attaining that end is, as he himself suggested, to have an *outside* collar 4in. or 5in. long made out of a brass tube, slit longways in halves, and then rejoined on one side by a hinge and on the other by two mill-headed screws. If a flat semicircular *eye* is screwed and soldered to the underside of this collar, it will form a capital clip for fastening the telescope on to a 12in. pillar standing on wooden tripod. The tube is cut in halves, perfectly square with its axis. Into one end is screwed an inner tube or lining, the other end then slides in over that until it meets its fellow, when the collar is shoved over the joint and tightened by the screws. The job is so simple that no brass-finisher ought to be afraid of tackling it. A. CAPLATZI.

[73404.]—**Photo-Micrography.**—The focussing glass is a magnifying glass, and the cover glass is what is used to cover the object on microscope-slides; it is very thin, and is cemented on to the centre of the focussing screen with Canada balsam, making the screen transparent. Try it, and you will find that you can focus better even without the aid of a magnifying glass.
Plymouth. B.Sc.

[73405.]—**Herpes.**—In reply to this query, I may say that the successful treatment of this skin ailment, of which there are many forms, is one of considerable difficulty, everything depending on the general health and length of standing of the case. After considerable experience, I have come to the conclusion that local treatment must be associated with general treatment of a tonic character. In this way I have succeeded in cutting short these maladies in remarkably short time, when other remedies, although pursued for many months, have signally failed. 1. Apply to the parts periodate lotion, to be frequently well rubbed in. 2. Internally, take either periodate tonic, a dessert-spoonful three times daily, or alternately a pint of a solution of the periodate crystals, composed of 1gr. to the ounce of water, and boiled until all is dissolved. For brevity, as much of the powder as lies heaped upon a sixpence is sufficient for a pint of water. This solution may be taken plain, or with milk, wine, or spirits, avoiding tea and coffee. Dr. Alder Smith, the specialist in ringworm, shows that this troublesome skin disorder of the scalp, if neglected in the early stages so that it becomes chronic, is practically incurable by medical aid, and children either out-grow the disease, or it is eradicated by the slow process of plucking out each diseased hair, and even this process is often a work of years. Now, by the periodate treatment, I have, during the past year, cured many bad cases and of long standing, by the method advised your correspondent for herpes within a few weeks. In particular, I have in mind a lad who was almost bald, who within three months had a luxuriant and vigorous growth of hair. A F.C.S.

[73407.]—**Snow-Shoes.**—These articles are well described and illustrated in that popular periodical, the *Boys' Own Paper*. I have been rummaging in a heap of them, but the number appears to have been lost; it is in 89—90, and the volume index gives the page. EOS.

[73408.]—**Magnetism.**—The difference between the best malleable and ordinary cast iron is about 40 per cent. in favour of the wrought iron. The number of lines generated by a current passing round an iron core is independent of the shape of the iron, provided, of course, that the wire can be laid equally near to the centre. For this reason the circular section is the best. It is impossible for me to say what number of lines you could get in one square centimètre section with a current of 10 ampères without I also knew the number of turns. But, roughly, you may say you could get 16,000 lines to the square centimètre. For further details I must refer you to the excellent abstract of Prof. Silvanus Thompson's Cantor Lectures, which you will find in the "E. M." for Oct. 3, 1890, *et seq.*
S. BOTTONE.

[73409.]—**Model Locomotive.**—First fix axle slides to frames, then fit step and keep together; bore them out and face them, and from the faces scribe the edges that have to slide on the frames.
J. H.

[73410.]—**Running Resistance of Armature.**—This fact is fully acknowledged by all, and is mentioned in nearly all textbooks on the dynamo. The reason is self-evident. Since in a ring armature the current divides itself equally between the two semidiameters above and below the point where the brushes touch the commutator, it stands to reason that the resistance of the armature when running is $\frac{1}{4}$ that of the total length of wire laid on it. S. BOTTONE.

[73411.]—**Eclipses of the Sun.**—The last total eclipse of the sun, of which the total phase was visible in England, took place on 22nd May, 1724. The line of totality did not embrace London. The last eclipse of which the total phase was visible in London was nine years earlier, on 3rd May, 1715. As to future eclipses, on the authority of Rev. S. J. Johnson, the next total eclipse of which the central phase will be seen in England will occur on 29th June, 1927. The line of totality will extend from the Isle of Anglesey across Northumberland, the North Sea, and so to Norway and Sweden. The total phase will last only a few seconds.
Paisley. JOHN CROUCH.

[73412.]—**Relative Efficiency of Bichromate and Chromic Acid.**—To MR. BOTTONE.—Even at the prices you name, chromic acid would be the better, for two reasons—1. Because the bichromate contains about one-third its weight of potassium, which is paid for, and which is useless, and must be removed by using an excess of sulphuric acid to make the solution active. 2. Because bichromate of potash, when used along with sulphuric acid in a battery, gives rise to chrome alum, which crystallises in the cells. A very good mixture for single-fluid batteries consists in chromic acid 3 parts, sulphuric acid 3 parts, water 20 parts by weight. If to this be added 1 part sulphuric acid and $\frac{1}{2}$ part chlorate of potash, the solution will be found excellent for double-fluid cells. Unless the solution in a single-fluid cell can be stirred or otherwise agitated from time to time, the duration of the current is (if the cells exceed half a pint in capacity) about three hours, irrespective of size. But in double-fluid cells, as also in single-fluid cells, if the solution be agitated, the duration is proportional to the capacity. S. BOTTONE.

[73414.]—**Electrical.**—In such small dynamos, and indeed in any of less output than 100c.p., a laminated Siemens will be found more satisfactory than the Pacinotti. You can easily charge a quart Leyden jar from an electrophorus having a two-foot sole. All you have to do is to rub the sole of your electrophorus on the back of your living cat, then place the shield over the sole, touch the shield with your finger, then taking hold of the insulating handle at furthest extremity, lift the shield sharply off the sole, and approach it quickly to the knob of the Leyden jar, so that the spark may pass. Repeat this operation several times, until the jar shows, by the shortness of the spark which passes, that it has received as much as it will take. The series-wound dynamo is the better for arc lighting, for magnetic experiments, and for those purposes in which the conditions of the outer circuit do not greatly vary. The shunt machine is the better for incandescent lighting, for running motors, and is the only one admissible for plating or accumulator charging.

S. Bottone.

[73415.]—**Chucks.**—"Gunzine" should look up back numbers. Vol. XXXIV. is very rich in the class of information most likely to be useful to him.

R. R. N.

[73418.]—**Chucks.**—A satisfactory reply to this query would fill many columns of our "E.M.," besides which, many explanatory drawings would be requisite. I recommend you to buy that cheap and useful book, "The Amateur Mechanic's Workshop," containing everything you can possibly want, as it is profusely illustrated; you will save time and money by doing so.

Eos.

[73419.]—**Pickle for Brasswork.**—You must not use nitric acid. "Pickle" is dilute sulphuric acid 1 : 10; "dip" is aquafortis or sulphuric acid 3 parts, nitric acid 1 part.

Sm.

[73421.] — **Automatic Organ Played by Means of Paper Bands.**—Messrs. Metzler and Co. showed me an organ in which the last key touched remained depressed until the next was struck, thus prolonging notes till released by the following action. That superb instrument, the Mustel harmonium, by the same firm, is also fitted with a similar arrangement. Although my player gives a percussive stroke, it would perform with either of the above-named instruments. At first it gave a staccato effect on the piano, and therefore needed some appliance for prolonging notes till the next action. I commenced to alter the mechanism so that this should be effected by the player itself; but on account of the complex form that would be given to a very simple piece of mechanism, I preferred making the addition in the piano by which each damper was kept off the wires till released by striking the succeeding note. This gave the desired singing or sustaining effect. This application to the piano is a very simple one, and could be adapted by anyone possessed of slight mechanical skill. I think I have before described this arrangement in the "E.M."; if not, I will do so.

F. H. Wenham.

[73423.]—**Salt and Snow.**—When any body is reduced from a solid to a liquid state, a certain amount of heat must be supplied to it. On salt being added to ice it forces the latter to melt, and as in this operation the salt is also liquefied, there is a twofold absorption of heat, which is extracted from whatever substances the mixture is in contact with.

Atkis.

[73423.]—**Salt and Snow.**—When bodies pass from the solid to the liquid, or from the liquid to the gaseous state, a considerable quantity of heat becomes latent, or is absorbed. You cannot melt ice without the application of heat, and therefore when ice melts in a natural way it absorbs heat from the surrounding matter. The quicker it melts, the more rapid is the absorption of heat, and therefore the greater cooling effect on adjacent substances. There is chemical affinity between salt and water (ice) which accelerates the fusion.

Sm.

[73424.] — **Painless Teeth Extraction.** — I think this is merely a bit of Celestial brag; for three years ago, at Hong-Kong, my son and his friends always employed a pig-tailed professional dentist, who drew their teeth in the usual manner.

Eos.

[73425.] — **To Mr. Bottone.**—A 12in.-plate Wimshurst, with 16 sectors, should give about a 2in. spark. Cardboard is no use for the sole of an electrophorus. The best thing you can use is a sheet of ebonite about $\frac{1}{32}$in. thick, on the underside of which you should paste a rather smaller circle of tinfoil. The Bertsch machine would give a 2in. spark, but will not excite itself so freely as the Wimshurst, which is the best form of induction machine up to date. The best way to cast a lead ball on to a wire is to get a bullet-mould of the size desired, and put a rather fine wire in the hole, and then pour in the melted lead. Or make a mould in plaster of Paris (in two halves) from any ball of the desired size, and cast the leaden ball in that. The wire can then be inserted by drilling a small hole in the ball and screwing the wire in it.

S. Bottone.

[73427.]—**Making Magic Lantern.**—Do you intend making the body of tin or iron? Do you intend giving it a mahogany exterior? Why not make it 3$\frac{1}{4}$in. instead of 3in.? It will then be a more serviceable thing. I suppose you mean to buy the lenses, not make them. The transparency may be close up to condenser, as this is best place for it if you wish to take in the whole of it. The distance of lamp will vary as the size of picture on screen, should be movable of course. This distance is principally governed by focal length of condenser lens. State further particulars.

F. G. Willatt.

[73427.]—**Magic Lantern.**—The distance from light to condenser depends upon the focus of the latter. You must try with a candle so that the image of the flame falls upon the spot on which lens of the lantern is to be fixed. For instance, let us suppose that the light is 5in. on one side of condensers, and lens 9in. on other side; all the rays of light should enter the lens. The light must be adjustable, and not fixed. The correct position is ascertained by the appearance of the illuminated disc on the screen. If the edge is blue withdraw the light from, and if brown approach it towards, the condensers. The slide is usually placed close to condensers; but if the slide is smaller than the condensers it may be advantageously removed nearer the focussing lens, so that it is just covered by the cone of rays. It will be the more brilliantly illuminated the nearer it is to the focus of the rays.

Sm.

[73428.]—**Coil Boiler.**—Has "H. B. S." seen Mr. Cam's description of the above, which appeared in the "E. M." in two letters, about March, 1889? If not, he had better. I suppose he means by "piping 1in. thick," pipe of $\frac{3}{4}$in. bore, which would be a trifle over 1in. outside diameter. I don't think that such a short length of pipe of that diameter could be coiled into a satisfactory shape for a boiler. It should be in the shape of a beehive, having the bottom diameter about equal to the height. For his engine I should advise him to use 25ft. of copper pipe, $\frac{5}{8}$in. outside diameter. This must have a separator, for the steam will sometimes carry a good deal of water. For the separator I should get a piece of 3in. iron steam pipe about 16in. long, screw a flange on top, and bolt cover to this. Lead the lower end of coil into top of this (it must be vertical), letting it come through 5in. or 6in. Have a connection for engine, safety-valve, and pressure-gauge also on top. Close bottom in same way as top, fitting a small cock so as to blow off the water from time to time as required. Lag separator with two thicknesses of hair felt. A special pump is not necessary; but if "H. B. S.'s" is 4in. stroke, it is too large. Work above at 40lb., and if not satisfactory advertise your address, and I will try and help you.

London River.

[73431.]—**Soldering Tin Tubes.**—Use a blowpipe, a tallow candle, a fine stick of soft-solder, and a little powdered rosin. No particular instructions are necessary. You are not so liable to melt the tube by using a blowpipe as you are by a hot bolt.

Sm.

**Building Stones and Frost.**—Experiments on "The Frost-resisting Power of Natural and Artificial Building Stones" have been made by Mr. Bauschinger (*Journal* Soc. Chem. Ind.) with twenty-one different kinds of natural building stones, 3—6 test pieces of each being used. Their tensile strength, wet and dry, their capacity for absorbing water, alteration in volume, tensile strength and behaviour towards water after freezing and thawing twenty-five times, and their specific gravity, were determined. Out of this number of samples, ranging from limestone to sandstone, only six were found to resist repeated freezing—viz., one of dolorite, one of diorite, and four sandstones. Four other samples were found to resist freezing fairly, but not absolutely; but of forty-one samples of artificial stone similarly tested, only three were found thoroughly unaffected, while eight proved fairly resistant.

**Locomotives for the St. Clair Tunnel.**—The Baldwin Locomotive Works, Philadelphia, are building four decapod tank locomotives for service in the new railway tunnel under the St. Clair river between Port Huron, Mich., and Sarnia, Canada. These engines are to have cylinders 22in. by 28in., five pairs of driving wheels 49in. in diameter outside of tires, and will weigh in working order, including 1,800 gallons of water in the tank, about 180,000lb. They will have boilers 74in. in diameter, carrying 160lbs. steam-pressure. The fire-box is 11ft. long by 3$\frac{1}{2}$ft. wide. There will be about 280 tubes, 2$\frac{1}{4}$in. in diameter, and 13ft. 6in. long. The cab is placed centrally over the boiler with foot-plate and coal-box at the rear of the boiler. The wheel base is 18ft. 3in. As the track through the tunnel is straight, the engines are not required to pass curves on the main line, and are only required to enter ordinary sidings. Additional play will be given the tires of the extreme driving-wheels. The second and fourth pairs of driving-wheels will be flanged with the usual play, and the distance between their centres is 8ft. 9in. The tires are to be secured by Mansell retaining-rings, and each engine will be fitted with two sandboxes and two headlights, a Cooke steam bell ringer, and the Westinghouse automatic brake, with equalised driver brake fixtures acting on all the wheels. The fuel will be anthracite coal or coke. The load which these engines are intended to haul is about 760 tons, and the grades are 105·6 per mile.

# UNANSWERED QUERIES.

*The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.*

72840. Focussing Concave Lenses, p. 236.
72849. Moles in Ireland, 236.
72867. Organic Analysis, 237.
72868. Spiral Drills, 237.
72875. Chemical Analysis, 237·
72877. Engine Cylinder, 237.
72880. Recorder for Piano, 237.

73089. Equation to Curve Wanted, p. 321.
73094. Isle of Man Steamers, 321.
73104. Model Traction Engine, 322.
73111. Model Engine, 322.
73116. Screws for Instruments, 322.
73124. Traction Power, 322.
72127. Quadrant Electrometer, 322.
73131. Switch-board, 322.
73144. Strength of Cylinder, 322.

# QUERIES.

[73432.]—**Surface Condensers.**—I read that the surface condensers on the *Teutonic* s.s. are 7ft. diam. and 20ft. long, and have twelve miles of brass tubes for cooling surface. By what means are the ends of the tubes made tight in tube plate? Are they ferruled with iron, wood, rubber, or fibre? What means are taken with long tubes like them to overcome the leakage caused by contraction and expansion which will tend to loosen the ferrules?—Ixion.

[73433.]—**Botanical Query.**—The Jaffa oranges have no pips or seeds, and the same may be said of Sultana raisins. Can anyone give a theory how the ovary should swell and produce fruit without fertilisation, or if fertilised, why the ovules should not be present in the fruit?—Puzzled.

[73434.]—**Electro-Magnet.**—I shall be obliged if some qualified reader will tell me how to construct the above to get the best attractive result from six No. 1 Leclanché cells? The battery will be close to its work.—Sam.

[73435.]—**Telephone.**—Will some one kindly inform me if there is anything special about the manufacture of the carbon buttons in Blake's transmitter? I have ground down ordinary carbon to shape, but the result is poor. In what manner are they polished?—Terracotta.

[73436.]—**Electric Lighting.**—I have a dynamo capable of lighting two 5c.p. lamps. Could you give me any information as to what motor, also what battery power, I would require to drive it at about 2,500 revs. per min.?—Amateur.

[73437.]—**Faulty Sewing-Machine.**—I have a Wheeler and Wilson's sewing-machine which misses stitches at intervals, the work between being perfectly good. Can any reader tell me the cause of this?—Aktis.

[73438.]—**Accents in Greek.**—Can any reader tell me the use of the accents in Greek? In reading Greek prose, does the position of the accent affect the pronunciation?—Aktis.

[73439.]—**Manufacture of China and Earthenware Plates.**—Is it usual to mould or turn dinner and tea plates? A few hints would oblige.—H. U. S.

[73440.]—**Heating Water.**—Will some reader say if water, say, in a large dye-pan, can be heated to 212° or as hot as by fire, by means of a jacketed pan, or by steam piping coiled round the bottom of the pan? I find that loose steam blown into the water will not give this heat. Shall be glad of some of your readers' opinions on this matter.—Jas. Moon.

[73441.]—**Faulty American Organ.**—Would some kind reader of "Ours" tell me how to cure a Smith American organ? On pressing some of the treble notes they do not speak singly, but other notes chime in and spoil the harmony. This fault is confined to the treble. There is also a general loss of power. I am afraid the instrument has been damaged by being kept in a new house.—Melrose.

[73442.]—**Electrical.**—What is meant by saying that the time constant of a telegraph circuit is ·5 second? 2. What is a choking coil (not a shocking coil)? I understand that it has something to do with the suppression of sparking in alternate current working. A sketch would oblige. 3. What are the connections necessary when six double-current circuits and four single-current circuits are to be worked from the same battery? A sketch would oblige.—Mac.

[73443.)—**Field-Magnet Winding of Dynamos.**—Suppose it is calculated that 8,000 ampère turns are required in a particular dynamo to give a certain output, and it is decided to compound-wind the machine, should the series and shunt together give the 8,000 ampère turns, or should there be 8,000 ampère turns of each of them, so that when no lamps are on, the shunt wire is doing all the excitation, and when full load is on the series does it all? If there is some proportion between the two to give the necessary excitation, please say what it is, and oblige.—Unsettled.

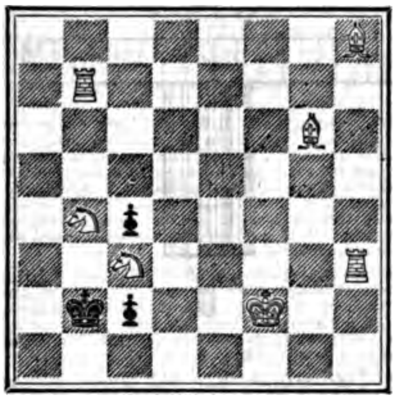
[73444.]—**Medical Coils.**—To Mr. Bottone.—I have a friend who is suffering from an affection of the spinal cord. His doctor has advised him to use a medical battery. He has done so, and has spent a deal of money in buying and hiring costly batteries, which seem to have done him no good. He knows that I dabble a little in electrical matters, and he has asked me whether I think there is use in him continuing to use his batteries. Now I would be obliged to our mutual friend if he would help me a little by answering the following questions. Is a

## CHESS.

ALL communications for this department must be addressed to "J. PIERCE, Knollside, Yawl, Lyme Regis, Dorset."

### PROBLEM MCCXXXVII.

*Black.*



*White.* [7 + 3

White to play and mate in two moves.

### SOLUTION TO 1235.

| *White.* | *Black.* |
|---|---|
| 1. Q-Kt 7. | 1. R moves (*a*). |
| 2. Q-K 4 (ch). | 2. P or Q takes Q mate. |
|  | (*a*) 1. Q-Kt sq (*b*). |
| 2. Kt takes K B P (ch). | 2. Q takes Kt mate. |
|  | (*b*) 1. Q takes Q (*c*). |
| 2. Kt takes Q B P (ch). | 2. R takes Kt mate. |
|  | (*c*) 1. Any other. |
| 2. Q takes R (ch). | 2. B or Q takes Q mate. |

### NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1235 by W. L. Martin, W. Gleave, Biene, W. A. Clark, C. P. P. (very nice indeed); to 1234 by Squire, W. L. Martin, Lieut.-Col. Ryan, W. Jay, D. Mackay, and E. Perrin.

WE deeply regret to record the deaths of two great English problem composers—Mr. Campbell and Mr. Grimshaw. Some of their finest productions will be found in old volumes of the *Illustrated London News*, "Chess Gems," and "English Chess Problems." Mr. T. P. Bull, a talented American problemist, also died towards the close of last year.

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### PAYABLE IN ADVANCE.

6s. 6d. for Six Months and 11s. for Twelve Months, post free to any part of the United Kingdom. For the United States, 13s., or 3dol. 25c. gold; to France or Belgium, 13s., or 16f. 50c.; to India (via Brindisi), 15s. 2d.; to New Zealand, the Cape, the West Indies, Canada, Nova Scotia, Natal, or any of the Australian Colonies, 13s.

The remittance should be made by Post Office Order. Back numbers cannot be sent out of the United Kingdom by the ordinary newspaper post, but must be remitted for at the rate of 4d. each to cover extra postage.

Messrs. JAMES W. QUEEN and Co., of 924, Chestnut-street, Philadelphia, are authorised to receive subscriptions for the United States for the ENGLISH MECHANIC, at the rate of 3 dols. 25c. gold, or Thirteen Shillings per annum, post free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the receipt of the subscription. If back numbers are required to complete volumes, they must be paid for at the rate of 3d. each copy, to cover extra postage.

Vols. XXIV., XXX., XXXII., XXXVI., XXXIX., XL., XLII., XLIII., XLIV., XLV., XLVI., XLVII., XLVIII., XLIX., L., and LI., bound in cloth, 7s. each. Post free, 7s. 9d.

All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each, post free from the office (except index numbers, which are 3d. each, or post free, 3½d.)

Indexes for Vol. VII., 2d. each. Post free 2½d. each. Indexes to Vol. XL., and to subsequent vols., 3d. each, or post free 3½d. Cases for binding, 1s. 6d. each

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*** It must be borne in mind that no Displayed Advertisements can appear in the "Sixpenny Sale Column." All Advertisements must be prepaid; no reduction is made on repeated insertions, and in cases where the amount sent exceeds One Shilling, the Publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

The address is included as part of the Advertisement, and charged for.

Advertisements must reach the Office by 1 p.m. on Wednesday to insure insertion in the following Friday's number

**Holloway's Pills** are specially adapted for the young and delicate; their gentle and purifying action ranks them above all other medicines. In indigestion, nervous affections, gout, and rheumatism these Pills have achieved for themselves universal fame. They expel all impurities from the blood, and thus restore cheerfulness and vigour.

## ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

### HINTS TO CORRESPONDENTS

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries, put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Jan. 14, and unacknowledged elsewhere:—

W. WRAY.—W. H. Bailey and Co.—S. Cambie.—A. S. L.—Royal Microscopical Society.—Cable.—Pattern-maker.—Frequent Traveller.—R. A.—Electric.—Lal Tulwar.—O. D. Tredegar.—B. H. Wilkinson.—Induction.—Helios.—Magnus.—Sparrow-hawk.—C. E. Ellison.—Fish.—Mere Noise.—S. M. B L.—S. L.—C. Q. T.—W. B.—Vitrix.—Slade.—Puzzled.—J. D. Malley.—Ric. A.—Geo. Whittle.—D. S. B.—R. C. Taylor.—J. R. C.—F. A. M.

### GOOD FOR "OURS."—ADVERTISERS, NOTE THIS!

"I HAVE advertised in the ENGLISH MECHANIC almost from the commencement (about twenty-five years ago, I think), and have had more business through its agency than all other publications I have employed together. I have sent goods to France, Spain, Constantinople, India, Africa, Australia, America, California, New Zealand, and other countries where the 'E. M.' circulates.

"Rochford, Essex. "JABEZ FRANCIS."

A. E. B. (The telephone is still under the control of the company, who use either Blake's or the Gower Bell transmitter as a rule. The device sent does not answer as a transmitter. Nothing can beat the microphone or carbon-contact principle, the patents on which expire shortly, when we may expect a development of the telephone. See the articles on Telephones, commenced May 16, 1890.)—JOHN MCHARG. (Mr. G. Westinghouse, jun., invented the brake which bears his name. The company's premises are in York-road, London, N. We do not know his private address; but the Westinghouse Co. has extensive works at Pittsburg, Pennsylvania. See "Hints" above.)—BIRMINGHAM. (You can find full particulars about the construction and fitting-up of electric bells in recent volumes, and you must determine for yourself whether it would be cheaper to do the work or put it out to contract.)—PONTO. (If it is the usual ink, add some lithographer's ink varnish to it.)—SPARK. (A 2in. achromatic would be superior to a 4in. non-achromatic; but it would not be worth while mounting either with the "circles." See the discussion on the subject recently, and in back volumes.)—AMBIGITUS. (Some carry camphor, others a piece of brimstone, and others again, as you mention, a potato; but neither is a preventive of rheumatism. Your friend asserts his belief as to the efficacy of the potato: he has nothing to "maintain." There is not even an hypothesis.)—OBSERVER. (The useful primary batteries are all well known, and have been described in our columns. Which battery you saw at the Stanley Show several years ago we do not know; but we do know that no battery yet devised will "light a 4-volt bicycle lamp for 9 hours" at what is generally understood by "nominal cost." We can quite understand that you have "looked in vain" for a description of such a battery in our columns.)—NEMO. (Why make a cylinder machine, when a Wimshurst is no more trouble? See the indices of back volumes for Replies as to size of spark, &c. Dutch metal is not as good as gold leaf for the electroscope—in fact, it is practically of little use, being much too stiff for the purpose.)—F. (Yes, many "analogies" of the kind exist, and many papers have been published on the subject of the unity of the so-called sciences.)—WOLRAB. (Rubber solution to be bought at any indiarubber or leather shop is used to cement the seams of a waterproof coat. 2. No cure for real colour-blindness. It is a defect of the eye. 3. We do not know; but the assistant secretary of the Royal Institution may be able to tell you.)—B. W. L. (Has anyone proved that the satellites rotate on their axes; or has anyone asserted that they do? The latter is probable, but as to the time, we must wait. 2. Why not try the experiment? It would be easy to release a piece of sunk cork 20ft. below the surface of water, and then, if it rose, that would settle the statement mentioned but not verified. Where did you find it?)—OLD COIN. (The "coppers" ring just the same as ever, unless there is some flaw either in the ribbon from which they are stamped, or in the "coin" after being pressed. You cannot have tried many bronze pennies as to their ringing qualities. Some are, however, very dead, having probably been injured after manufacture.)—FLINT. (Very indefinite still; but any of the large firms can supply you with glass that can be made to pass through a red-hot tube without cracking.)—P. J. W. (A difficult job; but soaking in paraffin oil is generally effectual. The brass collar may be carefully warmed up, which will help to start it; but if it has been put on properly, especially on a porcelain or glass reservoir, it will be very difficult indeed to remove all the plaster, as, if good, it bites into the glass or porcelain.)—W. G. (To prevent chilblains, attend to the general health, and do what is possible to prevent the extremities becoming chilled. Very fine oatmeal rubbed over chapped hands is a simple remedy; but there are many recipes in back volumes, and any druggist can make up a simple lotion.)—W. M. S. (Probably you fail to make the storm-glass because you do not go the right way to work. The usual solution is made of camphor, 2 drachms; nitre, 1½ drachm; sal-ammoniac, 1 drachm; and proof spirit, 2¼ fluid ounces. A glass tube about 12in. long by ¾in. diameter is three-parts filled with the solution and closed with a brass cap having a minute pinhole through it, or else tied over with bladder. As a storm or weather-glass, it is of no use whatever.)—OLIC. (Any patent agent will make a search and give dates and numbers of patents for a comparatively small fee, the charge depending on the amount of time occupied.)—G. C. W. (It is made by dipping paper (thin) into sulphuric and nitric acids, subsequently washing. See indices. No doubt it can be bought at any of the fancy dealers.)—R. G. (Any good dictionary explains the meaning of the words. For the rest—that is the weather aspect—we must refer you to a work on meteorology, unless you can refer to the back volumes, where the whole subject has been discussed.)—E. G., Matlock Bath. (Thanks for the pieces of yew and letter, which confirm previous replies. We think enough has been said now.)—J. M. (The upper part of a cartwheel does undoubtedly move more quickly than the bottom, when going along the road. This has been answered many times.)—PHOTO. (There is no book that we know of, but instructions are to be found in back vols.)—E. S. (Much simpler things have made patentees' fortunes. Consult a patent agent as to the other matter.)—BAT. (We have no faith in any such appliances. The cures are all due to fancy. Go to Dr. Allinson, the Medical Editor of the *Weekly Times and Echo*, and give his rational system of diet cure a fair trial.)—HARRY HOWARD. (The circumference of a circle 7in. in diameter is 21·99in.)

**The Largest Electro-Therapeutic Institute** IN THE WORLD is at 52, Oxford-street, London, W. It is known as the Electropathic and Zander Institute, and is owned by the Medical Battery Company, Limited, proprietors of Harness' Electropathic Belts, one of which should be worn by every sufferer from rheumatism, gout, sciatica, sleeplessness, nervousness, torpid liver, kidney disorders, &c. Book of testimonials, pamphlet, and consultation free. Mr. C. B. Harness, President.

## NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a PINK WRAPPER, as an intimation that a fresh remittance is necessary if it is desired to continue the subscription.

## OUR EXCHANGE COLUMN.

*The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.*

**Homing Pigeons,** the best breed out. To reduce stock will accept any reasonable exchange.—Address A. [illegible], Wool-road, Saddleworth.

**Telescope Equatorial,** 12½in. With reflector, slow motion R.A., 2in. finder, six eyepieces, Barlow's lens, diagonal, and stops. Photo 12 stamps.—Below.

**Transit Instrument,** 2⅝ o.g., silver circles, striding level, collimating eyepieces; photo six stamps. Photometer by Hilger, micrometer by Grubb, astronomical books and instruments.—Below.

**Barometers** two aneroid; patterns for Equatorial stands, dynamos, tricycle, Cromartie lamp, new ebonite Wimshurst machine, 9in. spark; lantern photos. List stamp.—Box 30, Liversedge.

**Tricycles** (two), nearly new. Telescope, 2¼ Wray, new books, and Scientific Apparatus, various. Wanted, Chronometer, by good maker; also small Transit.—Box 30, Liversedge.

**Ship Connoisseurs.**—For disposal, cheap, magnificent collection of large Models of Ironclads and Ships, under glass cases; made for Jubilee Exhibition; part cash, part exchange; any inspection.—19, Plymouth-street, Broughton, Manchester.

What offers for handsome wire-haired **Irish Terrier** Bitch, also five Pups; silver English Lever Watch, Cottage Piano.—81, Shepherdess-walk, City-road, N.

**Wire.**—Four hundred yards d.c.c. 20 Wire, new; Induction Coil, with regulator, working order; Model Launch Engines. Exchange.—BENNETT, 30, Albion-road, Pontypool.

Hand or quarter-plate **Camera Stand,** walking-stick pattern, value 18s. Exchange accepted in photographic requisites, dishes, &c.—K., 189, Southampton-street, Reading.

Wanted, **Coleoptera.** Exchange with collectors, especially abroad; also books, papers, on subject, cartoon, and store boxes.—D. D., 89, Elms-road, Clapham, S.E.

Exchange—part cash.—**Pictures, Furniture,** Tools, groover and gas fittings, books on music, poetry, photography, mechanics, chemistry, magnetism, fiction, &c., &c., musical instruments, and various articles all in good condition. Can be seen any time.—Apply by letter W. MORRIS, 10, High-street, Plaistow, Essex.

Wanted, **Magic Lantern or Biunial and Slides.** Exchange for SAFETY BICYCLE, cost £8 18s.—3, Havelock-road, Great Yarmouth.

Exchange small **Engine and Boiler** for good Stamp Collection, or cash to value £7 10s.—Write to HAWTHORNDEN, Clifton Down, Bristol.

"**Amateur Work,**" last three volumes, complete with plates, unbound. Vertical Riveted Copper Boiler, 10 by 5 fire-box, taps, &c. Exchange Horizontal Engine, with governors and pump, about 1¼in bore; or Vertical Boiler, with tubes and fittings.—A. E. S., 75, Biggin-street, Dover.

"**Smith's Bicycle Home Trainer,**" "Electrical Review" for 1890. Exchange.—[illegible], Colston-street, Bristol.

**Astronomical Telescope,** 3in. O.G., one day and two astro. eyepieces, sun-glasses, achromatic finder, rack focus, best brass body, pillar and claw stand, in case. Exchange for good Microscope, or anything useful.—L., 28, St. Augustine's-road, N.W.

Piano wanted in exchange for 5in. centre **Lathe,** value about £8.—A. W., 16, Charles-square, Hoxton, N.

**Galvanised Iron Cistern,** strong, well made, nearly new, 6ft. by 3ft. by 1ft. Exchange for ½-horse Engine, or offer.—MARSHALL, Whipps Cross, Walthamstow.

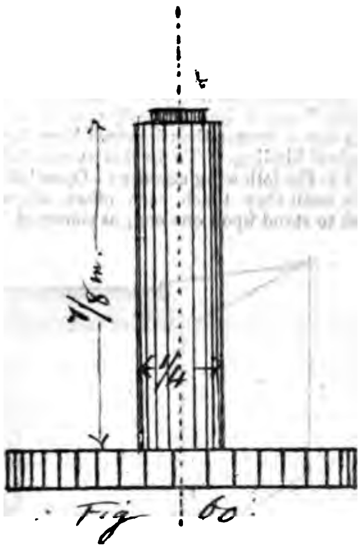
**Cylindrical Frictional Machine,** with accessories, complete, in case, worth 3os. Wanted, Magic Lantern or Camera.—Apply to [illegible], 8, Lawson-street, Newcastle-on-Tyne.

e English Mechanic
WORLD OF SCIENCE AND ART.
FRIDAY, JANUARY 23, 1891.

## TO CONSTRUCT A QUARTER CHIMING CLOCK.—VIII.

### 27.—The Cannon Pinion.

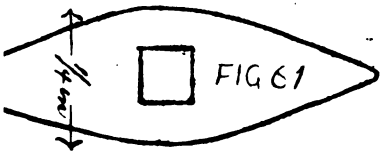
E Cannon Pinion, shown in Fig. 60, is lin. in diameter and $\frac{3}{32}$in. thick. It ns 40 teeth. Its arbor is of brass, and r throughout its entire length. The



own centre is tapered to fit on centre- arbor easily, but without side play. heel is riveted on to the brass centre same manner as some of the train- s were riveted on to collets.

the extreme end of arbor a small square ned, as shown in Fig. 60. This square be $\frac{1}{16}$in. deep, and about $\frac{1}{8}$in. square. inute hand fits on this.

naking the centre-wheel arbor (No. 4), be seen that a shallow square was d flush, or nearly, with the front plate. rence to Fig. 23 (p. 240), will show it. is square fit a small brass spring (Fig.

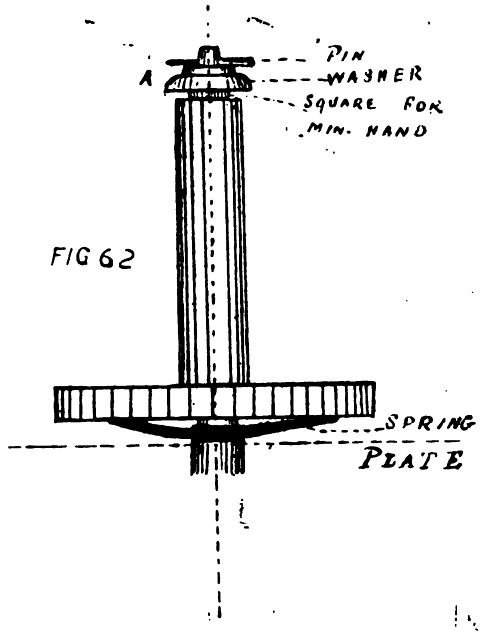


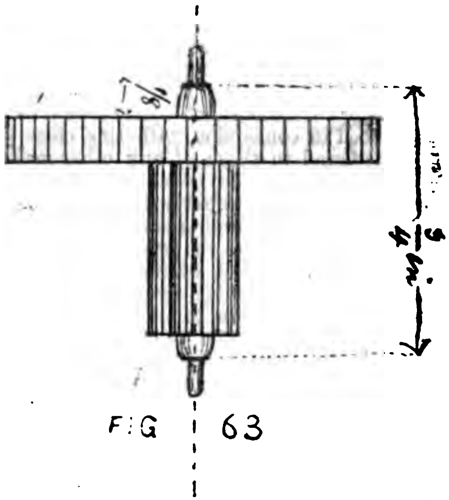
nd curve it upwards at both ends ly. This spring is to exert a constant d pressure on the cannon pinion. To the latter down a brass washer is l (A, Fig. 62), and a small hole drilled gh the end of centre-wheel arbor, into a tapered steel pin is fitted tight, g it all down as shown.

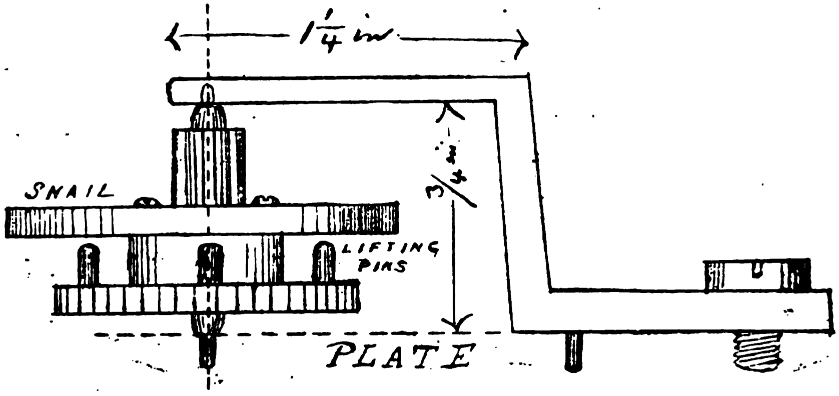
ference to Fig. 62 will show that the n pinion is thus held friction tight to entre-wheel arbor, and at the same an be turned to set the hands when ary.

### 28.—The Minute-Wheel.

s is exactly the same size as the cannon , as a reference to Fig. 1 will show. It unted upon a pinion of six leaves (Fig. d held in position by a brass cock, 4, screwed to the plate in the position in Fig. 1, and further held by two -pins. The chiming "snail" is fixed wheel. It is made from a disc of $\frac{1}{16}$in. thick and $1\frac{1}{4}$in. in diameter. In ntre of this snail a brass boss, $\frac{1}{2}$in. in







diameter and $\frac{1}{4}$in. thick, is soft-soldered. The centre hole is then opened out to pass easily over the pinion, and the whole is fixed to the minute-wheel by two screws. The cutting of the snail will be left till the chiming-rack is made.

Fig. 64 shows minute-wheel, snail, and cock in position. The four pins for discharging the chiming mechanism must be fixed in minute-wheel as shown, and must be of a hardened and polished steel, about $\frac{1}{16}$in. thick.

### 29.—The Bridge.

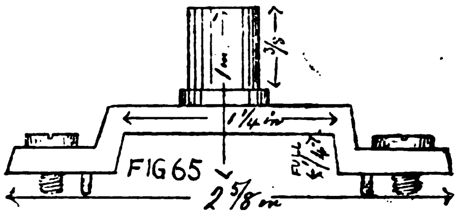
This is a brass casting of shape and size shown in Fig. 65. It is fixed to the plate by a couple of screws and steady-pins. The centre pipe must be bored for the cannon pinion to pass through without touching anywhere. Care must be taken in fixing the bridge in position to keep the pipe perfectly central. The position can be seen from Fig. 1. The *outside* of the pipe must be turned quite straight and smooth, and a shoulder left at the bottom for the hour-wheel to rest upon.

### 30.—The Hour-Wheel.

The hour-wheel is $1\frac{3}{4}$in. in diameter and $\frac{3}{32}$in. in thickness. It is driven by the minute-wheel pinion, and has 72 teeth, and consequently revolves once in the hour. It carries the hour-hand.

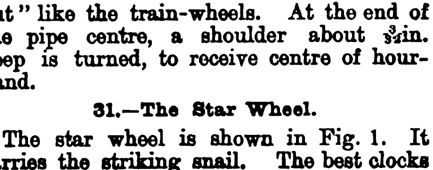
Fig. 66 shows dimensions, &c. A reference to Fig. 6 (p. 159) will show the general arrangement of the entire motion work. Fig. 6, however, is not drawn to scale, and was not given as a working diagram. It was only given to show the relationship of the various parts.

The hour-wheel is mounted on a pipe-centre, which revolves easily on the pipe of the brass bridge just described. This centre had better be made from solid brass and bored. The wheel can be riveted on to it in the usual way. Some clockmakers key this wheel on to its centre, much after the same manner as the great wheels were keyed on to the fusee-arbors. But riveting makes a neater job and does not entail so much labour. This wheel need not be "crossed out" like the train-wheels. At the end of the pipe centre, a shoulder about $\frac{3}{32}$in. deep is turned, to receive centre of hour-hand.



### 31.—The Star Wheel.

The star wheel is shown in Fig. 1. It carries the striking snail. The best clocks are usually provided with star wheels and separate snails, and this arrangement will be followed in the clock we are now considering.



I need hardly say that all clocks are not made alike. Even clocks of the same general class differ considerably, and these differences are, perhaps, more noticeable in the case of striking and chiming clocks than any others. Every maker almost uses his own particular arrangement for bringing about the necessary notions, and this clock will be no exception to the rule. It is very possible that the exact combination to be described in connection with this clock will not be found in those of any other maker; but it has been selected as being the most easily made, and probably the most reliable.

A great many chiming clocks, and perhaps the majority, have the snail fixed to the hour-wheel. This, I admit, does away with the necessity of having two separate pieces, but is not so certain in its action as a star wheel and flirt. The snail and rack both have to be made smaller. The shake, or backlash, of the teeth render the exact position of the snail a matter of uncertainty. The hour-wheel also is not, as a rule, so steady on its centre—that is to say, it usually has more play than a separate star wheel would have, and it is evident that if the snail is not fairly rigid upon its centre a false hour may be struck. This last fault would not show itself so much in a new clock as in one which has seen some years' service. It is, then, often a constant source of trouble, both to the owner and the watch or clockmaker intrusted with its repair.

Figs. 67 and 67 *a* show the star wheel. It is mounted on a pipe-centre as shown, and revolves upon a steel stud screwed into the plate. Fig. 68 shows such a stud. A small tapered pin holds the star wheel down; but must leave it quite free to revolve. The stud must be nicely turned and polished. A square shoulder is left at the base, by means of which it is screwed tightly into the plate.

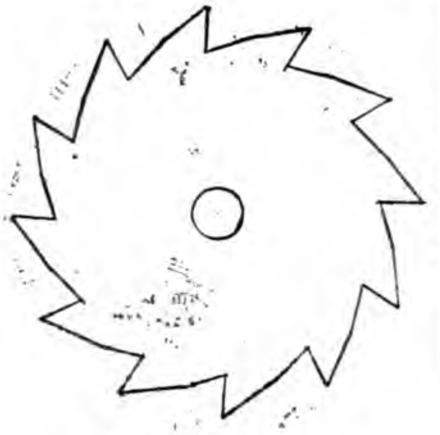


Fig 67

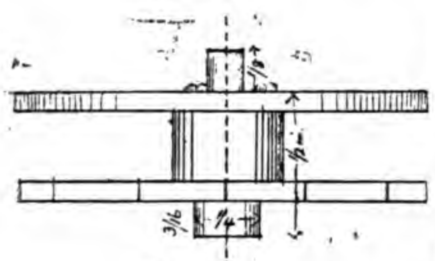


Fig 67 A.

The star wheel is $1\frac{3}{4}$in. in diameter, and need not be much more than $\frac{1}{16}$in. thick. It has 12 teeth. It gears with a pin fixed upright into the cannon pinion about $\frac{1}{8}$in. from its edge, as shown in Fig. 1. The depth to which the wheel engages with this pin must be such that at every revolution of the cannon pinion the wheel is advanced *nearly* to the extent of one tooth.

A reference to Fig. 1 will show that it revolves *above* the cannon pinion, and just free of it.

In scoring off the position of the stud upon the plate, care must be taken that the wheel revolves quite free of the winding square of the going fusee, and of the hour-wheel teeth. Fig. 1, I regret, is not quite correct in this respect.

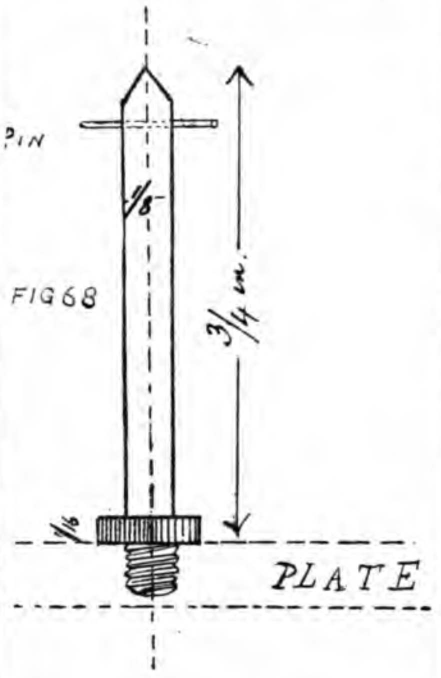


FIG 68

For the snail itself, turn a disc of brass $\frac{3}{32}$in. thick, and the same diameter as the star wheel, solder a boss to it in the same manner as the chiming snail, and fix quite centrally by means of two small screws. The snail must revolve *below* the hour-wheel.

To hold the star-wheel in position, and also to complete its forward motion when left by the pin in cannon pinion, a steel piece (10, Fig. 1) is screwed to the plate. It measures $2\frac{1}{4}$in. long, and is $\frac{1}{8}$in. wide. The whole forms a spring, and presses lightly against the teeth. It must be hardened and tempered to a blue, and the acting faces nicely polished. To save trouble in making, it may be built up as shown in Fig. 69. The spring can be riveted into an end block A, which is screwed to the plate, and a piece of steel, B, can be riveted or soldered to the free end. I have even seen these springs bent, as shown in Fig. 70.

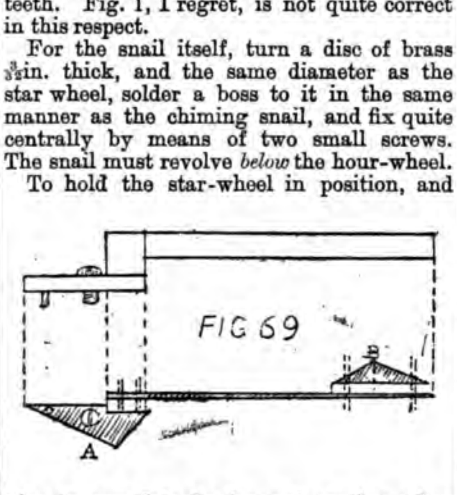


FIG 69

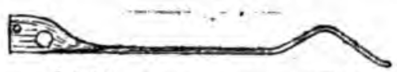


Fig 70

When made and screwed into position, it must be adjusted carefully. The pressure on the star-wheel teeth must be as light as possible to insure at the same time certainty of action.

## HOW BOOKS ARE BOUND.—

By "PRACTICAL BOOKBINDER."

CLOTH-BOUND books—that is, book
have been sent out by the publisher
cases, by reason of the demand for cheap
are, at the best, but very imperfectly boun
as a consequence, after the first readi
require to be repaired—in many cases
book is worth it, re-bound. This is not
of the publisher's binder; he must
cheaply because the public demand a che

These books, during the process of
pass through from ten to twenty differen
tions, and the price which the binder
his complete work would hardly cover th
sewing in other circumstances; and y
dodge is tried to make them as strong as
and to wear well in the hands of the publ

Whenever they begin to show signs of
loose, or if a leaf or a section comes aw
best plan is to take them to pieces and re-s
and put them into the case. We call th
casing," and if done properly the book
very much longer than it would have don
original binding. To do this successful
ceed in the following manner:—Open both
back until they touch each other, allow
book to stand upon one end, as shown at

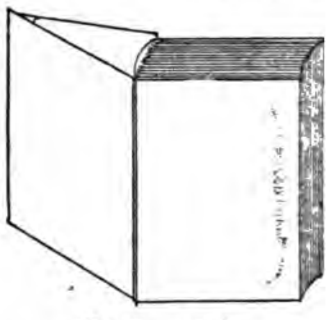


FIG. 46.

insert a sharp knife at the back between t
and the book, and cut carefully down o
through the lining (and tapes or cords,
then down the other side; this will s
the book from the case. The case m
be laid aside and the book taken to
Begin by laying the book upon the ben
the front up. The back will thus be at t
hand. Lift the half of the end-paper wh
adheres to the book, and gently but fir
move it, laying it over to the left-hand,
face down. Do not throw it away;
meantime, it will keep the title-page
Now turn over leaf by leaf until you co
signature: this is a letter or a number
bottom right-hand page of every section
first which you will come to is likely to
2, and this likely on page 17. When y
found this, give it a gentle pull, first fr
head, then from the tail; this will exp
thread with which the book has been sew
this all the way down with a knife, and s
rate the sheet from the rest of the book.
open this sheet at the centre, and remo
threads which will be found; then scrape
glue from the back of the sheet, and lay i
upon the end-paper *face down* at the left
Go through the book in the same way,
always for the signatures, which will fo
alphabetical or numerical order. If div
any other place the sheet will be torn,
should be carefully avoided. It may, ho
happen that a sheet has been torn even
the "taking-down" was commenced; i
case, "tip" the leaf or leaves with pas
lay it carefully along the back of the oth
of the section. Leaves thus pasted do n
up to the back like the other leaves of th
and this may be an objection to some peop
narrow strip of tissue-paper will join two
together nicely; they can then be placed
book, and will open up as well as any oth
If a leaf is torn across the page, take
paste upon the finger and paste the edges
torn part; place a strip of tissue along t
both sides, and leave it to dry. It can
torn away, and in doing so the tissue w
or split, and leave sufficient sticking along
it was pasted to thoroughly mend th
Music is mended in this way, but it will
to paste the tissue all over, and leave it u

the heavy printing of the music shows gh well enough to be read, and the mend is y seen at all.

g-ears can be taken out of the leaves of a by damping them slightly with the tongue, e most ready means, and pinching them the corner with the finger and thumb.

ien the book has been all taken down the is hammered of it—i.e, you will find some sections bent at the back, hammer these When this is done, it is knocked up straight awn in for three bands, and sewn as already ed. The case should now be cleaned inside, e old lining should be stripped off, the back thened by putting a strip of strong brown upon it. The book is end-papered, lined, out into the case; the directions for which already been given.

cloth case is torn at the joint, do not at- to mend it by *sewing it*, or even gluing a of cloth on the outside of the cover. Take the book, and insert a flat knife along the n part to raise the cloth from the board; strip of binder's cloth as near the colour case as possible. Glue it, and slip it in the part you have raised, glued side to the , of course; allow it to be broad enough to into the back about half-way, rub it down Now glue the part which was raised of the with the finger, and lay it down neatly the new piece. The dotted lines in Fig. 47 iow the position of the patch, which *must* ween the board and the cover. A corner e patched in the same way by lifting the and slipping the patch under. If patches th are put on the top of the cover, they eel off in no time, and will require continual ng down.

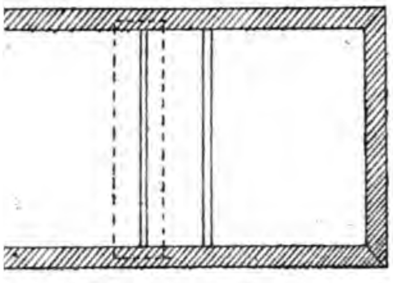


FIG _ 47

h cases which have become faded or spotted in or otherwise, may be freshened up by ng with diluted glair, about half and half and water. A large sponge should be used, e gilded parts avoided as well as possible. glair dims the gold; after the book has e thoroughly dry, it should be rubbed y all over with a piece of pure rubber not alcanised stuff that is used for cleaning ; this will take away remaining dirt, and en up the gold a little.

ther-bound books are treated much the It will, however, seldom be necessary to these, because they will have been sewn stronger than cloth books. If the board n away at the joint, treat it exactly as d for the cloth book: Take away the case tch it with a piece of leather same colour original cover, putting it between the and the board; if both boards are torn, e them and the old back as carefully as le; raise up the leather along the back of l boards, put on a new piece (bringing it n both sides), turn it in, and lay down the ver upon the top, pasting it well, and, thoroughly dry, paste on the old back upon w one. The book will also require new pers. These can be put in from the ons already given. Instead of washing covers with glair, use paste-water. When coat of thin shellac varnish will improve pearance.

, unfortunately, impossible to regild them they are taken to the original binder, one has the necessary tools. New letter- eces, however, may be made at any 's, the cost of which would only be a few and put on over the old one, or the old ay be removed entirely and the new one its place.

ographic albums are a source of much . The cheaper sorts are after a few weeks' usage very much dilapidated, and although we may feel proud of our collection of photographs, yet we feel ashamed of our album, and fail to bring it out when our friends call upon us, and thus deprive them of a pleasure and ourselves of a means of entertaining them.

Albums may, however, be patched and mended to look as good as new, and may even be made stronger than they were at first. The point of weakness in albums is the joints. Each leaf has, or should have, a joint. In the better kinds these joints are made of cloth or leather. You will observe that these joints are placed underneath the paper forming the leaves. When patching a leaf, remove the paper carefully, or rather raise it from the joint, take out the old one and put in the new one, whether it is leather or cloth, and paste the paper down again. Go over every leaf carefully, and put in new joints where required. I should have told you to take the album out of the case. This is easily done, as the end paper is thick, and only sticking to the board at the edges.

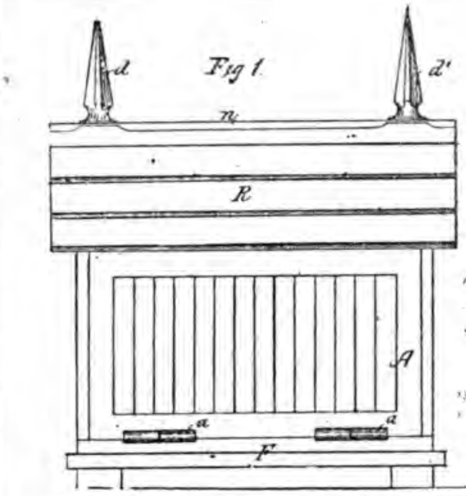
If there has been a lining on the back, take it off, and straighten every leaf. You will find them shift about in all ways if moved by the fingers. Glue the back well with good strong glue, not too thick, and cut a piece of strong linen the length of the back and about 2in. broader; glue this and put it on the back, allowing 1in. to come on each side. Take care to make this stick well to the back by rubbing it closely with a folder or the handle of a tooth-brush. Strengthen the back of the case by gluing a strip of brown paper inside. Place the album into the case again, glue the end-papers, and put it in the press. Leave the back open, for if glued to the album it will not open freely, and the leaves will stand up instead of lying flat.

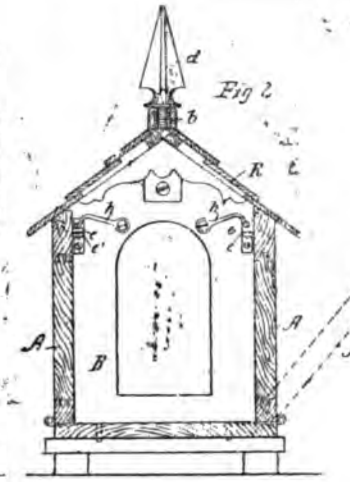
The leaves are often slit where the cards are put in. These can be mended as the leaves of a book are mended; description already given.

I have tried to be as complete as possible in these remarks upon repairing or mending books; but I will always be pleased to answer any special question through the "Query" column at any time.

## WHEELER'S PORTABLE SHEDS.

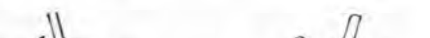
THE methods of constructing portable sheds, kennels, fowl-houses, &c., shown in the annexed engravings have been patented by Mr. F. Wheeler, of Brixton, and may be suggestive. The patentee says that his invention relates to improvements in portable houses, sheds, and the like, and refers more particularly to wooden or metallic structures applicable for dog-kennels, fowl-houses, rabbit-hutches, bicycle or perambulator sheds, and other similar houses or huts, capable of being promptly taken to pieces or erected for cleaning and transporting purposes. Figs. 1 and 2 show the application of the invention to a dog-kennel, Fig. 1 being a side elevation, and Fig. 2 a cross-section of the kennel. A A are the sides of the kennel, and are hinged to the under-frame F, the hinge being formed of a short longitudinal rod terminating with a central pin. This pin enters a barrel, *a*, fixed to the frame F, as shown in Fig. 1. The sides A are secured to the front and rear ends B and C in the manner shown in Fig. 2—that is to say, by means of hooks $h\ h^1$ entering a couple of eyes, $e\ e^1$, fixed one to the side A and one to the front end B. A similar fastening is used for the rear end. The front and rear ends B and C are secured in position by inserting the pins fixed to the bottom thereof in corresponding openings of the under-frame F. The roof R of the form shown in Fig. 2 is formed in one piece with the ridge *n*, and is provided with sleeves *b b*, which are passed over the two screws $c\ c^1$, while nuts $d\ d^1$, serving likewise for the purpose of ornamentation, are screwed on as shown to secure the roof in position.





## MARTIN'S TRICYCLE.

IN this machine, patented by Mr. F. Martin, of Fort Douglas, Salt Lake City, the driving mechanism is designed to propel the machine at a high speed with minimum power. Fig. 4 is a front view, and Fig. 5 is a plan view, with the seat removed. Upon the hub of each of the large wheels are attached two spaced discs, and upon the periphery of the discs a collar is held to slide, covering the space between the disc plates, as shown in the sectional view, Fig. 3. A box collar is loosely mounted on the hub between the discs, and within this collar a ratchet casting is attached to the outer face of the hub, pawls pivoted in one side of the collar being adapted to engage the ratchet teeth. Between the peripheries of the discs and the outer surface of the box collar are placed a series of spaced friction rollers. Four straps, each attached by one end to the box collar, are carried outward in contact with the friction rollers, their outer ends being attached to the sliding collar covering the peripheries of the disc plates. These straps are brought into operation by the back stroke of a lever attached to the outer surface of the collar, and extending within convenient reach from the rider's seat. A return strap is also attached to the outer surface of the box collar and the sliding collar, and makes contact with a friction roller on the side opposite that with which the other straps make contact with their rollers. One of these boxes containing driving mechanism is located at each side of the rider's seat, and provided with an upwardly-extending lever. Fig. 1 is a sectional view through the driving mechanism, illustrating the position of the parts at the termination of the forward stroke of the lever, Fig. 2 showing their position at the termination of the rear stroke, the



pawls engaging the ratchet teeth at each backward stroke, and slipping over them on the forward or recover stroke.

## A SIMPLE INTERFERENCE EXPERIMENT.

By Albert A. Michelson.

THERE is probably no experiment connected with the wave theory of light of greater fundamental importance than the justly celebrated one known as "Fresnel's mirror experiment," and accordingly many find it necessary to repeat the experiment for their own edification or for class demonstration.

Without the use of rather elaborate and costly apparatus even skilled experimenters find some difficulty in producing the desired effect—the interference of two pencils of light as manifested by the appearance of coloured fringes on a screen, or in the focus of an observing lens; and unskilled observers find it almost impossible, even with these aids. Even when produced under the most favourable conditions, the phenomenon is complicated and often much obscured by diffraction effects.

A very considerable improvement is effected by the substitution of Fresnel's "bi-prism," though in this case one of the chief points of interest is lost—namely, the change of breadth of the bands with alternation of angle. The phenomenon is also complicated by the dispersion of the glass.

The following method has the advantage of being easily within the reach of even unskilled persons, and of giving the required result in all its purity.

Fasten a piece of plane glass, *a b*, Fig. 1 (selected plate glass will answer, though sextant glass is much better), to a right-angled prism of wood, *d*; then press *d* against a second piece of plane glass, *e e*, by means of a little soft wax, so that the angle *a b c* is a little less than a right angle. If the light from a distant electric arc lamp be allowed to fall on the glasses (which should be silvered on the front surfaces), two rays, $s$, $s_{,,}$, starting in the same phase, after reflections at *f*, *g*, and *h*, *k*, respectively, will meet somewhere in the line, *b s*, in the same phase, the two paths being exactly equal. Accordingly this line is the locus of the central bright fringe and the system of fringes may readily be observed through a lens of about an inch focal length whose axis is anywhere along this line.

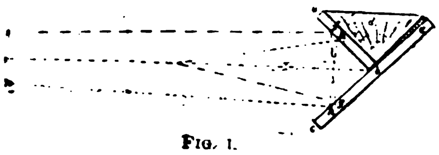


Fig. 1.

The figure is drawn for clearness in the vertical plane containing the source, and if the intersection of the two surfaces (projected at *b*) were at right angles with *s b*, it would be necessary to deflect part of the light to one side by a transparent mirror. But the appearance of the fringes is in nowise changed if the apparatus be rotated through a horizontal angle, *a*. The line *b s* is then rotated through 2*a*, and there is no difficulty in observing the fringes directly.

It will be noted that no adjustments whatever are necessary.

All that is required is that the surfaces be fairly true, and the angle slightly less than 90°. This last condition can be readily fulfilled by making the two images of a distant object nearly coincide.

The following may serve as a guide to the general disposition of the apparatus. Fig. 2.

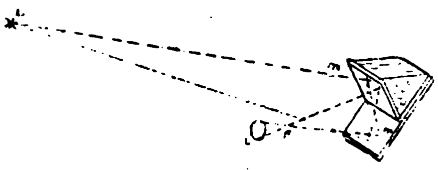


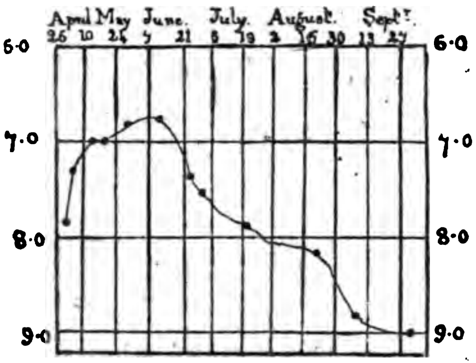
Fig. 2.

L is the arc lamp (if provided with a shade, the latter should be transparent, *m m* the two mirrors, *f* the fringes in the focus of the lens *l*, the eye being at an equal distance on the other side of the lens. L *m* may be 100 mètres and *m f* one mètre or more.

The fringes under these conditions appear as a series of fine lines parallel to the intersection of the surfaces *a b* and *b c*.

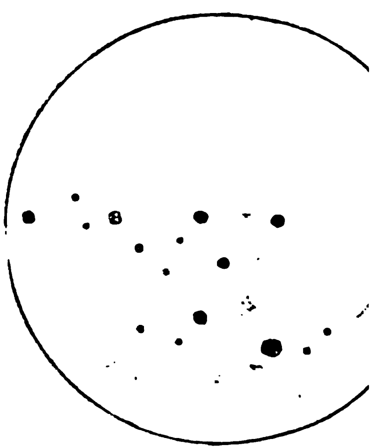
If the source be distant and the angle between the mirrors, 90 − *a*, and the wave-length, λ, then it may readily be shown that the width of the fringes is $\lambda/4a$.—*Amer. Jour. Science.*

Fig. 1.



Light curve of X Ophiuchi
April 26th to September 27th 1886.

Fig. 2.



Sketch of the Region o
4 Vulpeculæ, by Mr. Gor
with an opera glass.

## PRACTICAL WORK WITH THE TELESCOPE.

WE are indebted to the courtesy of the Rev. John Bone, F.R.A.S., of Lancaster, for a copy of the *Transactions* of the Lancaster Philosophical Society, of which society he is hon. sec., containing the paper on practical work with the telescope by the Rev. T. E. Espin, from which we make the following extracts. After some introductory remarks, Mr. Espin said:—If we look at some of the greatest astronomical achievements, we see it is really the skill and unwearied patience and dauntless spirit of overcoming obstacles, which has been the ultimate cause of success. Take one of our ablest modern observers of variable stars—Mr. Gore, of Ireland—what does he observe with? From the work he turns out we might suspect that he had large and powerful instruments at his command. Not at all! Every fine night Mr. Gore takes his station outside his house and observes—what with? Why, a simple and ordinary binocular field-glass, costing not as many shillings perhaps as the big glass of your telescope costs pounds. And this leads me to a second point, and that is that there may be someone in Lancaster whose interest in the subject is sufficiently great to take up systematic work with the telescope. We owe a very great deal of our knowledge to the amateur astronomer. While the professional is engaged in the regular routine of observatory work, the amateur is at liberty to direct his attention to any one, or to several, branches of astronomy. The great danger which I find besets the amateur is the too large programme of work he places before him. In this science it is the same as in all others: if a man is to make anything of it, he must select one branch, and neglecting all others, stick to it. It will be my endeavour to-night to indicate lines of research as seem especially calling for more attention, and which if followed out will, I think, lead our amateur to interesting and valuable results. I wish to emphasise one thing, that I assume him to be devoid of anything more than a distant acquaintance with mathematics. Astronomy naturally falls into two branches, mathematical and practical. It is with the last only that I wish to deal to-night.

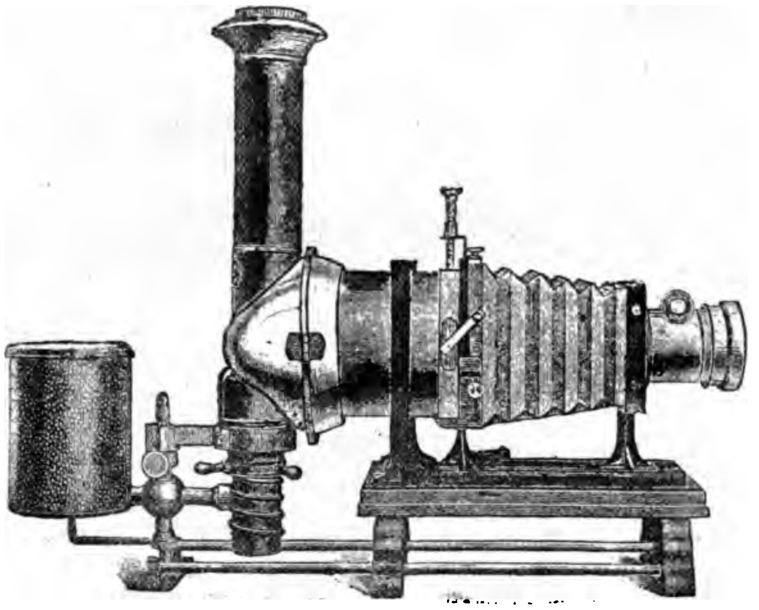
We naturally start with the sun. Considering that in many observatories the sun is photographed each day when it is visible, this may not seem at first a hopeful commencement. But Father Perry and Miss Brown have shown otherwise. Details which have been missed by the photographs have been detected by them from their observations. As this is a lecture not so much on what we see, but how we are to see, I shall not delay you by describing at length the aspect and phenomena of sunspots. It will suffice to say that from time to time large black spots appear on the sun. That these spots vary in size and extent, and also in their position. Here are copies of the drawings of a group of sunspots made by Miss Brown on April 24th and 26th, 1884. You would hardly recognise the second day's drawing as of the same group. Miss Brown, indeed, showed that even in twenty-four hours extraordinary changes had taken place, a result which other observers have arrived at through observations of other spots. There is no doubt, too, that these variations in shape and size are constantly occurring, and some observers have been so fortunate as actually to witness such changes. The careful drawing of such spots is then a line of work which is sure to lead to in results. The spots may be observed directl dark glass, or what is far better, they observed by projecting the image of the a screen with some such arrangement as I show you. By this means every faint m visible, and there is the additional adva seeing the whole of the sun's disc at once day by day drawings and observations made, which after a year's work will give a more exact knowledge of solar activity that year.

Then there is the moon. Although m been done, yet it has been very clearly s Mr. Elger and others that much remains to Careful drawings of the mountains and shadows; careful sketches of each faint streak—these things require artistic skill a severance, and open a wide field for the ente amateur. Hour by hour as the sun rises or the lunar landscape the appearance chang aspects come out under the side illuminatio rising or setting sun.

As regards the planets, there are s observers already engaged upon them that it is hardly at present worth the whil amateur to devote time to them. I may, h say in passing, that in this line the very lar scopes do not have it all their own way. T drawings of planetary detail have for the m been made with moderate-sized telescopes. the light-grasping power of large telescopes i them, and the eye is dazzled with the brill the object, and so loses the fainter and more details. To my own eye planetary work large aperture is hopeless, from the brilli the image, and I find that if I wish to get work out of my telescope it is necessary lightly-tinted glass, either green or blue, or tinted. Especially in the case of Mars noticed that the markings are much mor seen with a tinted glass. Very much m this apply to the difficult markings on V they really exist.

Comets of any size are such rare visitors t may be dismissed with the remark that w does turn up careful drawings and obse should be made of it at every opportunity guide, I will throw upon the screen a view great comet of 1861 from an exquisite drawi by the late Rev. T. W. Webb on July 3 copied from his observation book. Mr. custom was to make a drawing of the co night it was possible, and side by side to description giving a skeleton figure like t now place on the screen. Here you will each detail is carefully lettered, and so described and compared night by night.

We must now pass on to the starry heave may use our telescope for observing and m double stars. However, as so many obse are already engaged in this work, perhaps better turn our attention to some other b sidereal astronomy. The one that is really t profitable is the observation of variable s wish to take you shortly into the me observing them, and to do so will show y of two of the variable stars found in the o other work at my observatory, as you w best see how they came to be discovered. night of April 26th, 1886, while sweeping stars between Aquila and Ophiuchus, a star was found in field with a triangle



## PARABOLON OIL LIGHT LANTERN.

THE optical lantern as a means of instruction and amusement, and as an advertising medium, is becoming more and more popular as the lantern is improved in quality and rendered more manageable. One of the objects sought by makers and users of lanterns is an inexpensive, safe, and efficient means of illumination; something always ready and capable of being used anywhere.

The lantern shown in the annexed engraving, says the *Scientific American*, seems to have these qualities, besides being optically and mechanically complete. It is not presented as the equal of the electric or oxyhydrogen lantern, but great superiority is claimed for the oil light used in this lantern. The manufacturers have named it the Parabolon Oil Light Lantern, on account of the peculiar construction of the lamp, which permits of the use of a highly polished parabolic reflector, thus greatly increasing the effectiveness of the illuminating flame.

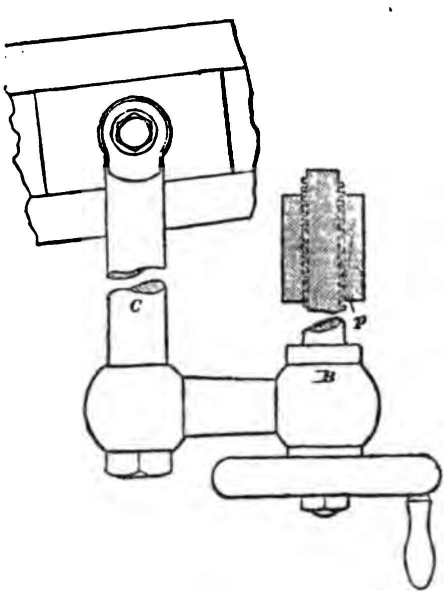
This lantern has a pair of 4½in. condensers, and an achromatic objective of fine quality mounted in brass rack-and-pinion tube, with milled head for focussing. The objective tube is mounted on a cast metal stand, the foot of which has milled edges to run in machine-grooved tracks for extra focussing. At the back of the objective stand is fastened the small end of a bellows hood, having its large end fastened to another movable stand, in connection with which is a lever-actuating movement to extend the bellows evenly back, and, if necessary, close against the front condenser, thus preventing the escape of light. In this lantern the oxyhydrogen jet may be used if desirable. The slide holder is arranged for the introduction of slides or negatives of any size, vertically or horizontally. Messrs. J. B. Colt and Co., 16, Beekman-street, New York City, are the manufacturers, and will furnish additional particulars to any interested.

## LATHE IMPROVEMENTS.*

IN an old-time shop where I served an apprenticeship there were two swivel-head lathes. I believe these are the only ones of the kind I have ever seen, and I must say that I did not fall in love with these two. Mr. Sweet says that a swivel-head lathe can be more easily kept in line than others. These two were got approximately in line with great difficulty. The trouble we found was this: we could never tell when these lathes were set right.

It is not a very accurate way of testing the alignment of a lathe, by boring a hole with a long, slender boring tool. A great many men will bother a long time trying to get a straight hole, and at last will set the head over a little, when really the trouble is in the boring tool. At last they are successful, and so as to know the location of head stock that they had the best luck with, for the next job, they make their own private mark. The next man does the same thing, and some, when boring a taper hole, make a mark. It is a fine job to set the head correctly enough for common work, even when we have fine, well made lines; but when we have a hundred lines of all grades, from a fine line to a cut with a dull cold chisel, and a bruise of a round pene hammer, and when we do not know which are the correct ones, and if we did know, probably we could not set to them, the difficulties are great.

One of these lathes was about 50in. swing, and the bed was about 25ft. long. The tail-stock was made to slide over in the ordinary way for turning tapers, and this had the usual number of scratches. This lathe was not so easily handled, while experimenting to get things in line, as a small one would be, and there was surely trouble at each end sometimes. A good suggestion might be to have a blank book and lead pencil hanging in a convenient place, with a request that when a new mark is made it be numbered, and the number be written in the book, with name, age, and experience of the workman, and under what conditions this mark was made. Of course some of these difficulties with lines might be overcome in a well-regulated shop; but I have never seen anything different from what I have described, and I think I have worked in some of the representative shops in this country. I do not see the need of a swivel head, if we have to have a taper attachment besides. It is getting to be pretty well recognised that setting the centres out of line is not a good way to turn tapers; it is also getting to be recognised that a compound rest is needed. If we have also a swivel head we will have too many ways of boring taper holes.



It is true that there have been a great many taper attachments designed that are not good, but it is possible and perfectly practicable to make one that no fault can be found with. I show in the sketch one of the oldest plans of arranging the taper attachment. We can eliminate most of the back-lash in this one, if we work right. The back-lash in the cross-screw, in its fit in the nut, is the greatest source of trouble. The looseness in the bearing B, of course, can be taken up. When turning a taper, small end to the tail-stock, if the cut is adjusted by drawing the tool out, the back-lash in the nut, marked P, will be taken out.

In boring a taper hole in the usual way (large end out), if the cut is adjusted by pushing the tool in, the back-lash will also be taken out, but these are very awkward ways of adjusting cuts. It has been quite a while since I saw such a taper attachment, and I make this plan from memory, but I believe the bar C passes quite close to the tool block. It seems to me a clamp can be provided very easily, so that when the cut is adjusted the bar C can be clamped to the tool block. The proper way to have a taper attachment, I think, is in combination with a compound rest, so the lower slide can be made fast to the sliding block on the taper bar, and the cuts adjusted with the compound rest.

I believe the head-stock should be cast on the bed, if for no other reason than for cheapness. Sometimes in a small shop it is found desirable to set the head up on blocks, but I believe, usually, the head is never disturbed. I always thought that the reason why the head is made a separate casting is because it can be planed together with the tail-stock on an arbor, to fit ways, and so get the two spindles in line. There is no need of doing it in this way; there are other ways that are cheaper and more accurate, and can be used with the head cast on. I made the remark to a shopmate some time ago, that I thought the head-stock might as well be cast on. He said if he were building lathes he would not dare to make any radical changes, for it would take too long to convince people that the changes were good. This is very true. A man may step boldly out of the well-trodden tracks by making some radical change; other will quietly look on, and if his undertaking is successful they will copy; if not, it is the usual "I told you so."

I have thought it might be a good plan to chill the outside ways in the mould, and finish by grinding. I am not prepared to say if this would be practicable, but I think if done in this way it would be a great improvement. Some makers now make a long carriage. I believe it would be an improvement to make the carriage longer than it is ever made now. It need not maintain the same size all the way, but might be made in the form of a good heavy guard; this would keep the constantly dropping chips and sand off the ways, and the large wearing surface and hard ways would well resist wear. The split taper boxes would be good, if we make provisions to prevent great wear on the ways; a new set of boxes, after the old ones have got worn, will restore the spindle to its original position, and we will still have an accurate lathe.

The spindle should be long and stiff, and be of hardened steel, or at least have hardened steel bearings, well ground and lapped.

I should use brass boxes, and should arrange to have the end thrust in each direction taken at one point, and should use (here) hardened steel and brass.

I do not see the need of finishing the whole top of bed, but believe if the ways alone were finished, and the space between was well rounded out and painted, it would be just as good, and look better.

It seems to me that the usual way of having the tail-stock rest on ways the same as the carriage is the best plan, for it acts as an additional tie to keep the side of the bed together. I think the tail-stock ought (unlike the carriage) to bear on the top of the ways as well as the sides.

Would not the Sellers planer motion (a rack and worm) be a better motion for the carriage, as it would be more even? A rack and pinion motion is not good when we want to make a fine adjustment, as is the case a great many times nowadays in squaring up work in the lathe.

The same handle which locks in the nut for screw-cutting can be made to throw out the worm, and vice versâ, so there would be no possibility of having a smash-up by getting both in together.

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[*] By A Mechanic, in the *American Machinist*.

THE tonnage of the shipping which entered the port of Antwerp in 1890 was 468,325 tons above that of the preceding year. The imports of cereals were 4,000,000 hectolitres more than in 1889.

**Frogs and Wasps.**—The common green tree frog, so often keep in ferneries, has been recently discovered to possess an insatiable greed for wasps. This extraordinary appetite does not seem to be in the least checked by an occasional sting. The protecting colour of the frog, which sits motionless upon leaves, no doubt deludes the most wary insects into a sense of security. The wasp, however, trusting to its formidable reputation, which is duly published and advertised to the insect-eating world at large by bright and conspicuous colours, does not need to be wary. This may perhaps account for the fact that a large Australian tree frog at the Zoological Gardens has the genial effect of its protecting green colour interfered with by numerous white patches and marks. Possibly it started life as a species by preying upon timid insects which were as green mentally as the frog was physically, and were duped into approaching what appeared to be merely a leaf; later on it took to more stimulating food in the way of wasps and bees; and, owing to the boldness of its prey, no longer needed to be concealed.

# SCIENTIFIC SOCIETIES.

## QUEKETT MICROSCOPICAL CLUB.

THE 289th ordinary meeting of this club was held on Friday, January 16th, at 20, Hanover-quare, Mr. A. D. Michael, F.L.S., vice-president, n the chair.

The minutes of the preceding meeting were read nd confirmed. Ballot for four new members was aken, and they were duly elected.

A list of the nominations for president, vice-residents, and other officers made by the com-nittee was read by the secretary. The meeting hen proceeded to nominate members to serve on he committee in place of the four seniors, who etire in rotation.

Mr. E. M. Nelson exhibited a microscope to which he had had fitted a telescopic draw-tube in wo sections, made to slide very easily. He said hat, although, of course, this was not a new idea, t would be found a most useful arrangement for ising objectives adjusted to various body lengths, nd also for the purpose of adjusting the objective tself to different thicknesses of cover. For this it was very essential that the movement should be asily worked, and, at the same time, not liable to ecome loose, and this was effected by making the lides the same as they were in the best class of elescopes.

The Chairman said that, besides the purposes tated by Mr. Nelson, such an arrangement as now hown was invaluable for microscopic drawings when these had to be done to scale. It was, of ourse, far easier to regulate the size of the image y lengthening or shortening the draw-tube than y changing the objective or eyepiece, as by the ormer method it could be made with the greatest ccuracy.

Mr. C. J. Pound read a paper "On Spirochæta rom Brent Water at Neasden," and "A Tetracoc-us from Pond Water at Woking." He described he method of making pure cultivations of these nd similar organisms, and the preparation of terilised nutrient media. Mr. Pound also made ome remarks on the permanent preservation of late-cultures of certain chromogenic bacteria, and n impression preparations for use with the lantern r microscope. The subject was illustrated by a eautiful series of plate-cultivations of B. figurans nd other species of chromogenic bacteria, tube pecimens, and photographs.

A cordial vote of thanks to Mr. Pound for his nteresting paper was proposed by the Chairman, who said that members would look forward to ther papers from one who was evidently quite at ome in this difficult but most promising study.

The annual general meeting will be held on Friday, February 20th, for the election of officers nd other business. The Presidential Address will e given by Dr. Dallinger, F.R.S.

## THE LANTERN SOCIETY.

ON January 12th, E. M. Nelson, F.R.M.S., delivered a lecture on "The Lantern in its Relation to Photography and the Microscope." Speaking of the fittings of a lantern, the lecturer bserved that no matter what kind of jet was used, t a certain pressure they will always kiss, and his cannot possibly be avoided. As regards limes, he conventional ones with a hole through them ppeared to be specially constructed with the view f making them easy to crack, and he advocated the se of a disc of lime, the jet playing on a point near he circumference, and the disc being revolved as t got pitted. He strongly objected to the use of nany taps as being likely to lead to confusion, and xplained a simple arrangement of taps of his own. Speaking of condensers, he described various forms, ointing out that for oil lamps having a large uminant, a condenser of long focus was required; lso explaining that the effective diameter of the ack lens was very much less than the diameter of he lens itself. Some very interesting experiments were carried out with condensers of various forms, he best shown being a triple one which showed a emarkable superiority in the brilliancy of the icture over all the others. Speaking of the lantern n its relation to the microscope, the lecturer eferred to Abbe's researches with apochromatic enses, and pointed out the superiority of photo-raphic lantern slides of microscopic objects over the rojection microscope for exhibiting results to an udience. The lecture was illustrated with micro-ope and other slides. The discussion afterwards rned mainly on the experiments which had been own with the condensers, which appeared to have cited general interest.

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**Tempering Cold Chisels.**—Heat the chisel at low heat so as not to raise a scale. Dip in a brine clear salt and water. About one quart of salt to n of water is the right proportion. Leave heat ough in the tool to run the temper down to a uired hardness, which is shown by the pigeon-e colour. Take care to make the chisel stout ugh that it won't spring in the using.

# SCIENTIFIC NEWS.

THE *Monthly Notices* of the R.A.S. contain a note on "Hind's Variable Nebula in Taurus," by Mr. Burnham, in which he says that the nebula is easily found from the 8·7 mag. star D.M. + 19°, 704, which is 15s. *p.* and 4′ S. Neither Mr. Barnard nor Mr. Burnham could on any occasion see the slightest trace of Otto Struve's nebula (observed at times by D'Arrest, Tempel, and others, but invisible in the Rosse), nor any nebula in the immediate vicinity. Nothing seems to be known of the variable T Tauri, which seems to have been as much neglected as the nebula.

An abstract of the observations of Spectra of Sunspots in the region B—D, made at Stonyhurst by the Rev. A. L. Cortie, S.J., is given in the *M.N.*, and the paper will be published in Vol. L. of the "Memoirs." The observations are divided into two periods – the "disturbed" period, from 1882 until the autumn of 1886, and the "quiet" period, from the autumn of 1886 until June, 1889. There are some notes on this important paper on p. 373.

Observations made at Turin give the mag. of U (nova) Orionis, according to Sig. Porro, as varying from 8·81 (Nov. 21, 1889) to a maximum of 5·80 (Jan. 21, 1890). Mr. S. C. Chandler, of Harvard, gives the period as 371 days, with a maximum on Dec. 7, 1885; but Sig. Porro gives it as 378·5 days from the epoch Dec. 7, 1885.

The death is announced of Mr. Henry Bowman Brady, LL.D., F.R.S., in his fifty-fifth year. The son of Mr. H. Brady, a well-known surgeon of Gateshead, Dr. Brady early developed a taste for zoological and biological studies, and soon became known as an expert microscopist, while his intimate knowledge of the Foraminifera pointed to him as the best man to do the report on that branch of the dredgings made during the voyage of the *Challenger*. That is his magnum opus, for it extends over 800 pages, and contains more than 100 plates. He was also the author or joint-author with Dr. Kitchen Parker or Prof. Rupert Jones, of many important papers connected with natural history. Carefully-selected series of specimens set up by Dr. Brady himself are in the Natural History Museum and in the University Museum at Cambridge.

Mr. George Gulliver, M A., M.B., F.R.C.P., is another victim to acute pneumonia from the ranks of the medical profession. Too young to be widely known to the public (he was only 40), he had attained such positions as senior assistant physician, lecturer on comparative anatomy, and demonstrator of morbid anatomy at St. Thomas's Hospital. The only son of the late George Gulliver, F.R.S., he inherited his father's love of natural science, and, in 1874, went to Rodriguez, as naturalist, with the Transit of Venus expedition, his report on the zoology of the island earning him the thanks of the Royal Society. Dr. Gulliver also visited Egypt during the last cholera epidemic, and contributed a paper on the etiology and pathology of that disease to the Epidemiological Society.

M. Clavaud, professor of Botany at Bordeaux, is dead. His work, the "Flora de la Gironde," is incomplete, but such parts as have been issued are all that could be desired.

The death is also announced of Herr Ignaz Rejacher, the founder of the Meteorological Observatory on the Sonnenblick, overlooking the Rauris Valley. It is the highest weather-observing station in Europe, and for several months in the year is shut off from all communication with the valley. Herr Rejacher was a great promoter of scientific pursuits in Austria.

The medals and funds to be given at the anniversary meeting of the Geological Society of London on February 20 have been awarded by the Council as follows:—The Wollaston Medal to Prof. J. W. Judd, F.R.S.; the Murchison Medal to Prof. W. C. Brögger, of Christiania; the Lyell Medal to Prof. T. McKenny Hughes, F.R.S.; and the Bigsby Medal to Dr. G. M. Dawson; the balance of the Wollaston Fund to Mr. R. Lydekker; that of the Murchison Fund to Mr. R. Baron; and portions of the Lyell Fund to Messrs. C. J. Forsyth Major and G. W. Lamplugh.

The Council of the Royal Meteorological Society have arranged to hold at 25, Great George-street, Westminster, on March 17th to 20th next, an exhibition of rain gauges, evaporation gauges, percolation gauges, and kindred instruments. The committee will also be glad to show any meteorological instruments or apparatus invented, or first constructed, since last March, as well as photographs and drawings possessing meteorological interest. Communications should be sent not later than Feb. 10.

The annual general meeting of the Institution of Mechanical Engineers will be held on Jan. 29 and 30, Mr. J. Tomlinson in the chair. After the routine business has been transacted, the following papers will be read and discussed as far as time permits:—"On Some Different Forms of Gas Furnaces," by Mr. B. Dawson; "On the Mechanical Treatment of Moulding Sand," by Mr. W. Bagshaw; and the Fourth Report of the Research Committee on Friction—"Experiments on the Friction of a Pivot Bearing."

It may be of interest to note that the lowest temperature recorded at Greenwich during December last was on the 22nd, when the thermometer registered 13·4°. There are only three instances of lower temperatures in December during the last fifty years, singularly all on Christmas-day—viz., 1860, 8°; 1870, 9·8°; and 1878, 12·2°.

Canon St. Vincent Beechey sends us a sketch of the sun as it appeared from Hilgay Rectory, Jan. 18, 4.15 p.m. Unfortunately, we cannot reproduce the sketch with proper effect, but to use the Canon's words—"the strongly-marked perpendicular ray ascended to a great height, and seemed to rise in front of a dark stratum of cloud. It was at first of a bright yellow colour, the setting sun being redder. As the sun went down it assumed a rosier hue." Has any other correspondent a note of such an appearance, as the Rev. St. Vincent Beechey, in his long life, has never seen anything like it before?

The announcement that a parcel of tea from the Gallebode Estate, Ceylon, was sold by auction at the price of 87s. a pound will cause some astonishment wherever the news reaches, especially when it is mentioned that the tea was resold at 110s. per lb. It is stated to have been a "perfectly wonderful and previously unheard-of specimen of tea," of most extraordinary quality, "the leaves being of the brightest golden colour, in appearance almost resembling small pieces of gold." Some of our readers who are engaged in tea-growing will no doubt hear more of this wonderful tea.

A section of the Manchester Field Naturalists' Society are endeavouring to set on foot a movement for investigating the air of Manchester and Salford in relation to its effects on animal and plant life. The section of the society to which the work will be intrusted will pursue their investigations in unison with similar sections in London and elsewhere.

At a meeting of the Photographic Society of Great Britain, Mr. E. W. Maunder, F.R.A.S., delivered an address on "Photography applied to Astronomy," and exhibited some excellent photographs which attracted much attention. In closing the discussion, the chairman (Capt. W. de W. Abney) said he was pleased to notice that Mr. Common's reflector had done work so excellent, and expressed the opinion that it was a great mistake on the part of the Paris Congress to insist on the use of refractors for the photography of the general chart of the heavens.

A bit of fast steaming was done by the *Umbria*, of the Cunard line recently, as she succeeded in landing passengers, with the assistance of the railway at Euston, in seven days two hours, from passing Sandy Hook. The run from Queenstown was accomplished in 10 hours 40 minutes, high speed being kept up in order to "save the tide."

Some experiments with a vessel called the *Evolution*, built by Mr. W. M. Jackson, of New York, may shortly create great interest for those who think much of hydraulic or jet propulsion. According to some writers, the system will "supplant the side wheel and the screw wherever speed and economy are estimated at their full importance." We shall see.

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WHAT would the British or Irish farmer not give for an acre of land which would produce 974 bushels of potatoes! This is the amount accredited to a farmer in Wyoming on virgin soil, rich in potash, and irrigated by water largely impregnated with saline matter.

# LETTERS TO THE EDITOR.

*[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]*

*All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

*All Cheques and Post-office Orders to be made payable to* J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

### SPECTROSCOPIC MEASURES OF STELLAR MOTIONS — THE VERY LATEST MARE'S-NEST FROM SOUTH KENSINGTON — COMPARISON OF PLACES OF THE MOON — LUNAR RAYS — COMETS — LENSES AND MIRRORS—MEASURING THE FOCAL LENGTH OF A TELESCOPE—PACKING TELESCOPES FOR TRAVELLING — LIEUT. WINTERHALTER ON EUROPEAN OBSERVATORIES — SCARING BIRDS — GREEK ACCENTS — DIAGONAL PRISM—A PRIME MERIDIAN.

[31997.]—BEFORE reading the immediately succeeding paragraph, I would beg everyone about to peruse this letter to turn back to p. 416, and make himself thoroughly acquainted with Prof. Young's very able and interesting article on "Spectroscopic Measures of Stellar Motions," which you there reproduce.

When, some couple of years ago, I commented unfavourably upon what passes for "astronomy" (Heaven save the mark !) at South Kensington, I was accused in these columns by a gentleman named Arman (letter 29792, Vol. XLIX. p. 110) of having "no love for Prof. Norman Lockyer," being actuated by "spleen," and so on and so forth. A very recent painful experience acquired by the Royal Astronomical Society may, perhaps, suffice to show what utterly irredeemable trash may be, and has been, "communicated" by the somewhat amply remunerated head of the "Astronomical" Department at Brompton to a learned society, and may suffice to convince everyone capable of viewing both sides of the question in a judicial spirit that my assaults upon the "astronomy" of that region are by no means without warrant. On November 14, then, at the meeting of the Royal Astronomical Society (vide p. 288), a paper entitled "A Preliminary Note on the Duplicity of α Lyræ," by A. Fowler, was "communicated by Prof. J. Norman Lockyer, F.R.S.," but was read by Mr. Fowler himself. In it (as may be seen in your own report, *loc. cit.*) there was an account of the duplication of the K line in the spectrum of α Lyræ, in certain photographs of a series, that line remaining sensibly single in the rest. A table of the separation of the K line in tenth-mètres on successive occasions was given, together with the (alleged) "Relative Velocity in the Line of Sight" deduced from them; in connection with which I may say, incidentally, that arithmeticians are eagerly awaiting an explanation of the method adopted in calculating these results, even assuming the accuracy of the data on which they were founded. Moreover, to give a more distinctly mathematical flavour to the paper, a wonderful diagram was appended, in which the variations are supposed to be "represented by the curve of sines" (with which, as was orally remarked at the meeting on the 9th inst., they had as much—or as little—to do, as with the law of sky-signs which is being enforced by the London County Council), the final conclusions reached being that α Lyræ was a double star, the components of which described a circular orbit whose plane passed nearly through the Sun, with a period of revolution of 24·68 hours. This paper, I should observe, was read at the end of the meeting, and no discussion took place upon it. Fortunately for the cause of scientific truth, but unfortunately for the credit of the Royal Astronomical Society, it was printed in the November number of the *Monthly Notices*, where it at once attracted the attention of a very much greater man than Mr. Fowler or Mr. Lockyer either—I mean our distinguished foreign Associate, Prof. Vogel, of Potsdam, who had himself been photographing the spectrum of α Lyræ assiduously. His absolutely crushing exposure of the latest South Kensington mare's-nest given on Friday week must be read in its entirety to be appreciated. I do hope that our Editor will find room for it in these columns when the next number of the *Monthly Notices* is issued. As for poor Mr. Fowler, he is profoundly to be pitied. How he got his double K line goodness only knows. Perhaps someone shook his camera. I think, though, that he has received a salutary lesson. It is rumoured that he—or someone in the "Department"—has photographed *triple* lines in another bright star. If, so, they will doubtless be suppressed. The moral of all this is not far to seek. It should teach every astronomer who grasps the significance of the facts, the salutary lesson, never to accept *any* "discovery" supposed to have been made at South Kensington until it has been corroborated by entirely independent testimony of sufficient weight and importance. I think, too, that our own Council of the R.A.S. may learn from this the absolute necessity in the future of referring every single paper from Brompton to an expert or experts before allowing it to appear in our publications. It may save us from becoming a laughing-stock in America and on the European Continent. By the bye, the fruit-salt and skin-soap style of puffing advertisement of "the Meteoric Hypothesis" and its author, which appears in the *Times* of January 10th, reads oddly in connection with such an *exposé* as that of which I have been speaking, following as it has done so swiftly on those of Dr. and Mrs. Huggins, Profs. Liveing and Dewar, Mr. Keeler, &c.

It may be worth while to mention, in connection with the second paragraph of your Scientific News, on p. 418, that it was the cost of computation of the tables to which you there refer that were defrayed from the Government grant. The very considerable expense of printing them was borne by the Royal Astronomical Society itself.

Premising that the absence of any sensible atmosphere on the moon would of necessity render the fall of meteoric dust at once more easy and more abundant than it could be upon the surface of the earth, I will just say (in connection with letter 31914, p. 420) that Mr. Peal's "homely illustration" supplies me with exactly what I want. Accepting it for my present purpose, I will venture to point out that although one of his scraped-off lines would (unless the room were *very* dusty) show as a streak lighter than the rest of the globe at the end of the week, it might reasonably be expected to appear homogeneous with the rest of the surface after the lapse of, say, 244 years! Did Mr. Peal ever hear of a Polish nobleman named Hevelius, who produced a work entitled "Selenographia" about the year 1647? Or, coming down to more recent times, can he be unfamiliar with the selenographical researches !of the Elder Herschel, of the classical work of Schröter, and of the subsequent one of Beer and Mädler? Will he, can he, show that the very slightest change has taken place in the Tychonic ray-system since Galileo first observed it? Why, if the colouring on the moon's surface has its origin in meteoritic dust, either such rays as Mr. Peal postulates *must* have been covered up many, many years since, or fresh electrical discharges must continue to take place along their lines from time to time. *Utrum horum mavis accipe!*

I cannot give a categorical reply to query 73385 (p. 428), for the simple, but sufficient, reason that I have no means of access to Guillemin's "World of Comets" at the place whence I write. But I can say, at once and definitely, that Henry's comet of 1873 did not divide, and that hence, in this case, Proctor is certainly right and Guillemin wrong.

And I am practically in the same condition with reference to query 73399 on the same page, as I have only Heath's smaller "Optics" here, and page 69 of that does *not* contain the reference furnished by "L." As for answering the last part of his very modest question, I can only say confidently that there is no one human being living who could do so. There is a list of all the largest refractors in the world, with their apertures (but not their foci), by Mr. Herbert Sadler, on p. 186 of your XXXIXth volume. I know of no corresponding one of big reflectors. Finally, if "L." requires the practical details for which he concludes by asking, he can only obtain those from the actual makers of the objectives themselves. He can ascertain the names of the greater number of them from Mr. Sadler's letter (*loc. cit. sup.*), and write to them seriatim himself.

The focal point of a telescope (concerning which "Telescope" puts query 73401, on p. 428) is that at which the rays from the object-glass cross and form an image of the sun, moon, or any other celestial object, and the focal length of the instrument is the distance between this point, and one, one-fifth of the thickness of the combined lenses of the objective from their exterior surface. Hence, to obtain very approximately indeed the focus of any given telescope, we may proceed as follows:—Taking out the eyepiece, we place over the open end of the instrument a piece of very finely-ground glass (such as used for cameras) with the ground side inwards, or next to the object-glass. Then, turning the telescope towards the sun or moon, we move the eye-tube in or out until the image of the object viewed is defined sharply on the ground glass. Evidently, then, the open end of the eye-tube will be at the focal point of the object-glass, and we can measure the distance of this from the back of the objective by a straight rod pushed up the tube, and add ⅕th of the thickness of the combined lenses. But should "Telescope" possess a very finely-graduated scale and a book of tables of logarithms, he may find the focal length of his instrument more accurately still—in this wise: Let him, as before, get an absolutely sharp image of the sun on the ground glass, and measure its diameter with all possible accuracy in tenths and hundredths of an inch. Now he must turn to the *Nautical Almanac* and find the angular semi-diameter of the sun for the day on which the measurement is made; and then do this sum: As sin. of sun's angular semidiameter : radius—i.e., 1 :: the measure of such semidiameter in decimals of an inch : focal length of telescope. We will work out a concrete example. Suppose that on the 24th inst. we find that the diameter of the sun's image on the ground glass is just 0·4in. Turning to p. 3 of the *Nautical Almanac*, we see that the sun's semi-diameter on that day will be 16′ 17″. Hence we see that 16′ 17″, or 977″, measures 0·2in. on our ground glass screen; so that we have nothing to do but to divide 0·2in. by the sine of 16′ 17″ to get the focal length we are seeking. Thus—

| | | |
|---|---|---|
| 0·2 | log. | 1·3010300 |
| 16′ 17″ | sin. | 7·6754678 |
| 42·2243. | log. | 1·6255622 |

So that the focal length of our telescope would be 42·2243in. Now in the case of a Ramsden or positive eye-piece, the field-lens is placed just outside of this focal point; but in that of the ordinary Huyghenian, or negative, eye-piece, the field-lens is placed *within* the focus, intercepts the rays before they form an image, and itself forms one in the focus of the eye-lens, or the place where the diaphragm is inserted in an eyepiece of this description.

Though not in accurate sequence, perhaps the compositor will insert this paragraph immediately after the one above, with which it has more or less connection. I would say, then, in reply to "Wega" (letter 31973, p. 442) that even the age of the observer enters as an element into the determination of the accurate focus of a telescope for a given object. The young eye possesses a power of accommodation which diminishes with advancing life; so that, to take a familiar instance, while a man of five-and-twenty will see a high star and one near the horizon with practically equal sharpness without change of focus, another, past middle life, will have to move the focussing tube to do so. Another consideration, too, comes in. If we are looking at a faint star, the pupil of the eye is expanded to the utmost. If we are viewing the moon, the glare of light contracts the pupil, and to a small, but appreciable extent, changes the focus of the eye. This is, so far as I am aware, not a subject which has been discussed in any of the textbooks. May I say half-a-dozen words in connection with "Wega's" concluding sentence? I am, as a rule, "miles away from my library" once a year, when I take a month's holiday. Surely my querist does not regard me as a salaried officer of this paper, kept in a back office by you, Sir, expressly to answer questions!

I do not think that Captain Battersby (query 73402, p. 428) need fear that the definition of his telescope will suffer if it is properly divided. At all events, I remember a Dollond of about the size of his which was centrally divided (one half, by the way, screwing into the other, without any external collar), for convenience of package, and which left nothing to be desired in respect of defining power. But the division will have to be made in a lathe of which the mandrel runs very true. As for packing a telescope for transit, I have known a pretty big instrument travel safely in the hold of a "trooper," simply packed in a stout deal case. But, of course, the object-glass was carefully done up in cotton wool, etc., and carried in its owner's cabin. I do not think, judging from personal experience, that my brother F.R.A.S. need be the least nervous as to his tube, if he will only have its box strengthened a bit.

Among the leading observatories in the world that of Harvard College, at Cambridge, in the United States, occupies, as is well known, a foremost place. Hence astronomers will welcome a very interesting little pamphlet which has just been issued by Prof. Pickering, entitled a "History of the Harvard College Observatory during the period 1840-90," originally written by Mr. David W. Baker as a series of articles in a newspaper, the *Boston Evening Traveller*, and now collected in a book form. Mr. Baker's instructive little book, though nominally confined to a record of the last fifty years of progress at Harvard (its organisation having had its inception at the beginning of the year 1810) shows us how the interest in astronomy manifested in the (then) province of Massachusetts, prompted the fitting out, at the public cost, of a sloop owned by it, to convey Prof. John Winthrop and others to Newfoundland in 1761, to observe the Transit of Venus; while, *malgré* the financial straits entailed by the war, a "galley" (some

of war-ship), was despatched to Penobscot
780, to take Prof. Samuel Williams and
to observe a total eclipse of the Sun.
he history of the observatory proper really
s with William Cranch Bond in 1840, the per-
f the account of whose connection with it may
e commended to all those who can appreciate
-hearted devotion to science and an exalted
of duty. Let any Englishman read of the
ces, both personal and pecuniary, that this
American made in the cause of science, and
st his behaviour with that of the wretched
f cadgers in this country who have clamoured,
re clamouring, for "the Endowment of Re-
" (which, being interpreted, signifies paying
exorbitantly for advertising themselves), and
be strange if he does not blush at the con-
To Prof. W. C. Bond succeeded his son Mr.
Bond, who was succeeded in turn by Mr.
h Winlock, on whose death the present
nt director, Prof. E. C. Pickering was
ated. It would be filling space for filling's
vere I to attempt here to give any detailed
nt of the work which has rendered Harvard
vatory famous wherever astronomy is
ated in the civilised world. The Harvard
metry and the part which the observatory has
in celestial photography and spectroscopy will
e occur to every reader of these lines. Any
r details must be sought in the pages of the
book of which I am speaking. Perhaps,
h, in these days when the photography of the
ns is making such rapid strides, it may not be
ut interest to note that, in 1850, daguerreo-
of Vega were obtained by Prof. W. C. Bond
Ir. Whipple.
a matter of equal scientific, if of less popular,
st, I may mention that Vol. XXIV. of the
als" of the Harvard College Observatory has
een issued, containing the results of observa-
with the meridian photometer during the
1882-88. The nature and value of the
al work of which this forms a portion are so
nown as to absolve me from the necessity of
g anything to this mere mention of its appear-

gret my inability to give an absolutely definite
r to "J. A. F." (letter 31979, p. 443), as the
ican Government do me the honour to present
ith their Official Astronomical Publications;
should think that the volume to which he
would hardly be procurable under a guinea
enty-five shillings. Messrs. W. Wesley and
28, Essex-street, Strand, London, W.C.,
doubtless obtain it for him, and would also
e to inform him at what price it is published.
en Mr. Vinicombe recommends "Old Jack
e's Boy" (in reply 73252, p. 447) as a bird-
, does he not rather ignore the 39 and
t. c. 79, and 43 and 44 Vict. c. 23, s. 4?
g Master Hodge must now be learning decimal
ns, freehand drawing, and geography, at the
hen he was formerly allowed to earn a little
ghtening birds; by the time he is emancipated,
s now at much higher game.
"Aktis" (query 73438, p. 450) gets on, he
d that the Greek accents have very little to do
he pronunciation of the words. The (so-called)
tus asper" is the principal one he need trouble
lf about in the beginning. It is equivalent
aspirated H. Thus, 'Αδης is pronounced
.

eply to "Junior" (query 73474, p. 451), the
listance between the object-glass and the eye-
must remain invariable, whether a diagonal
be interposed or not, so that it resolves itself
question of measurement with a two-foot
hether the focussing-tube of his telescope
require cutting or not. Of course, a prism
he eyepiece simplifies everything very much
l, though at the cost of a somewhat contracted

e is yet another illustration of the ignorance
nce displayed by Government officials, and of
nner in which we are tied and bound by the
f red tape. I cut it out of the paper on
lay morning, the 17th.
the weekly meeting of the Balloon Society,
st night at St. James's Hall, Piccadilly, Mr.
Lefevre, President, in the chair, a letter was
rom Sir James Fergusson, Under Secretary
oreign Affairs, writing on behalf of the
is of Salisbury, with regard to a resolution
subject of the prime meridian, passed at a
meeting of the Society. Sir James said he
structed by Lord Salisbury to acknowledge
otest of the Society against the adoption of
lem instead of Greenwich as the prime
an of the world. The resolution had been
ded to the Science and Art Department,
was the adviser of the Government in these
s. The President added that he was in-
that the Goverment did not intend to be
nted at the Conference on this subject to be
Rome during the present year. A more
ous idea than the alteration of the prime
n from Greenwich to Jerusalem could not
imagined.
ising that I wholly fail to see what a "Balloon Society" (whatever that may be) can have to do with the question of prime meridian, I would invite particular attention to the mere idiocy of referring such a question to "the Science and Art Department." God help Her Majesty's Government if they have no better "adviser" than that! This is pre-eminently a matter on which the Royal Astronomical Society and the Astronomer Royal should have been consulted. Any information the Foreign Office is likely to obtain from South Kensington upon this subject, will be about as valuable as that which they could procure from the Manchester Unity of Odd Fellows—there or there about.

**A Fellow of the Royal Astronomical Society.**

## PROCTOR'S "OLD AND NEW ASTRONOMY."

[31998.]—On arriving in England only a few days' since, I took up a copy of the English Mechanic—as an old favourite of my husband's—and in the report on the "Progress of Astronomy in 1890" I was sorry to find the following: "The 'Old and New Astronomy' of the late Richard A. Proctor, which was to have been completed by a gentleman currently reported to be of Mrs. Proctor's own selection, seems to have come to an untimely end altogether." I am glad to be able to say that this is not the case. Eleven parts have now been published, and the last part (XII.) will, I hope, appear in the course of a month or six weeks. I was aware when I, with others, pressed Mr. Ranyard to undertake the completion of this work, that he had other and pressing duties which would delay its completion; and, though the delay has been longer than Messrs. Longmans and I expected, I trust that the English public has not forgotten my husband's work, and will welcome this book, which he had long prepared for, and had intended to make his most important work.

Your readers may be glad to hear that some of Mr. Proctor's friends in that most astronomical State of the Union, California, are proposing to found a "Proctor Memorial Observatory" near San Diego. It will be made a teaching institution, open to the public every night from eight till ten. The ground has already been given, and an 18in. achromatic ordered from Messrs. Alvan Clark and Sons. I hope that before another year has passed sufficient money will have been collected to enable us to put up the necessary dome and buildings. I have come over to England to lecture, and, if possible, to interest the English public in the "Proctor Memorial Observatory."

**S. D. Proctor.**
(Widow of the late Richard A. Proctor.)
5, Montagu-street, Russell-square.

## THE MOON'S ATMOSPHERE AND WATER.

[31999.]—Either I must have expressed myself badly, or Mr. Ranyard (31968) must have read my first letter hastily and carelessly, to justify his arrival at the conclusion that I am one of those who "have spoken of the height of the moon's atmosphere as if it was quite indeterminate, and depended upon the amount of atmosphere or gas surrounding the moon." What I said was precisely the reverse of this. My words were:—"Gravity is the power which restrains the indefinite expansion of an atmosphere into space. This being less at the surface of the moon than that at that of the earth, the moon's atmosphere (if it has one, and whatever may be its density) should extend further into space than does that of the earth." I really do not see how I could have more clearly expressed my opinion that the extent of the moon's atmosphere does not depend on its amount, unless I had indulged in prolixity. On this point Mr. Ranyard's views and my own are identical, and of course I am gratified to find my anticipations confirmed. His calculation is precisely what I had made at the outset for my own guidance, although I have seen occasion to modify it, so as to extend rather than to restrict its significance.

In one respect Mr. Ranyard and I do not agree. He assumes that, neglecting differences of temperature, all the strata of an atmosphere are of the same thickness. He overlooks the fact—a most important one in respect to an atmosphere on the moon—that the super-imposed strata undergo an ever-decreasing gravitational value. He argues as if pressure and density were convertible terms. They are so at the surface of a globe; but they are not convertible in a comparison of the lowermost stratum of an atmosphere with its upper strata, nor are they convertible when comparing one atmosphere with another. In regard to the strata of an atmosphere, Mr. Ranyard's proviso, "neglecting differences of temperature," should be amended by adding, "and neglecting also differences of gravity." This latter difference should not, however, be neglected, because it is a rapidly-increasing difference, whereas the difference of temperature proceeds in a diminishing ratio, being greater in the lower stratum than in the higher strata.

Keeping these considerations in view, I am prepared to maintain that (1) the quantity—that is, the number of molecules—of the earth's atmosphere below the datum line of 3½ miles is less than the quantity above that line; that (2) the corresponding datum line in a lunar atmosphere is higher than 21 miles; and that (3) the height of a lunar atmosphere must be enormously greater than six times the height of the earth's atmosphere. Taking the gravity at the surface of the moon at one-sixth of that on the earth, it appears to me that the gravity of the molecules of a lunar atmosphere at a height of about 1,000 miles above the lunar surface can only be one twenty-fourth of their gravity at the earth's surface, and that, therefore, it cannot be right to assume that the gravity of a lunar atmosphere averages so much as one-sixth of gravity at the earth's surface. I say nothing here of another element in my favour—namely, the growing increase, with elevation, of the gravity of a lunar atmosphere towards the earth and sun.

The concluding sentence of Mr. Ranyard's last communication requires to be supplemented. It is perfectly true that the presence of water in any form on the moon implies the existence of an atmosphere with a pressure at least equivalent to the pressure of aqueous vapour at a corresponding temperature; but he might take another step and tell us what the density of a lunar atmosphere at that pressure should be.

I am glad to find that the differences between Mr. Monck and myself are reduced to mere matters of opinion, and do not call for further argument.

January 19. **Ja. Ha.**

## THE MOON'S ATMOSPHERE.

[32000.]—If matter above the absolute zero of temperature evaporates even to exert a pressure, then there must be an atmosphere around the moon, though possibly of a vastly different character to our own. **S. H. B.**

## GLACIATION OF THE MOON.

[32001.]—In reply to "W. J. S." (letter 31969), who, on page 441, refers me to Prof. Tyndall's statement as to the amount of thickness of ice that the solar heat is able to melt at the earth's surface in a year, I wish to draw attention to the fact that Prof. Tyndall assumed the ice in question to be already at the freezing point (32° Fahr.), and the solar heat is thus expended entirely on *melting* the ice, whereas on the moon it has first to raise it to the freezing point, if Mr. Peal's theory is correct, which makes all the difference.

Does "W. J. S." believe that this statement of Prof. Tyndall necessarily implies that 100ft. of ice is melted on the earth in a year over all those parts where its surface is perpetually glaciated?

I should also like to point out that, although "W. J. S." states that "Without an atmosphere the solar rays must be more powerful on the moon than on the earth, and therefore melt more ice there . . . .," yet it is a curious fact that on the earth perpetual glaciation exists chiefly in those high altitudes and latitudes where the terrestrial atmosphere is more rarefied, or clearer, or both of these combined, than elsewhere, which fact seems to me at variance with "W. J. S.'s" conclusions, and to support the theory of Mr. Peal.

Shanklin, I.W., Jan. 18. **H. G. Dixon.**

## IS THE SUN A SOLID BODY?

[32002.]—The following ideas have occurred to me in reading the late numbers of your paper, to which I have recently become a subscriber. Is it not possible that the sun is a mass of energy (excuse the phrase, for the want of a better one) which we know in the various forms of electricity, heat, and motion? That these forms bear a similar relation to the parent (the sun) as colours do to solar light? That this energy, after fulfilling its mission in the Solar system, is not destroyed, but percolates into space, to ultimately find its way back to its original source? That the mass of energy (the sun) has the power of gravity, and reduces matter which finds its way there into an incandescent envelope? If the sun is an immense fire, where does the supporter of combustion come from? **S. H. B.**

## TELESCOPE FOCUS.

[32003.]—Taken literally, "Wega" (letter 31973) may well be astonished at the statements he quotes from Webb and the *Photographic Journal*. They seem unwarrantable conclusions drawn from *abstract theory*, rather than from actual observation, and in that sense they are true enough. To satisfy the law of conjugate foci, the rays coming from an object in the sun must come sooner to a focus than those from the same object placed on the moon. *How much* sooner, or how much shorter a focus they will produce, perhaps some mathematical correspondent will tell us, and we shall then see whether the difference between these two foci is large enough to be appreciated by our instruments. Lucky would be the observer who possessed an eye or a telescope capable of dealing with such minute differences.

I do not think that optical art can as yet so *definitely* fix the foci of a system of lenses, nor that the sight of man is sufficiently keen to judge of their identity, and exact spots, to satisfy theory.

A. Caplatzi.

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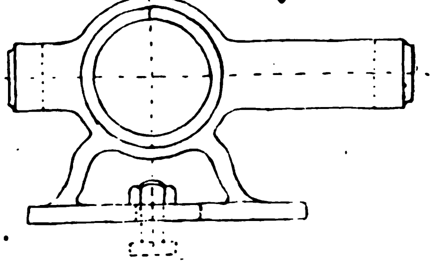
## THE REVOLVING NUT—OVAL CHUCK RING—SHARPENING DRILLS, &c.

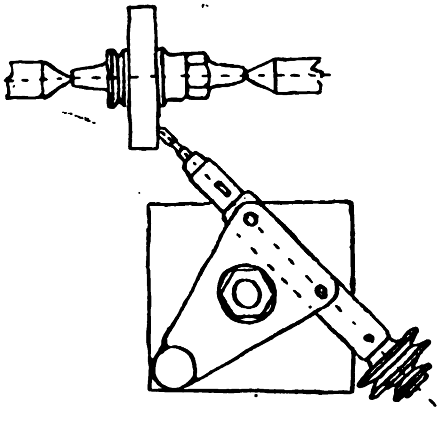
[32004.]—WITH regard to the *revolving nut*, suppose a thread of 5½ turns to the inch is required and 2ft. long, you would not care to treadle the slide-rest back; in the Cooke lathe, you must give the handle $\frac{24}{\cdot 4} = 60$ turns, taking, say, half a minute. In the L.L. and T. Co.'s lathe you require $\frac{24}{\cdot 25} = 96$ turns of handle on end of screw, say 48 seconds, two turns per second in both cases; but now comes the question of running into the cut again, and, I think, if the nut is to be brought back to an index mark, whilst the mandrel and screw remain stationary, that it must be moved 5½in., or some multiple of 5½in., which would be, for 24in., 27½in. Is this correct?

Fig. 1



I congratulate "Rushlight" on his success with his simple *oval chuck*. I think it was probably because the front of his headstock was not got up true that he was led to fix a board with wire, &c. I send Fig. 1 to show how an oval chuck ring may be made to stand on the bed. Mine has screws, as usual, in the ears, but I doubt whether it is necessary to have them, provided the sole of the ring is guided by the front of the headstock, so as to keep it parallel. It is of course just as easy to mark the divisions on the slides of the chuck as on the ring in the orthodox way. I got my castings from Milnes. I should advise "Rushlight" to get a good firm ring, and the rest of his chuck he can renew as it wears out.

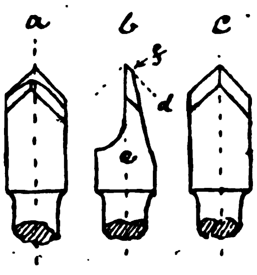
Fig. 2



I was delighted to see the kind reply of "Earlswood Park," and have very much appreciated his excellent articles. I should much like to see the lengthening spindle of the spherical rest, and the way to combine the spherical rest with the change wheels. I should also much like to read a good article from "E. P." on the sharpening of ornamental drills, cutters, and slide-rest tools for ornamental turning. The side tool, for instance, in which the edge should be parallel with the shank, the pointed drills V-shaped, of which I wrote last week. Perhaps I may say I have found I could get the points true by putting a small emery-wheel between the centres, to drive from the overhead, and then fixing the driller with drill to be sharpened upon the tool-plate of rest, so that the point presents at the correct angle to the wheel, and then turning the pulley of driller by the hand as the drill is brought up to the revolving wheel by the slide. This *centres the point*, and equalises the angle. Of course, it produces a point shaped like a half-cone, which would not cut; but then, it is easy to apply the drill to the emery wheel to bring up the edge. The little sketch at Fig. 2 shows the arrangement. Fig. 3 shows the effect on the drill point at (*a*), where the drill is supposed to have got ground to one side and been rectified by the emery wheel; at (*c*) the cutting edges have been backed off on the wheel by hand, and are ready for the oilstone; at (*b*) the side of the drill is seen to show the importance of grinding to a sharp enough angle, *d b e*, else the heel of the drill *f* will rub, and disturb the position of the point, making it impossible to get the bottom of a V-groove out sharp and clean.

As to the necessity or otherwise for the binding-screw, as advised by "C. C. E.," I wish someone accustomed to the use of the American milling machines would tell us whether the arbors ever work loose, and, if so, whether this can always be traced to bad fitting? I gather from a recent correspondence in the *Am. Mech.* that they do work loose sometimes, and I wonder some kind of binding screw has not been used there.

Fig 3



I am delighted to find the articles on "Lathe Appliances" are to be continued. Let me assure "E. P." that one of his readers, at any rate, is "sufficiently interested."

I thank Mr. Maclean and "C. C. E." for kindly answering some of my queries. I have seen one of the little drillers referred to by Mr. M.; it would not throw out very far—not more than ¼in., I think—and it must require great care to get the point true that way, and would take as long as to grind it true. I think it was partly because it seemed so difficult that I wanted to get the groove out quite sharp. I think the little facet at the end of the point is just the thing to do.

I am not sure whether my plan of forming the little cutters like drills is quite understood. Surely the drill shape is the proper one where interchangeability is required. I don't see that it need entail greater length. The square-shaped shanks will never be made so exact that will go in without shake, whilst it is easy to do it with the cone shape.

I have tried Madagascar redwood, and think it contains silica, and is, therefore, rather inclined to blunt tools. I have also tried Indian redwood, and like it much, though it will only stand ornamental cutting when rather bold and on the end grain; side grain it is very apt to break away. The wood is very sound, can be had of large size, and is of a very fine scarlet red, something like ivory stained red, and about as hard as boxwood.

F. A. M.

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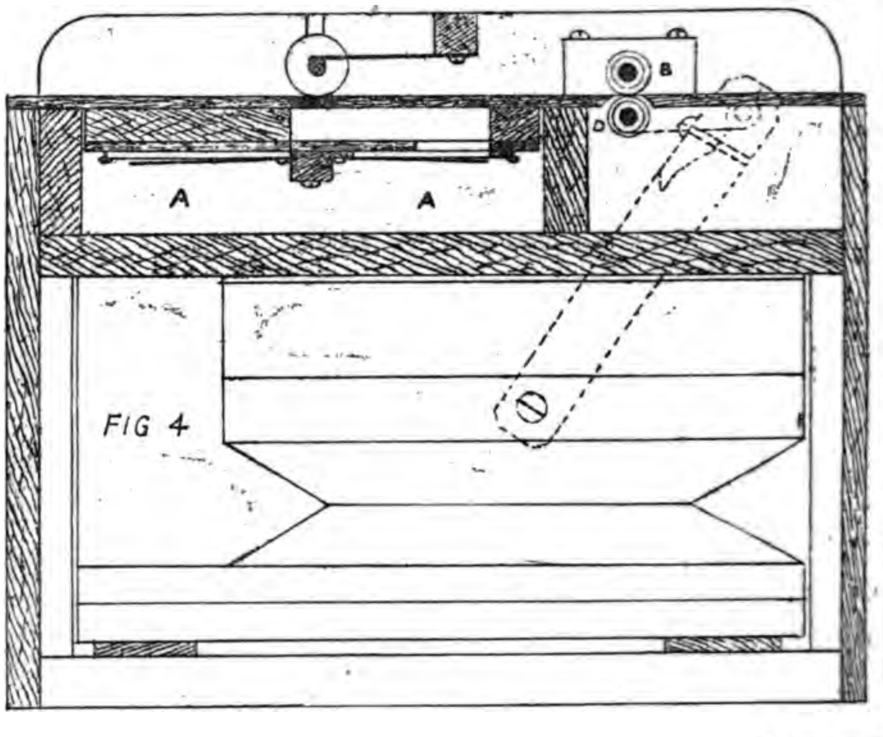


FIG 4

## ORGANETTES.

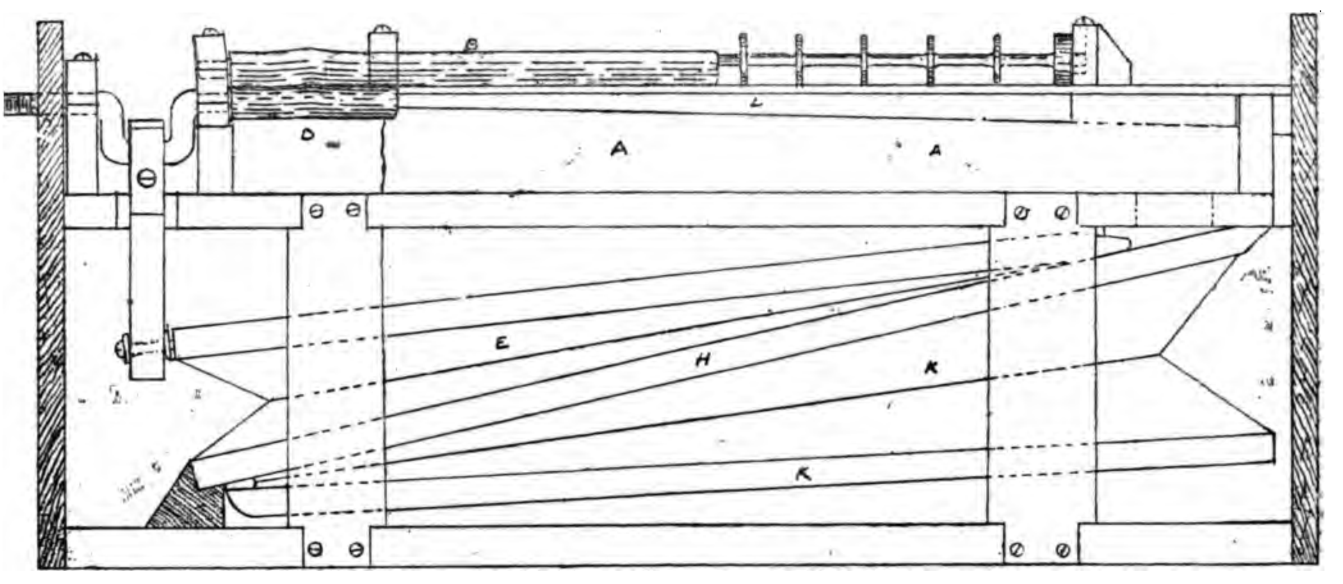
[32005.]—HAVING dealt with the component parts separately, we may now consider them in combination. The first example is one in which the tune-band itself acts as the valve, and in which the reeds are sounded, as in a harmonium, by forcing the air outwards by means of pressure bellows.

Fig. 4 shows a cross-section taken very near the end of the instrument. Fig. 5 is a longitudinal section; but neither is taken exactly on one plane, in order the better to show the construction of different parts simultaneously.

In Fig. 5 the back of the windchest has been partly removed to show the interior. A A is the windchest, which is shown about 15in. long by about 5½in. broad, being suitable for reeds spaced and arranged as in Figs. 1, 2, and 3. The bottom, the front and back, and the ends are permanently fixed together, and may be of ½in. stuff carefully glued up so as to be perfectly air-tight. The upper edge all round is covered with soft leather, evenly glued on in order to make a tight joint with the upper board B when the latter is screwed down in its place. To the under side of this upper board is attached the reed pan with its channels and reeds already described. Though the width of the channels is constant, their length varies with that of the reed, the outer end of the channel coinciding with the end of the opening in the frame of the reed. The depths also vary from about ½in. at the lower end to a bare ¼in. at the highest reed. This channel block may be either sawn out, and have only the end strips attached separately, or may be built up of distinct pieces throughout—the latter is the easier plan.

Instead of using harmonium reeds, I find American-organ reeds speak more promptly and are less harsh in tone; so I have shown them in this instance, only instead of placing them in the usual tube-board, they are fixed over the channels nearly like harmonium reeds. The channels are covered in with a veneer (shown too thick for the sake of distinctness) in which the openings must be neatly cut. Properly-made instruments of the harmonium class have these openings graduated in size, and the same would be the case with the apertures in the upper board. As, however, the latter must necessarily be all alike, no great refinement is possible; and, in point of fact, the reeds are sometimes fixed directly on the channels without any veneer at all.

As American-organ reeds have no screw-holes like harmonium reeds, they must be fixed differently. The central bar seen in section in Fig. 4, and in plan in Fig. 3, has on its underside curved notches into which the rounded ends of the reed frames are slipped, while the other ends of the frames are secured by shoulder-headed screws in small notches, which have to be filed out of the brasswork. Care must be taken to bed the reed-



evenly, and that it fits airtight to the veneer nannel edges, if no veneer is used). I have a little cement run round to make all secure, ood work is better than cement. The contion of the bellows-reservoir and the feeder is vident to need much description. They may their folding sides made of stout millboard, the joints covered with very thin leather. le directions for this kind of work may be l in back volumes, and need not be repeated.

e tune-band is drawn forward by the two ing rollers B and D. These may be both ed with indiarubber tubing, or one may be of l. I have seen one instrument in which the r roller was of metal, and Mr. Wenham, I re, uses a pair of steel rollers; but his pianoplayer requires a comparatively small pull on and, as the friction of the working parts is so . I show *both* rollers covered with indiarubber. ore of these rollers consists of ⅜in. round iron, ed to ¼in. where it rests in its bearings. The bearing does not show, as only half the length ller is shown. The upper roller is a plain ht bar; the lower one is cranked, as shown k has 1⅝in. throw), to work the feeder E, and longed through the case to allow the handle to rewed on. H is the fixed middle board, and e reservoir, with its springs underneath gs not shown). Referring to what has said as to the relative speed of the tune-band of the handle (and therefore of the windy), the rollers are about ⅝in. diameter over all, ne turn of the handle moves the band forward ⅞in., which seems rather too fast for the wind y from the bellows.

the organette from which the sketches are , the tune-band is held down by a broad bar od, grooved over each note to let the sound e. As this causes much friction, I have shown d a metal roller (formed of discs fixed to a l axis) held down by springs. It has 28 notes, two reeds to each note, arranged opposite each on the same channel; but the working is bad, think 25 reeds arranged as in Figs. 2 and 3 l be far better, and this is, therefore, why I in Fig. 5 the shortened reed-pan L. Appa-, too, the bellows might advantageously be he other way up, so as to have the feeder neath, and thus secure a longer connectingd avoid the "skew" action of the present A less "throw" of the crank would then . In fact, though I give this as being the simple form I know of, it should be considered as an example of a class than as a model to ctly copied.

some organettes one or the other of the ng rollers has a little vertical motion given to lever, so as more easily to insert the tune-, but I have in this example shown fixed gs for both of them. Of course, if *endless* are to be used, one of the rollers must admit ire removal and replacement.

ve said that the original instrument has 56 *two on each channel*, so that we only get ind power but no variety. If, however, we the wind-chest longitudinally down the , and use a separate channel for each reed, have two "Stops" to admit the wind to or both sets of reeds at pleasure, and thus a little variety, provided, of course, the reeds a different "pitch." In accordance with a s remark, the *reed-pan* is only shown of a for 25 reeds (arranged as in Fig. 3), though d-chest itself has been retained of the full the original. The "gripping" rollers are own at one end of full length, but the "disc" s shown shortened.

With the two distinct sets, the reeds must be side by side, instead of alternately. This involves having the holes farther apart, and therefore a wider tune-band is necessary—a point to be borne in mind in designing such an arrangement.

By reversing the action of the bellows and the mode of fixing the reeds, we can obviously alter the instrument to one on the American-organ principle, without altering the other details.

The next will be an organette of quite a different description. A. S. L.

(*To be continued.*)

## SNOW, THE SCAVENGER OF THE AIR.

[32006.]—IT may be interesting to your readers to know the sanitary value of a heavy snowstorm in filtering the sewage of the air. We read of "the pure riven snow"; it *certainly is not pure*. Melted snow is more prejudicial to health than the worst well-water in Worcestershire. On the night of December 16th, 1890, snow fell in my garden to the depth of 6in., wind N., barometer 29·45, thermometer 28° Fahr. I skimmed a sample from the surface, about 2in. in depth, away from the house, and in the centre of the lawn. The following is an analysis of that sample melted, and expressed in parts per 100,000:—Total solid matter 11·43; organic matter 3·21, mineral matter 8·22, 11·43; free ammonia, 4·36; organic ammonia, 6·60; oxygen required to oxidise organic matter, 1·03; smell, at 60° Fahr., none; smell, at 220° Fahr., like burnt leather; colour, dirty brown; sediment, opaque black deposit. Owing to the amount of organic matter and ammonia, the melted snow was lighter than pure distilled water, having a specific gravity of 0·99995. It is evident, therefore, that the snow, in falling, collected from the air soot and greasy matter, as well as germs and microbes, and may truly be called "a filter of the sewage of the air."

This analysis will show not only how the air is purified for the use of man by snowstorms, but also how the land is benefited by its manurial value. I have no doubt also that many germs of blight, which so grievously affected the crops last year, will have been caught by the snowflakes and brought down to be killed by the frost that has followed, there having been 30 degrees of frost the next night, with the barometer at 30·7.

**Horace Swete, M.D., D.P.H.,**
Analyist to the City and County of Worcester, etc.
Worcester, January 19th.

## PHONOGRAPHIC RECORDS OF DELICATE SOUNDS—TO A. R. MOLISON.

[32007.]—THE part of letter 31982 (page 443) referring to myself may be thus paraphrased. "What 'A. S. L.' states does not agree with my own theories and experiments, therefore he cannot have experimented with a phonograph."

It happens, however, that I have had a phonograph almost from the time of their invention, and have experimented with it, both in its simple form and as a transmitter to a distant telephone; also in the form of a phonautograph for obtaining a record in ink on paper. I gave some of the results in the "E.M." a few years ago.

Moreover, I have heard and closely examined the phonographs made by Edison, both in the original and in the most recent forms, and possess one of the wax cylinders with its impressed record. Mr. Molison will therefore see how far his conclusion is from being correct. My own conclusion is that we, *none of us*, are able to follow out, either by theory or analogy, the action of these vibrating discs in the telephone and phonograph. I myself should have expected that in repeating the cornet solo, the pitch would have varied *considerably* as the speed of the cylinder was changed; but such did not seem to be the case (so far as I could judge), the only effect being to reproduce the air as slowly as if it were a funeral march, or at a rate that not even the most rapid player could possibly have achieved. The experiment was made at my own suggestion on purpose to hear what *would* be the effect.

I noticed, too, another curious thing. Before the "stylus" reached the impressed record it was rubbing against the smooth surface of the cylinder (and the smoothness was so perfect that the cylinder appeared highly polished), yet the noise that one heard through the ear-tube was (I may say) tremendous. The moment, however, that the "stylus" fell on the impression the "burring" noise entirely ceased, and the words (a speech of Mr. Gladstone's), sounded clearly and distinctly. How does Mr. M. account for the fact of a smooth cylinder producing a far louder sound than the actual indentations on the impressed portion?

Let us look at the matter in another way. I have one of the Zigang electrical trumpets, with a disc a little less than 1⅞in. diameter, which gives the note A when in action. Now, suppose we use a precisely similar disc as the diaphragm of a phonograph, and sound before it the note C (for instance), what theory can trace the compound effect of what I may call the conflict of vibrative tendencies? Is it not probable that this conflict between the disc's own individuality (if I may so call it) and the sounds forced upon it may produce the peculiar "Punch and Judy" tones that are always noticed when large-sized metallic discs are used in such instruments?

Again, Mr. Molison probably knows that in the new phonograph a very small disc of glass is used instead of the large metallic one. May it not be that what I may call the natural note of this is so high pitched (and so faint) that the ear fails to recognise its effect in modifying the sounds which it receives and repeats, and that we thus get the latter without the former, and so lose the unpleasant nasal twang?

It seems also quite contrary to theory to make the recording stylus and the reading-off one of different shapes, yet the former is a semicircular cutter and the latter a minute ball. A. S. L.

## ETHER AND ELECTRICITY.—VII.

[32008.]—I MUST point out to "G. J. B." that his letter 31936, p. 403, in no way supports his theorem, that energy *per se* occupies space: it only proves what I said, that energy, in all forms, is related to properties of different forms of matter. For instance, his iron ring and centrifugal force, which is really energy charged on the iron, the quotient would be entirely different in equal size or equal weight of cast iron, steel, &c.; that is, the relation is not to space, but to matter.

Then, "G. J. B." ought to see that it cannot be called argument to dismiss an essential fact by the mere *ipse dixit*, "It is not relevant." My point that water and many other substances diminish in volume with increase of contained energy, appears to be very relevant indeed to the question whether energy itself occupies space.

Turning to letter 31966, p. 424, it is obvious th the explanation about "the energy is conve the wire by a series of ring-shaped con waves" is all mere imagination, like all talk: there is no single evidence to prov what is worse still, it does not prove t fact or meet my objection.

Let us admit the incoming rings of energy, and that they account for the intensity of magnetism being inversely as the square of distance from the wire: it follows that the linear transmission parallel to the wire must occupy indefinite space, which will be awkward, as I shall show in due time, when we come to explain the action of coils of wire. But it lands us in an absurdity as usual, when these imaginations are followed out. These rings of inflowing energy extend all along the wire; they are, according to "G. J. B.," positive at one end and negative at the other; that is, the energy flows out equally at the + and – ends of the circuit; but they produce magnetism of the same order at both ends. The energy in each of these parallel rings depends upon, and varies with, the resistance of each part of the circuit, yet the magnetic effect is equal at every part of that circuit, while the one fact we know as to such rings is that the field of force along the wire lowers from a maximum to nil as we travel to the middle—not of the circuit, but of the resistance of that circuit, which we are told does not conduct.

As to opacity, we have now a new property of this chameleon, the ether; "in all good insulators, the ether must be elastic"; the converse is, of course, that in bad insulators it is not elastic. That is something like Dr. Lodge's two sets of wheels. But surely the definition of the ether is an infinitely elastic and incompressible medium. Does it freeze, or what? in order to be not elastic, when elasticity will not suit a theory?

I must enter strong protest against the two last pars, p. 424, "When we say matter exists, we mean that we perceive it by ourselves." We mean nothing of the sort; that is, if we employ common sense. This is the old metaphysical fallacy which confuses existence and cognition. Cognition is the basis of our "concepts," and our concepts may be representations in our minds of true natural things, or of abstractions necessary to understanding those things; but existence is independent of perception or conception. We have all heard of the flowers that blush unseen; were the flowers the less true existences? Things do not exist because we perceive them: we perceive them because they exist; except, of course, those things which philosophers, so-called, invent and insist upon other people perceiving.

But the quotation from Ferrier is the worst of all: it is positively criminal to teach that it is more important for a system "to be reasoned than that it should be true." It may pass in metaphysics, because, there, absolute truth is absolutely out of reach; but in experimental science the sound law is, Prove all things—hold fast that which is true. A well-reasoned false theory may prove a curse to generations of students; in fact, if false, the better reasoned, the more noxious it is.

Now is it true that "matter and ether are merely names that each connote a bundle of co-existing properties"? No! The word "matter" connotes a mass of natural obvious records of our cognition; the word "ether" connotes nothing but our difficulties of defining some of those facts. What an infinite difference this is!

Let us consider now some of the facts of what we call matter, and the gradual development from cognitions into "concepts." The first general recognition is that it affects our consciousness through several of our senses. Then we find that whatever its differences there is one great property —viz., *mass*, manifested to us as weight: it offers resistance to motion, and it occupies a measurable space. We can do a great deal with it, and we find that the fundamental general perceptions can be sub-divided into a vast number of different forms, all possessing the general properties, but each having distinct properties of its own. So we pass from matter to substances, though in mere cognition, of course, we really go by the other road.

We find that we can divide these substances into smaller and smaller masses, without change of their specific properties, till the limit of mechanical power is reached, and even then can extend the process very greatly under the microscope; then our reason tells us we can extend this process till we reach a limit which neither perception nor direct reasoning would indicate, had not the process of investigation called chemistry given us new modes of perception: that limit we call the "molecule," the smallest particle of the substance which we can conceive as existing without change of substance and properties.

By chemical investigation we discover that apparent substances are really built up from a small number of definite primary forms of substance, which we call "elements," merely because no means at present at our command enable us to sub-divide them into different constituents. So far we are in observed probable facts; but we can form "concepts" which may or may not correspond to truth in existence; we can imagine that the 60 or 70 known elements are really complex substances, themselves built up from a few simpler ones, or even from one substance, the primordial "matter." But if we may imagine this, we have no right to assert it, or to base any reasoning on the imagination, because it is a mere imagination, not a fair deduction from observed facts; for this makes a fundamental distinction between two classes of hypotheses or imaginations—1, hypotheses which becomes "theories"—i.e., reasonable explanations of real facts, derived step by step from wider generalisations; 2, hypotheses which are purely imaginary; dreams about the unknown; mere leaps into the darkness.

Chemistry then reduces the elements to the conditions of "atoms," which are really hypothetical existences, though so very high in the ranks of the first order that they may fairly be considered as natural facts perceived by the intellect. They are the smallest quantities of each element which we can recognise as taking part in chemical actions. But they are not of necessity the smallest or ultimate particles existing. The facts presented to us by the spectroscope, as well as many we meet with in science, may well lead us to believe that the chemical atom is really a complex structure, and itself composed of several or many sub-atoms, not necessarily of different ultimate material, as in the other hypothesis of structure of matter, but as giving rise to some of the properties of each element by the various energies which the parts may possess. Still, this is a hypothesis of much lower validity than that of the atom. It is, however, rendered highly probable as relates to our now recognised chemical atoms by the fact that the atoms which we should conceive from the electrical functions are not those derived from chemical actions and relations to space as gaseous volume. If the now recognised atoms really exist, as these relations indicate, we must recognise something in them—that which chemists call valency—which indicates subdivision; the electrical current does most certainly distribute itself, not according to atoms, but according to valencies. The various motions revealed by the spectroscope, which shows each element as having each its own, and often many, distinct specific rates of motion, become intelligible if we thus extend the sub-division of structure of matter to sub-atoms.

But our consciousness recognises an existence acting on our senses, yet not having the properties of matter, which we call "energy," and which we can trace in its passage from one mass of matter to another through many many transformations of form (or forces), and can conceive as "motion of matter." This motion furthermore is clearly subdivisible in exactly the same order as the structure of matter. We have—1, mechanical motion, that of masses of matter; 2, molar motion, that of internal structure of substances, such as vibration of solids. 3. Molecular motion, imperceptible as actual motion, but presented to our senses as heat, &c., as also in the various states of matter as solid, liquid, and gaseous. 4. Atomic motion, as manifested by the energy related to chemical action; and probably (5) sub-atomic motion, such as is revealed by the spectroscope.

Now, *what is electricity?* Where and how is it manifested? Is it in matter, or must we invent something which is neither matter nor energy, and of which our consciousness gives us no evidence? As a matter of simple, indisputable fact, we have no single instance of the existence or action of electricity except as related to the known structure of matter, and as measurable in terms of energy.

But we are told that electrical action and electrical transmission involve wave motions of such velocity as matter is not capable of, and therefore we must fall back on an "ether" whose very existence is imagined in order to explain one fact: the transmission of light across space, but of which our consciousness tells us nothing whatever.

Is the assertion true? It is not true. We actually *know*, if we can be said to know anything not directly testified by our consciousness, *that matter is not merely capable of such motions, but that it is constantly making them.*

The etherealists confine their ideas as to the motions of matter to mechanical and molar motions. They omit to consider that if the ether transmits undulations across space, it is because it is *itself shaken and set in motion by a primary motion occurring in matter.* Throw a stone in water and you have waves; yes, but the stone was moving first, and gave up its energy to the water. Sound reaches us from a distance by undulations in the air; yes, but those undulations were set up and carry the energy of a similarly vibrating solid—a wire, a bell, or a man's mouth. Light from the sun reaches us by undulations in the ether. Very well; why does the ether undulate? Because the matter on the sun is itself making identical motions and shakes the ether. These motions, not of ether, but of common matter, analysed by the spectroscope, actually enable us to say what forms of matter exist in distant stars, and the motions of those stars.

It just comes to this: We know nothing of electricity, except as manifested *by* matter; we can trace its actions *in* matter; we know that matter possesses all the powers needed to explain electrical actions. Which is true science? To examine those functions, and if we have for the moment to carry our imagination into action, should we employ it on the possibilities of atomic motions, which we know exist, and sub-atomic motions, which we have much evidence of?—or shall we go wholly into imagination, and attribute any convenient properties to a thing of which we know actually nothing, and can only say that its existence is probable?

This last is what the etherealists are doing; and they call those who follow the recognised law of science, heretics and sceptics for refusing to do the same.

**Sigma.**

## AUXILIARY POWER FOR TRICYCLES

[32009.]—HAVING read the remarks of "Jack of All Trades," in which he suggests an expensive and troublesome piece of apparatus to work for the generation of $CO_2$ under pressure, I think "Jack" would not have troubled his brain to the extent he has, had he have known that liquid $CO_2$ was obtainable—and in the market—at a price per pound which it would cost for the chemicals alone "to generate the same quantity of gas"—viz., 3l. per pound. This gas is now being collected, liquefied, and stored in steel cylinders at a pressure of 70 atmospheres, at the extensive brewery establishment of Messrs. Guinness's, Dublin, and is now being used for many useful purposes, such as cooling purposes in refrigerator machines, in place of ether and ammonia, in restaurants, &c., for forcing the beer, &c., from the barrels to the bar; also for the manufacture of mineral waters, as there is as much as 30 tons of $CO_2$ produced per day from fermentation, which was formerly running away to waste.

Dublin, Jan. 17. **F. C. S.**

## LATHE MATTERS—VELOCIPEDE TREADLES.

[32010.]—I SAID that my need for an oval chuck was another question, and as it rather bears on "Phederick's" letter (31977), may I tell it? A year ago I bought a Yankee lathe with velocipede driving gear, hoping that it would give me exercise comparable to that got on a tricycle, for I find the one-leg action of the ordinary lathe unsatisfactory as exercise, besides, when tired, it is a great comfort to work seated. From this point of view the velocipede lathe is a complete success, and it has completely solved for me the problem of exercise, so difficult for the professional man in London. It has mechanical advantages as well. One can start, and stop, or reverse almost instantly, and there being no dead centre, one is independent of the momentum of the flywheel, and can turn as slowly as one likes. It is the only screw-cutting lathe I ever had as a "home pet," so I am not a good authority on its general merits; but it appears to me a very ingenious and convenient tool for light work. As I said, I have had the tool for a year, and have passed the stage at which I found it amusement enough to turn up odd ends of iron rod and make bits of apparatus on the chance of finding them useful some day, and find an urgent need of work that I can fall straight to every evening when I come home, and get my hour's exercise without too much scheming and standing about fiddling with gear, which is fatiguing, and not exercise. And this, I take it, is "Phederick's" position, only he is an ornamentalist, and I am not. Now, the first want I have come across is for small platters to put under hot milk-jugs, flower-vases, and other destroyers of French polish, and there seems an unlimited demand in the home circle for running sizes of these. After a time we find it a dull job, but it is just a dull job the brain-weary man wants, and if he has any tendency to fall asleep over it (which is unhealthful), the lathe soon makes matters lively enough, and that is why, since I last smashed a thumb-nail, I like to have a rubber fetlock ring round the jaws of the scroll chuck. But the family teapot is oval, not round, and sooner than own myself beaten I had to rig an oval chuck. The said chuck shook itself pretty well to pieces on the next job, which was an oval napkin ring of tough sycamore, so that was somewhat of a failure, and the chuck is now in for reconstruction with a brass ring instead of a wooden one, and sundry other improvements. I hope the ornamentalists will take up "Phederick's" challenge: the gear of an ornamental lathe is so beautiful to behold, that one always hopes to see something pretty made by it. One sees very pretty geometrical studies in black and white print; but cut, say, on a wooden box, they are not as ornamental as Swedish carving cut with a shilling knife, and that is dull enough considered as carving. By the bye, have you noticed that the boxwood rollers of rink skates at one penny each make excellent small chucks? I screw them to a piece of plank and hold them in the scroll chuck. **Rushlight.**

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[32011.]—ON page 422 "Earlswood Park" makes an offer all lathe-men will be glad to accept. The only difficulty is what to ask for first. The readers are keenly interested, and are seriously "asking for more." May I suggest—(1) the heavier drill spindle asked for by "Dunelm" (31551); (2) the interpolating index; (3) compensating index for equal division of the ellipse?

Maclean (31976) give scale drawing of
double eccentric chuck"?
'hederick" (31977) ever tried "sandal-
st Indian, and "bastard ebony" from
If not, let him try them, and he won't
Indicus.

## ECTROSCOPIC DOUBLES.

—It appears that Mr. Fowler was wrong
ıg that the duplication of the spectral
Lyræ in his photographs was due to *a*
ıle. What is the evidence that some un-
ıtrumental imperfection may not have
lly effective with Vogel's spectro-photo-
Virginis? If the stars are really close
ıuld not evidence be got by photographing
l image of the stars themselves, formed
ıe eyepiece, much in the same way as a
ıction image of the suh is produced?
know the exact details of the spectro-
ı method; but it seems possible that a
ı of lines might be produced by the
ıck's rate *oscillating pretty regularly and*
*dly between a minimum and a maximum*
so, the direct method I have proposed
ıqually fallacious. L.

## IOTIVES, AND LOCOMOTIVE RUNNING.

—Except in one point, Mr. Stretton
imply re-states what I had already ex-
Coupling-rods are known to be an
f "risk" (better word, perhaps, than
nd the single engines on the Midland are
" I admit, but not more splendid than
ers on the G.N., which have been illus-
many times. Mr. Stretton seems to be
gical, or not too much to the point, when
at the "17½ tons" gives them "ample
and yet hints or says that coupling-
sential. But that is not the point. The
, Which is the better system—the com-
hout coupling-rods driving on two axles,
npound which drives on one axle without
? Then, as to coupling rods, what is
ection, [], 0, or I, and why? The I is
y some designers, and not without good
hink. As Mr. Stretton says that "eight-
upled engines are not required in this
that settles the matter, and yet I often
nd six-coupled (as good as they are
uggling along. Mr. Stretton does not
which railway his reading of the
ls applies, and I suppose I must
mistaken when "two" meant "stop"
lines and "all right" on others.
's lamp may be an additional safeguard,
need of the detonators if the fogger's
signal? As to what Mr. Stretton says
ers running with the fire-door open—that
revent smoke"—I wonder how locomo-
ers like that reflection, for, apart from
hat you can't see the "dense smoke"
omotive is going at speed with steam on,
the designers about that they do not
eir furnaces differently? It is true that
work, where it is necessary to fire lightly
there is a great temptation to leave the
; but if Mr. Stretton's statement is to
ıext question will be—What is the use of
at all? But practical men do not hold
iews as Mr. Stretton. Thus, Mr. Sinclair,
comotive Engine Running and Manage-
scribing one type of fireman, says, "A
ing fire, which heats the plates and flues
ghest temperature is continually being
l by the sudden cooling from a heavy
np coal, or a chilling current of cold air."
escribing the model (the scientific) fire-
ys, "When he *opens the door*, his loaded
c. Seems to me that the fireman must
he door closed; but it was in America,
and "dense smoke" don't count there.
s this I see in Michael Reynolds's "Loco-
gine Driving"?—"The interval between
of firing, which should consist of six
only, *each time the door is opened*," &c.
door must have been closed, too! Now
Mr. Forney's "Catechism of the Loco-
nd I find him saying "that the air which
l above the fire should enter the firebox
nall jets," and, further, "if the feeding
ıent, there is more loss from the cooling
h results from the frequent opening of the
or than is gained from the regularity of
" Now, I ask, if it is necessary for
run with open fire-doors, because they
rwise be reported "for making a dense
it not time that those who favour us with
n as to the numbers of engines and
or less accurate sketches, set to work to
notive designers how to supply a proper
air to the furnace (which includes the
egulating the supply), and thus, while
the life of the furnace plates, do some-
event so awful an affair as that which
ome time ago on the South-Western
when a driver's greasy clothes caught fire and roasted him to death? There are some other points about locomotives and their running which may be discussed with advantage. **Nun. Dor.**

## SHARPENING ANGLE TOOLS FOR ECCENTRIC CUTTER.

[32014.]—Mr. N. Maclean (31976) very kindly showed me his ingenious eccentric drilling-spindle a while ago, and though doubtless in his experienced hands it is most effective, the facilities it affords for centring a tool are far more than counterbalanced by complication, overhang, and consequent instability. Made in its best form, and with the best workmanship, the eccentric cutting frame is all too weak for much of the work it has to do, and the addition of an eccentric slide would greatly limit its utility. My friend "F. A. M." would, I know, be able to sharpen and centre his cutters to perfection in a very short time, if he would only try. I have seen schoolboys re-cut an eccentric pattern without a mistake. Mr. Maclean's eccentric spindle would doubtless produce some highly complicated work in the hands of an expert.

If "Phederick" (31977) can find any wood quite equal to African blackwood, or anything like it, he will merit the endless gratitude of all turners. I have tried one called "Madagascar redwood," and though valuable for many purposes, it had the one fatal objection common to all, save box and cocus—viz., it is full of *silica*, which forbids its use for ornamental turning. **C. C. Ellison.**

## THE VIOLET FLAME FROM COMMON SALT.

[32015.]—Surely "W. T. N." (31190) is not confounding the flame of ignited carbon monoxide, produced by the deoxidation of carbon dioxide by means of red-hot coals, with that produced by salt. The one is a pale lambent blue flame not possessing any characteristic spectrum; the other is rich in violet rays, and shows a series of double bands in the green, blue, and violet, the less refrangible of each pair being the broader. How does "W. T. N." know that there is no hydrogen present when coals cease to flame? I should say there was a good deal left in combination with the carbon. The fact that the spark spectrum of hydrochloric acid is lacking in the four pairs of violet bands is no proof that the flame spectrum is not due to the same substance, because the conditions under which they are produced are markedly different. Another point is, that I found great difficulty in comparing the two spectra. The light from the spark spectrum was very feeble; that from the flame, brilliant, but transient, and the one would outshine the other, rendering measurements exceeding hard to obtain. The chief thing to remember is, that common salt, when placed in a coal fire, or heated with coal in a crucible, or on wire gauze, with coal gas, or with pure hydrogen, produces in each case the same spectrum, and that I copied this spectrum when there was nothing else present but hydrochloric acid and hydrogen.

Birmingham. **A. Percy Smith.**

Some nickel steel plates recently tested at the Carnegie Works, the specimens being cut from a ¾in. plate, gave excellent results. The elastic limit is said to have been from 59,000lb. to 60,000lb., and the ultimate strength 100,000lb. and 102,000lb. The reduction of area was 29½ per cent. and 26½ per cent. respectively.

**The Affinity of Metals for Sulphur.**—The insoluble sulphides can precipitate the solutions of the salts of other metals as sulphides of these metals. Thus the sulphide of copper gives a precipitate of sulphide of silver in a solution of nitrate of silver: $CuS + 2, Ag\ NO_3 = AG_2S + Cu\ (NO_3)_2$, showing that silver has a greater affinity for silver than copper. In 1837 Anthon published a table of the metals arranged according to their decreasing affinity for sulphur. Silver is at the head, then comes copper, followed by lead, cadmium, iron, nickel, cobalt, and manganese. According to the *Moniteur Scientifique*, E. Schurmann has taken up M. Anthon's investigation and carried it further. His list enumerates the metals in the following order: Palladium, mercury, silver, copper, bismuth, cadmium, antimony, tin, lead, zinc, nickel, cobalt, iron, arsenic, thallium, and manganese. The salt solution of any metal in this series can be decomposed—at least to a great extent—by the sulphide of one of the subsequent metals, but the sulphides of the preceding metals cannot be decomposed by that of any subsequent one. The decomposition is the more complete the further away the metals are placed from one another on the list. The metals at the head of the series have the greatest affinity for sulphur, and the affinity decreases insensibly up to manganese, which has but very little. The sulphide of manganese is decomposed by the salt solution of any of the preceding metals.

# REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[72951.]—**Pidgeon English.**—In a recent book this is spelt "Yokohama *pidgin* grammar." But I asked as to the origin of this pidgin or pidjin. Is it a corruption of Chinese for "business"? What does "joss pidjin" mean? I am told that three or four years ago the *Cornhill* had an article on this dialect. Can any one supply the date? A. C. G.

[72951.]—**Pidgeon English.**—All the dictionaries that I have before me at present spell this word, "pigeon." Dr. Ogilvie, in his latest Imperial Dictionary, spells it in this way; but perhaps our English lexicographers are wrong, and if so, they should be put right. I should like to know how Dr. Murray intends to spell the word in the dictionary he is now compiling.

N. Edwards-Robson.

[72960.]—**Equation.**—"Q." is in error again. The molecular weight of KCl is 74·41, not 74·71. On making this correction, the number obtained for K is 39·5. To insure greater accuracy, you must work the decimals out to six or seven places. Let me take this opportunity of pointing out to "Q." the difficulty of this method of analysis. A mistake of 3 in 744 has made a difference in the result of 4 in 39—i.e., an error of about 0·4 per cent. in the experiment (weighing, &c.), would make a difference of 10 per cent. in the result. Assoc. N.S.S.

[73037.]—**Wood, to Slice.**—I wonder it did not occur to you to go to a joiner, and get him to make you the finest shavings he can. I wanted lately to mount cross and longitudinal sections of all the woods I could lay hands on, so I asked a neighbouring joiner to sharpen his plane, and he soon turned off lovely shavings, from which I picked out lots of pieces thin enough (some too thin) to mount. To get good cross-grain shavings of wood only 1in. in diameter, I think you would require to glue six or eight pieces together, so that they would form an end of a plank, and then they can be easily planed cross-grain.

Plymouth. B.Sc.

[73167.]—**Spinning Metal.**—If this querist really wants information, I would suggest the advisability of his saying just what he wants to do, for it is difficult to ascertain his meaning, and those who can, and possibly would, reply ought not to be asked to solve conundrums. Is the disc (*sic*) to have sides, or what is it he does want? Brass properly annealed can be spun into any desired shape; but the query, as stated, is incomprehensible.

E. C. T.

[73190.]—**Fret-Sawing Machine.**—A sewing-machine treadle frame can be made useful in designing a fret-saw arrangement; but how can anyone say what device should be adopted without some idea of the arrangement of the "table," which is not given? There are many designs for fret-saws in back volumes, one of which may suit querist; but all he need do is to secure some means of getting an up-and-down motion of the saw.

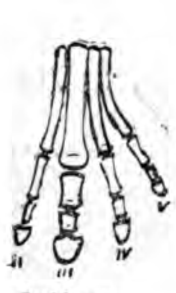
T. L.

[73200.]—**Cell of Speculnm.**—"C. D." asks why oak or ash is not as good as mahogany for speculum to rest upon. Well, no one can answer, I suppose, because mahogany is cheap enough, and is well known to be durable and not likely to twist. Probably either oak or ash would answer as well. Might as well ask why cups and saucers are not made of glass. See T. J.

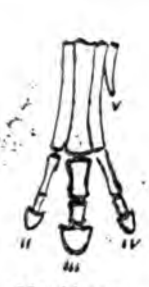
[73205.]—**Trouve Motor.**—For what purpose is a motor wanted in a "rowing" boat, or is "rowing" merely intended to give an idea of size? To work for "eight or ten hours at a time" is, however, a caution. Better try Bunsen cells, and look through back indices for electric launches. I suppose the 20ft. boat is required to do at least 10 miles an hour. It can't be done, except at heavy expense; but a launch can be fitted with an electro-motor, plenty of designs for which can be found in back volumes. Nun. Dor.

[73218.]—**Asphalte.**—The best asphalte is Claridge's, but how long that or any other wears depends on the amount of traffic. From the City Engineer information could no doubt be obtained as to the wearing qualities of Val de Travers, which certainly seems excellent both for roadways and footpaths. Nun. Dor.

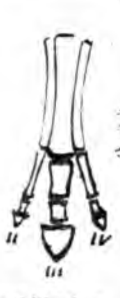
[73261.]—**Problem.**—I shall be obliged if "M.I.C.E." will give any other solution to this problem than mine on p. 406, for he will find that the first nine only of my solutions have a common difference of unity, and the remaining 14 have one varying from 2 to 5. Again, assuming as "M.I.C.E." does, that the amount expended by each is 80 pence, it will be found, of course, that there are still the 25 solutions given by me. For instance, take solution (3). It will be found



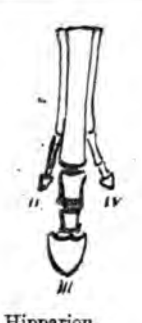
Orohippus.



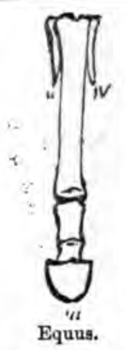
Mesohippus.



Anchitherium and Miohippus.



Hipparion and Pliohippus.



Equus.

in this case that the eggs are at 3 for 56 pence, and 9 for 8 pence respectively. A buys 4 of first kind and 6 of the second, making 80 pence; B buys 3 of first kind and 27 of the second, making 80 pence; C buys 2 of first kind and 48 of the second, making 80 pence, and so on, for all the other solutions. Again, "M.I.C.E.'s" only two results are both the same, being my solution (13). For, in his first, A buys 7 eggs at 11 pence each and 3 eggs at 1 penny each; and, in his second, he buys 3 eggs at 1 penny each and 7 eggs at 11 pence each, and similarly with B and C. Perhaps "M.I.C.E." will forgive me if I point out that his $x$ and $y$ need not be integral, though they must be positive; for instance, one can frequently see eggs quoted at 5 for a shilling, which would give $x = 2\frac{2}{5}$ pence. Also, supposing, as he does, that the number of eggs bought by each must be integral, he is incorrect in saying that there are no end of answers to the question, as he will find that whatever the price spent, there will be always 25 answers, neither less nor more.

D. S. B.

[73370.]—**The Missing Link.**—The "missing" link is not by any means "only an invention of the opponents of evolution." The missing links in the "Darwinian hypothesis" are many. It is true that when, in ordinary parlance, "the" missing link is spoken of, one particular gap is referred to—namely, the animal which should connect man with the most closely allied living ape. In other words, we have not yet found an animal which we can say is the nearest ancestor which living man and living ape have in common. Our knowledge of living animals is complete enough for us to predict that whenever this missing link is discovered, it probably will not be a form now living, but a fossil. When discovered, it will almost certainly be found in the Old World, and when we consider how little is known of the fossil remains of Central Africa or of Central Asia, we need not yet despair of some day finding it. If we take living forms only, we find many and great gaps, many links missing from the chain of "evolution." Birds and reptiles have certain characteristic points in common which seem to indicate a blood-relationship, but the links missing are numerous between the two groups. One great link is, however, supplied by the interesting fossil form known as the Archæopteryx, found in the Secondary rocks at Solenhofer. This creature was certainly partially, if not entirely, covered with feathers. Its fore-limbs bore long, strong feathers and formed wings. The bones, however, of this wing resemble those of the fore-limb of certain reptiles more than those of the wing of any living bird, the digits being more complete and bearing claws as in reptiles, but in no living bird. The beak was not horny, but the jaws were set with teeth; and instead of the stumpy tail with bunch of feathers, the Archæopteryx had a long, lizard-like tail, with a pair of quill feathers to each vertebra thereof. Many other intermediate characters might be mentioned. Perhaps no better example of one kind of missing link can be cited than that between the horse and its nearest living relations. Many features in the anatomy of the horse pointed to a comparatively close affinity between it and the tapir; yet anyone can see that a great gap exists between the two—a far greater gap than that between man and the most man-like ape. At the time of the publication of the "Origin of Species" this link was missing; but owing to the recent researches of Marsh in the Tertiary deposits of North America, this link has been found. For the sake of brevity, a description of one part—perhaps the most striking—must suffice. From the deposits of Lower Eocene age have been obtained skeletons of a form to which the name of Eohippus has been given, in which the "toes" of the fore limb are five in number—four well developed, and the fifth merely a rudiment. From about the same geological horizon the Orohippus, with four toes, only three of which reached the ground, and the middle of these three larger than the others. Then the Mesohippus, in which the fourth toe is reduced to a splint. In the Miocene deposits is found the Miohippus and Anchitherium, in which all trace of the fourth toe is gone, so that only three remain, the central one being much the largest. In the more recent beds still, the Pleiocene deposits, a stage nearer again to the horse has been found in Hipparion. Here the three toes are existent, but the central toe is very large, while the two outer toes are greatly reduced, and do not nearly reach the ground. In the horse of the present day these two small toes are reduced still further, so much so as to be invisible to the casual observer, and are only represented by the "splint" bones. The subjoined sketch (after Marsh) of some of the above-mentioned forms will serve to illustrate the point better than words. Thus the link which was missing between the state of the toes in the living Tapir (which is very similar to Orohippus) and that in the living horse is supplied by the series of fossil remains of animals which existed during early Tertiary times. I have here given two instances of once "missing" links which have recently been found. Many are being found every year, and many hundreds remain yet to be searched for, the majority of which will, no doubt, never be discovered.

RIC. A.

[73370.]—**The Missing Link.**—As nothing but Darwin's famous book (or, as Huxley terms it, "the Devil's Gospel") drove me out of its theory, which I had previously held for many years, into that of "special creation," it may interest some to know how I superseded it, and what a more important part "missing links" bear in this than in any form of Darwinism. I still believe in evolution, the coming of all new species from earlier ones; but, instead of their surviving by "natural selection," I ascribe this to their birth by "supernatural creation"—supernatural in the exact sense that the New Testament makes the birth of Christ supernatural. Throughout the ages of creation that ended at the Flood, I suppose that whenever there was occasion for a new species, Divine power interfered exactly as when the Virgin Mary was ordered to bear a son, some virgin of the race nearest the intended one was ordered to bear a specimen. When Luke calls Adam "the son of God," we cannot hold him to mean he was more directly and miraculously a son of God than the son of Mary was. If Christ had a mother, we may conclude, so had every earlier protoplast. Adam's mother, whether tailed or tailless, or as low perhaps as the skull of Neanderthal, would be a "missing link." So were the earlier men and women, "in God's image," mentioned in Gen. i. 27, to create or make a man "of the dust of the earth," or of an earlier dust-created mother, being equivalent. So, again, was Eve, if having parents or a parent; and there is no Scripture against her having them. The phrase that God caused a sleep to fall on Adam, and took away a rib, and made it a woman, may only mean that in his sleep he broke a rib, and it was providentially the means of bringing him the maid of another tribe, who became his wife. Fourthly, her tempter, the speaking being who is called *Ha-nahash*, because of the hideous doom inflicted on him, of crawling prone and eating dust, was yet another possible missing link. Fifthly, those called in chap. vi. the "daughters of men" were of one or more races inferior to the Adamite, or "sons of God," who seem, as a Brahminic caste, to have kept separate from then till Noah's time. When they began to intermarry, in his youth, the children were "the mighty men of old, men of renown," and none have been of greater renown than Shem, Ham, and Japhet. The phrase that Noah begat these does not imply they were his own sons, but were the only three of his numerous descendants who could be persuaded to believe him. Their mothers were doubtless of the "missing links," and so were their wives. Thus the book of Genesis alone gives us at least five different specimens of "missing links," to any one of which we may ascribe our tail-muscles, ear-muscles, or any other degeneracies that have never been of utility. Of the races that supplied the mothers and wives of Shem, Ham, and Japhet we have at least three-quarters. We can barely reach the eighth of an Adamite's age, for similar reasons. Now, Darwin's and Huxley's theory of apes producing men is just as supernatural as this Biblical theory—just as unknown to nature around as Virgins producing births; but neither have we any trustworthy history of one species begetting another, whereas, of Virgin producing a birth, we have a great historical notice, the base of our religion.

EVOLUTION AND SPECIAL CREATIONIST.

[73353.]—**Expansion in Series.**—Will "Esa Caralita" kindly say where the French book he quotes is to be obtained? It seems to be just the sort of book I should like to have; I hope my last reply was considered satisfactory. I see the symbol $n$ in my reply has been changed to $u$ in his note; however, both mean the same thing—viz., $\frac{a-b}{a}$ where $a$ and $b$ are the Equatorial and Polar Radii of the earth, or if the diameters be represented by $a$ and $b$, the result will be the same. I find the value to be ·003337, according to the lengths given by Lockyer. The two series we have been dealing with in my two replies have suggested to me a means of calculating the length of a degree of latitude measured on any meridian. The differential calculus is also required to find the radius of the curvature at any latitude; it may be of interest to quote the result, as it is an instance of the system of cosines of multiple arcs, shortening the work considerably. If we represent the length of a degree of a meridian by D, and the length of a degree of longitude measured along the Equator by E, the result for any latitude $l$ will be—

$$D = E\left\{1 - \left(1 + 3\cos.2l\right)\frac{n}{2} + \left(+ 15\cos.4l\right)\frac{n^2}{16}\right\}$$

The value of E is 69·165896 miles. While on this subject I should like to ask why the Admiralty knot is fixed at 6,080ft., which I find in a *Nautical Almanac*. Has this any reference to the length of a degree of a meridian at any particular latitude?

Bath. M.I.C.E.

[73374.]—**Slade's Universal Micrometer.**—Would "Arcturus" kindly say how his telescope is mounted? I have not tried the glass reticule exposed to direct sunlight. Will experiment and report next week.

SLADE.

[73381.]—**Glass and China Riveting.**—Full details with illustrations of the method of riveting china and glass will be found in the numbers for Aug. 18, and Sept. 22, 1882; also in Oct. 20, 1871. There is nothing very difficult in the work, and an intelligent youth would, with a little practice, soon become expert. Except as a "fill-up," the work is not worth making one's self competent in, for the trade price is only 1½d. a rivet, though some may get 2d., which pays well enough when there is plenty of work to do.

NUN. DOR.

[73383.]—**Hong-Kong.**—The effect of the climate of Hong-Kong upon Europeans will differ vastly, owing to the great range of climate in the particular quarter of the globe referred to. The effect of so great a heat as that of Hong-Kong upon an Englishman is to cause him to dress in white linen or very light flannel, cotton socks, and light shoes. The town is healthy and very hilly. If you possess a liver, as you say, mind it, by not taking strong drink, as many do out there. Soda-water, Bass's beer, Guinness' stout, and all the rest of the English drinks may be had there, and of the very best. Mosquitoes—there are millions, and some of the most venomous on the face of the earth; exceedingly painful. Living—depends how you live; if you live like the natives, on rice, soup, and vegetables, about 4d. a day may clear you; but if in European style, then £300 a year may be spent. Chinese dollars are at the present time at a discount, and English gold at a premium; therefore you will make well with your money. Outfit—John Chinaman can supply you with flannel, white linen, boots and shoes, umbrellas, spectacles, furniture, and clothes, such as you need out there—all good. They are excellent tailors, and reasonable. Drugs are dear, therefore take them. Barbers are also dear; but that must be put up with.

STUDENT.

[73388.]—**Re-Gilding Old Frames.**—The burnish is obtained by gilding, on burnish gold size, with water, and, when dry, burnishing out with agate burnisher; but as it requires a lot of practice to get a good burnish, I think E. E. Balley would find it expensive. He does not say how he is gilding other parts of frame.

MOUNT CUTTER.

[73394.]—**Clock Trains.**—Much obliged for replies. What is the arrangement of hammers for striking on tubes (instead of gongs)? What part of tube should hammer strike? Are the latter faced with leather? What are the tubes made of? What is the lowest price these can be bought for?

A. W. G.

[73396.]—**Water.**—The length of pipe from main to outlet is 35ft. Thanks for your reply.

S. S.

[73387.]—**Pressure Gauge.**—The construction of this instrument will be easily understood by a glance at the sketch, and, with a little care, one could be made well in steel or brass for a model. The gauge is screwed into some part of the boiler

optician who supplies them. You will probably not get all the required sizes, but something near them.
A. CAPLATZI.

[73423.]—**Salt and Snow.**—When a body passes from the solid state into the liquid it absorbs a large quantity of heat. Salt has a peculiarly powerful affinity for water, in which it freely dissolves. When salt is mixed with snow, the attraction of the salt for the water in the latter causes the snow particles to melt, absorbing a great quantity of heat in their change from the solid to the liquid state. When Fahrenheit invented his thermometer he mixed salt and snow together, and in this mode produced the most intense cold known at that time. He therefore made this the starting point, or zero, of his thermometer.
O. D. TREDEGAR.

[73428.]—**Coil Boiler.**—I should like to ask "London River" how it is possible for water to circulate in a coil, "the lower end" of which is taken to the "top" of reservoir or separator? He evidently thinks he is going to obtain steam from the bottom end of coil. He does not say what is to be done with the top end of coil. If it is to be closed up, the water will soon be driven out of the coil. The coil, as the water cannot return into it, will soon become red-hot and collapse. He evidently does not intend to carry the top of coil to lower end of separator, or it would not be necessary to put a cock there to draw off waste water. How, also, does "London River" propose to ascertain whether there is any water in the coil or not? He makes no provision for a water-gauge. and there is no place on his arrangement to fix one. If "H. B. S." attempts to make a coil boiler from "London River's" description, his engine will contine to work "by fits and starts," or rather more "fits" than "starts." I am experimenting with coil boiler for small powers, and when I have obtained perfectly satisfactory results, will forward same to the "E.M." SOLENT.

[73433.]—**Botanical Query.**—The *summum bonum* of horticulture consists in improving the size, flavour, and edible portion of all fruits and esculent roots. This has been largely accomplished by the artificial processes of selection, hybridisation, manuring, and pruning, thereby augmenting the deposit of cellular tissue (pulp) by the obliteration of ovules. After the usual stage of fermentation has elapsed, an abnormal flow of concentrated sap, due to the stimulating operations of the gardener, is the primary cause of the juicy and bulky development. If such a fruit-bearing tree or kitchen vegetable be neglected, the produce soon reverts to the original seed-bearing species. I know no better oranges in any part of the world I have visited than those of Natal. They are very large, thin rinded, dark coloured, juice filled, and usually seedless, or with a few shrivelled seeds. Here a congenial climate has assisted the horticulturist largely. The Sultana raisins of Singena, as long ago as I can remember, have perpetuated their seedless character: so have the closely-allied Kishmish of Afghanistan, so abundant in that country that even beggars eat it. Over 40 years ago, at Peshawar, when annexed by the British Government, about three-farthings a pound was a market price. I have seen the small three leaved vines of this variety; but they would not bear fruit in Hindostan, though I have grown and eaten other delicious kinds raised from imported seed by myself and others. I will now give an example of a favourite garden esculent, the "globe artichoke," requiring a warmer climate than England to attain perfection as a delicacy. When I was residing in the North of India I obtained seeds from America, said to be of a superior growth. I raised many plants rapidly in the deep sandy alluvium of my garden, eventually exhibiting heads, each one of which covered a cheese-plate; moreover, they became seedless, both "scales and bottoms" running very thick and fleshy." I need hardly say that attentive thinning of the flower-buds, special manures, and frequent irrigation, combined in the production of a type only to be propagated in future by offshoots, which I distributed among my friends. Dr. Balfour's "Classbook of Botany," with over 1,000 illustrations, I strongly recommend to all who take an interest in the secrets of vegetable life. EOS.

[73434.]—**Electro-Magnet.**—"Sam" gives no sizes; however, let him select a wire which, when wound, shall increase the diameter of the magnet from 1 to 1¼, and give a resistance of about 20 ohms. This will give about as strong a pull as he will be able to get from his six No. 2 Leclanchés, but I must warn him it will not last long. If he wants continued pull, 50 ohms is the very lowest resistance, and with the best known Leclanchés, it will drop 50 per cent. in about 150 hours' continuous work. J. W. W. B.

[73434.]—**Electro-Magnet.**—You do not say the size you wish to construct your magnet, nor the approximate size of armature you wish to attract. In the following reply I have reckoned for a magnet made of ¾in. iron rod, 20in long, bent to the shape of a horseshoe, with parallel limbs about 4in. apart. I am also taking it for granted that you mean greatest attractive power, and not greatest sustaining power. Wind each limb of the above-named ¾in. rod with about 80 yards or six layers of No. 24 single cotton-covered wire, previously well basted with melted paraffin wax. Let the wire extend for about 6in. up each limb. In crossing over from one limb to the other, remember to reverse the winding, thus ∽. Work this with the six cells in series.
S. BOTTONE.

[73435.]—**Telephone.**—Your difficulty is no doubt in polishing the carbon, which must be highly polished so as to give it a hard smooth surface. A soft button is useless, as the surface is soon worn away by the platinum point.
F. C. ALLSOP.

[73435.]—**Telephone.**—The carbons of the Blake transmitter are made from electric light carbon rods about ⅜in. diameter, sawn off about ⅛in. long. They are polished on several grades of emery paper glued on to a flat piece of board; commence polishing with the coarsest, and finish off with the finest till a semi-lustrous polish is obtained. It sometimes happens that the texture of the carbon at the centre of the rod is not close, or shows a small star-like crack; in either case it is useless for this purpose. Another important thing is to see that the small piece of carbon is firmly burnished into the brass mount. J. B. E.

[73436.]—**Electric Lighting.**—If "Amateur" will give speed of machine when running as a dynamo, voltage of lamps he uses, and what power he wants out of machines as motors, I can recommend a suitable battery. J. W. W. B.

[73436.]—**Electric Lighting.**—How many more times is this question going to be asked? Can "Amateur" not see the absurdity of using batteries in connection with a dynamo for lighting. Use one or the other, giving preference to the latter, if you have power to drive it. You could drive it from the foot-wheel of a lathe for short experiments, but it will soon tire you out if used for any length of time. Supposing that your motor took 20 cells to drive it with the dynamo to light two lamps, the batteries alone would light three or four; thus the absurdity of using an electro-motor for driving a dynamo for lighting. F. A.

[73436.]—**Electric Lighting.**—Two 5c.p. lamps require 35 watts to light them. Thirty-five watts equal $\frac{1}{21}$ of a horse-power. Supposing your dynamo were of 90 per cent. efficiency, which such small dynamos seldom are, you would need $\frac{1}{20}$H.P. to drive it to give this light. Now, an electric motor, more especially a small one, wastes quite one-third of the energy put into it, in conversion, so that to work your electro-motor by battery to drive the dynamo, to give this amount of light, the battery should give at least $\frac{1}{14}$ of a horse-power, or 53 watts. Now 53 watts would light three 5c.p. lamps. So you see this would be even worse than buying a penny to buy a penny to buy a pussy. If absolutely necessary to do it, the result could be obtained by using a small Siemens motor, with armature about 2in. by 5in., worked by 12 chromic-acid cells, quart size, connected in series.
S. BOTTONE.

[73438.]—**Accents in Greek.**—Opinions will always vary as to the correct position of the Greek accents. The English usage differs very much from that obtaining in Greece itself. The rules followed in English schools are minute and perplexing; but the general law is that the accents as written do not affect the pronunciation of the words, but that all words are accented on the penult, or last syllable but one, when that syllable contains a long vowel, and upon the antepenult, or last syllable but two, when the vowel of the penult is short. Diphthongs are generally long. Greeks, however, maintain that their pronunciation of their ancient language, which is the same as that of modern Greek, is correct, and it is highly probable that they know better than Englishmen how their own tongue was pronounced. The pronunciation adopted in modern Greek (or neo-Hellenic) prevailed at least as far back as the days of Xenophon, and it regulates the accented syllable entirely by the written accent. The ancient Greek articulation was, however, more nicely regulated than the modern, for it distinguished between the several intonations of the varying accents—acute, circumflex, and grave. The Greek pronunciation of the letters of the alphabet is also entirely different from that taught in English schools, the vowels resembling those in Italian (except η, which has the English pronunciation), and the consonants β and δ having the sound of "v" and "th" respectively.
J. M. WAGSTAFF.

[73440.]—**Heating Water.**—I have a tank holding some 630 gallons of water, which is heated as high as 214° by means of a coil in about one hour and forty minutes. The coil consists of about 30ft. of 2in. iron tubing, fed by a tube from boiler same size as coil, the same having an outlet of quarter tubing. Steam pressure 50lb., turned on full at boiler, and allowed to pass uninterruptedly.
G. B.

[73440.]—**Heating Water.**—To heat water i jacketed pan will depend upon the pressure of t steam. You will be aware the heat of steam vari in proportion to the pressure. So far as my e perience goes, a coil of pipe in pan would not he water to boiling point; loose steam blown into t water at sufficient pressure, would heat the wat to boiling point.
Sunderland. W. GRIMSHAW.

[73440.]—**Heating Water.**—Yes, a steam c in bottom of dye-pan will heat the water to 212° F and a fire under the pan will not make the wat any hotter—that is, if the top of the pan remai open to the atmosphere. Loose steam blown in the bottom of the pan will also produce this resu and if you have not found it so, it is because y have either not enough steam or too small a pipe.
SOLENT.

[73440.]—**Heating Water.**—"Loose" stea as you call it, blown into water will certainly rai the temperature to the boiling-point, provided yo have enough steam. Of course, if the loss of hea by conduction and radiation is greater than th increase by steam, you will fail in your object. Theoretically, 1lb. of steam will raise 5lb. of water to boiling if there is no loss. In a jacketed pan, or steam-coil, everything depends upon the temperature and pressure of the steam. It can be done if you have pressure enough. SX.

[73441.]—**Faulty American Organ.**—The cause of the fault complained of is due to a leakage of air between the under portion of the tubeboard and the mortise-board. If the fault is very bad, I should recommend a new tubeboard. The same reeds would no doubt do. A new tubeboard would not exceed 10s. or 12s., if a three-row. If the fault is only a slight one, take off pallets, &c., and run in a little hot thin glue where the leakage is. Write again if you don't succeed. Be very careful with the glue. It requires care and some degree of judgment to make the job successful. G. FRYE

[73443.]—**Field-Magnet Winding of Dynamos.**—Prof. Silvanus Thompson's rule for compound winding is as follows: "The number of series turns must be to the number of shunt turns, as the sum of the resistances of the armature and series coils is to the sum of the resistances of the armature and shunt coils." Since the resistance of the series coils is generally about two-thirds that of the armature, while that of the shunt coils is 400 times that of the armature, it will be seen that the number of ampère turns in both is about equal; but since in no case does all the current pass through the series, or through the shunt coils, but through both, in varying proportions, it follows that if 8,000 ampère turns are required in all, it will not be necessary to put quite 8,000 ampère turns in each.
S. BOTTONE.

[73443.]—**Field-Magnet Winding of Dynamos.**—If 8,000 ampère turns are required to give a certain output, it means that both series and shunt combined are to give the above exciting power. The proportion between the two windings depends entirely upon the design of the machine—i.e., upon mass of iron, point of magnetic curve at which iron is worked, and the number of turns of wire on the armature. I have known dynamos where the No. of ampère turns in series winding equalled those in shunt; but such a machine would be very costly if made efficient. The more usual proportion is series to have 30 to 50 per cent. of the total ampère turns required. As an example, in a 500-light dynamo we recently sent out, the ampère turns on shunt were 15,000, those on series 5,500. If "Unsettled" will give exact dimensions of his dynamo, particulars of winding, I can tell him approximately how to compound.
J. W. W. B.

[73444.]—**Medical Coils.**—I once knew a Mr. Hay, who used a number of Grove's cells (about 30 to 50) for the application of the direct current to medical purposes. SX.

[73444.]—**Medical Coils and Batteries.**—To MR. BOTTONE.—No coil can possibly give a continuous current. The current, if such it can be called, is intermittent and alternate in direction. A battery, such as the "Spamer," which consists of 30 or 40 compact chromic-acid cells, is the one used by medical men when a continuous current i desired. The current from such a battery can b interrupted when a "shocking" effect is called fo by the use of a tapping key in circuit. The word "medical battery" are very loosely used, especiall by vendors, who palm off coils furnished with single cell to work them, as "medical batteries" but the physiological effect of the alternatin currents or shocks given by the coil, is quit different from the gentle and hardly appreciabl sensation set up by the "direct" or continuou current. Both are useful in their way; but neithe should be used except under the direction of medical man—no advertising quack, mind. I coul not possibly say whether the application of elec tricity would benefit your friend. S. BOTTONE.

[73444.]—**Medical Coils.**—I imagine that M Bottone will find some difficulty in answering th chloride and estimation of the Cl. Can't say more without knowing circumstances. A bit of porcelain, such as a broken crucible, is the best substitute for Pt foil in the CrMn test. Sm.

[73475.]—**Lathe.**—It no doubt "could be a possible thing" for "Fitter" to fit up a 3½in. screw-cutting lathe, but if he only does so in his spare time he will not want another job before next Christmas. If you buy the castings in the rough, you will want a planing machine for the bed and a planer or shaper for slide-rest fittings, &c., as you would have an immense amount of work to finish them with a file. From personal experience of this sort of thing I would say to "Fitter," Don't attempt it in "an ordinary fitting shop"; the tools to be found there are not sufficiently accurate to turn out a first-class job. Solent.

[73477.]—**Brazing Iron Bands.**—In such cases my native blacksmiths used to secure the "laps" with light rivets before brazing. Eos.

[73479.]—**Water-Power for Electric Light.** Water-power is the cheapest way of obtaining the electric light, and turbines are eminently suited for driving dynamos, as from their high speed they can be coupled direct. You would require approximately 10H.P. for your 100 16c.p. lamps.

F. C. Allsop.

165, Queen Victoria-street, E.C.

[73479.]—**Water-Power for Electric Light.** —The turbine that I have in my charge for electric lighting is a 21in. one, that is, the revolving part, and is 12H.P., with 8ft. head; 6ft. head it is 8H.P.; but with 5ft. 6in. head the dynamo has given off 3,600 watts, or enough to light sixty 60volt 16c.p. lamps. The flood is said not to make much difference if the head remain the same. Such a turbine with 8ft. head, if you count ten lamps per H.P., 10 × 12 = 120 16c.p. lamps. I cannot give the quantity of water it takes; but there are 21 openings around it 1in. wide by 12in. high.

J. Vinicombe.

[73480.]—**Gas-Lighting.**—Core, 7in. by ⅝in., and wound with 1lb. of No. 18 double cotton-covered wire. You require special burners.

F. C. Allsop.

[73480.]—**Gas-Lighting by a Coil.**—A well-made coil, with iron core about 3in. long, ¼in. diameter, wound with two layers of No. 24 silk for primary, and 2oz. of No. 40 silk for secondary, well insulated between each layer, will give satisfaction. The coil should be provided with a proper contact breaker. For full directions for making such a coil I must refer you to my book, "Electrical Instrument Making for Amateurs."

S. Bottone.

[73483.]—**Dynamo-Winding.**—In my book, "The Dynamo: How Made and How Used" (seventh edition), I give the calculations required for winding dynamos of all kinds, and I specially point out that in small machines, Sir William Thomson's rule, that the resistance of the shunt coils should be 400 times that of the armature, is not applicable. I may mention that in practice I find that in a 5c.p. machine the ratio must not exceed 1 to 4, in a 20c.p. machine the ratio may be 1 to 8, and in a 100c.p. machine 1 to 12, or even more, if the iron is soft and good; but the resistance of the shunt, even in a 100c.p. machine, should not exceed 50 times that of the armature, otherwise the field magnets will not excite themselves at all, unless the armature is driven at a very high speed. The reason of the discrepancy between the different authorities named is that some are purely theoretical men, while others give the results of actual practical work. S. Bottone.

[73484.]—**Secondary Battery.**—Lead grids can be purchased from the patentees and their agents. Twenty-five cells will give a very good light. S. Bottone.

[73484.]—**Secondary Battery.**—Certainly you can purchase them. You can get them of almost any manufacturers of accumulators. By using a small arc lamp you could obtain this light from about 25 cells. F. A.

[73485.]—**Motor: Winding with Finer Wire.** —To Mr. Bottone.—You would not get better results except under two circumstances: First, if the batteries were distant; second, if the batteries were increased in number, and placed in series. If the motor is near the batteries, it would be better to leave the winding alone, and add a cell or two, coupled in parallel.

S. Bottone.

[73487.]—**Paint for Bath-Room.**—I think the "liquid glass varnish," as used for the preservation of stone work, on a clean level surface would succeed; possibly "Robinson's patent cement," so much used for lighthouses nowadays. This consists of calcined alabaster, looks very like plaster of Paris, and dries very hard and quickly. I think it could be coloured with any suitable mineral pigment kneaded into the cement. I have some of the latter work round the inside of my front bow-windows, done three years ago, and painted white —there is not a crack. Eos.

# UNANSWERED QUERIES.

*The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.*

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# QUERIES.

[73488.]—**Armature Punchings.**—Will Mr. Bottone kindly give the dimensions of Pacinotti's punchings—that is breadth of tooth and breadth of space, depth, thickness, &c., from 4in. upwards to largest diameter, with different number of teeth, so that people may know what wire space they have?—Bermuda.

[73489.]—**Pocket Galvanometer.**—Will Mr. Allsop or Mr. Bottone kindly inform me as to the best ways of making a pocket galvanometer, watch size, with quantity and size of wire for ordinary bell-work, &c., also mode of winding and connections? Any information or sketch would oblige.—Constant Reader.

[73490.]—**To Mr. Bottone.**—Please give number of laps and size of wire for primary and secondary coil, as dimensioned in your book on "Electrical Instrument-Making"?—Coil.

[73491.]—**Wimshurst Machine.**—I am told that the plates for one of these machines can be made from pasteboard, and to act satisfactorily. Can any one of "ours" tell a beginner what I shall have to do to the boards? Shall I have to coat them with shellac varnish, and if not, with what am I to coat them? Also must the coating (whatever it is) be put over the small pieces of foil on the plates or not, and also the distance the plates should be apart from each other? I propose making the plates with a 6in. radius.—A. H.

[73492.]—**To Mr. Bottone.**—Will you kindly tell me how many volts I can get from an accumulator? The size of cell is 7½ depth, 5⅝ length, width 3¾, fitted with 13 plates, 6 by 5, lead. And what quantity of sulphuric acid shall I want to charge the cell before fitting with a dynamo of 150 volts? What candle-power lamp will this bell light, and how many hours will it burn, and what will the time be filling the same with the current before it is ready for lighting?—Anxious Inquirer.

[73493.]—**Charging Accumulators.**—I want to charge a set of accumulators from a compound-wound dynamo, and, at the same time, to run a few lights from the machine—is this possible? If so, how shall I arrange them, and what precautions will it be necessary to take? What size, and how many cells shall I require to light 25 30-volt lamps, 16c.p., for 8 hours? Dynamo gives 200 ampères at 105 volts, and is 300yds. from accumulators.—Electric.

[73494.]—**Rapidly Rotating Spindle.**—I wish to run a small spindle at a very high velocity. The spindle is of steel, about 2½in. long, and carries a small brass pulley, and also a thin brass disc 4in. diameter. I propose to cone and harden the ends of the spindle, and run it in cast-iron centres. I want to get the highest possible speed—from 500 to 800 a second. Is this speed possible, and am I going the right way about it? How about lubrication? I should not want to run more than 5 or 10 minutes at a time. Any hints or references to books, &c., on the subject of high-speed machinery will greatly oblige.—C. Q. T.

[73495.]—**Ice.**—What is the best method to adopt to economise ice when large blocks are used piled round a cold chamber? Required to be kept at freezing point, or as near that as possible for months. We have tried piling the ice by itself in pieces—from 2ft. cubes to size of 9in. cubes, and also by surrounding the pieces with sawdust, and incline to think the former less wasteful; but would be glad of any experienced opinion on the matter. The cold cellar is bedded in a sand-hill covered with turf.—G. H. Hosie.

[73496.]—**Ferrotype.**—Could any of your kind readers favour us with some quasi-American ferrotype process, by which thin sheet-iron, latten brass, &c., could be so backed, bodied, or tinted chocolate, black, &c., as to readily get any letters or motto, &c., in white, rose, or cream colours, to appear clear yet not obtruded, so as to resist both wet and heat—just like the Pears' soap and other big mural tablets at the railway stations?—Constant Reader.

[73497.]—**White Brass.**—Will any reader assist me with particulars of white brass, the alloys used, and quantities of each? Also can it be melted in a common fire? Also any kind of brass that can be so melted. I want to make a few small castings, but am at a loss how to proceed.—Brassey.

[73498.]—**Plaster of Paris.**—Can plaster of Paris, which is rather weak from age, be made fresh and useful by any process?—if so, what? What thing can be mixed with plaster of Paris to make it set harder than it usually does, if only mixed with water? How can I soften plaster of Paris where it has been used to attach metal-work to glass, so as to separate them?—Cement.

[73499.]—**Silver-plating.**—Can any of "our" readers furnish me with a reliable method of cheaply silver-plating some small brass articles, so that it does not come off very easily?—Amateur.

[73500.]—**Grinding Lawn-Mower Cylinders and Plates.**—Will some reader please give me a few particulars with diagram of method for grinding the above —from 6in. up to 42in.? I have a lathe I can fix apparatus to. Do they require grinding together with emery and oil after being ground in such an apparatus? I have all makers' machines to repair.—Fitter.

[73501.]—**Exhaust Valve.**—Would any reader tell me what to joint the exhaust valve chest of my 8H.P. Otto gas-engine with? I have tried asbestos soaked in boiled oil, also asbestos with white and red lead, also red lead and lead wire, and fail to keep it tight. It stands all right for a short time, until some morning when I go to start I find the cylinder partly filled with water leaking through from jacket. The faces of joints are good. I may state that the engine works very well. Indicates 12H.P. on a consumption of 90ft. of gas per hour.—Gasman.

[73502.]—**Hydrostatics.**—Will any reader kindly help me out of the following difficulty? I have a tank 4ft. long, 3ft. wide, and 2ft. deep; from a point, 80ft. above the tank, water is delivered to the tank (which is closed at the top) through an inch pipe. Now I am told that the pressure on the bottom of the tank is the same as if the sides of the tank were as high as the height of the small pipe—that is, as if the tank was a tube, whose sectional area is that of the bottom of the tank, and its height 82ft. This appears to me to be quite absurd, and yet I cannot prove it to be so. However, I should feel thankful if any of "ours" would kindly work out the pressure in each case.—Hydro.

[73503.]—**Phosphorescent Tubes.**—How small could phosphorescence tubes or globes be made to emit enough light to distinguish type?—Istriel.

[73504.]—**Watch Key-holes.**—As the subject of a new invention for drilling square holes has recently been described in these columns, I should like to be informed, as a matter of curiosity, how the square holes in the keys of watches and clocks are made ordinarily. Are they cast or punched, or drilled by some process, and if drilled, how?—Ch. Robinson.

[73505.]—**Electric Clocks.**—I have two electric clocks labelled, "Patent, Dixon and Cassey." One with a pendulum is used to drive the other, which I wish, if possible, to fix a short distance from my house to give the time to villagers who have no public clock. The pendulum clock wants adjustment, and I shall be obliged if you could refer me to any article that may have appeared in your paper, or if some good friend would give me a hint regarding it. The clock works, or should work, with two Leclanché cells. As the pendulum swings to the left, it carries forward an arm which touches the armature at a point that is insulated. It should at a particular moment of its swing be propelled to the right by the armature being attracted to the coil or strong magnet, and as it moves to the right, a platinum point on another arm on the same movement touches the inside of a cup which apparently should contain water. The pendulum as it swings to the right by a ratchet movement operates on the hands by pushing forward a large wheel. The intermittent current should communicate movement to the secondary clock; but, for want of proper adjustment, no doubt, it fails with both after a few swings of the heavy pendulum. I have endeavoured to find out the makers, but cannot, and appeal to your paper, with which I was familiar up to 14 years' or more since before I left England.—Guardian.

[73506.]—**Royal Engineers.**—Is there a Photographic section of the above? If so, what qualifications are necessary? Any particulars will be gladly received by—Argenti Nitras.

[73507.]—**Distances of Stars in Klein's Atlas.** —I have lately purchased Klein's star atlas, and have found it most useful. The one thing which has astonished me in it has been that he (Klein) gives such exceptional parallaxes for the distances of the stars. He says that the distance of Eta Cassiopeiæ is 11 billion miles (π ·35"). That of Polaris he gives as 40 billions. He gives the distance of 61 Cygni as 8 billions. Now I had always thought the nearest star (Alpha Centauri) was distant 20 billions, and was perfectly sure that 61 Cygni was at least 37 billions. Would some kind reader say how this can have happened, and what the real distances are? Perhaps the mistakes have been made owing to translation, and have been overlooked.—Julian.

[73508.]—**Reflecting Microscopes.**—How is it there are none of these? Has it ever been tried, placing an object in focus of elliptical speculum, say, and wherein has this failed?—Reflector.

[73509.]—**Electric Light.**—Having read Mr. Bottone's answer to "Dynamo," will he or some other reader kindly explain how a shunt-wound machine is self-regulating? For if your lamps are arranged in parallel arc, does it not increase the resistance in the circuit if you switch a lamp off, and thereby driving more current round the shunt and making the dynamo give off more current for fewer lamps? If resistance-coils be used, is there any saving to the dynamo when fewer lamps are lit?—H. F. M. P.

[73510.]—**Dynamo.**—I want to substitute electric light for 60 gas-jets which burn all night. There are four rooms 42ft. square; in each I would like an arc lamp, and in the other rooms incandescent lamps. Would Mr. Bottone or anyone who may have a good machine, kindly give sketch and sizes of F.M.s and armature? I suppose I must have it compound-wound. What voltage and current would be required?—W. G.

[73511.]—**Oil of Bergamot.**—How is this made, and from what?—Learner.

[73512.]—**Spinning Top.**—There is a hollow metal top with two square-cut openings each side, which, upon being released from spring-wound shaft, emits a note going from a high to low tone. After a few moments, the tone suddenly rises again, though not to the former high note, and then descends. What is the explanation of this second action?—A. C. G.

[73513.]—**Recovering Zinc.**—I have a quantity of lved in muriatic acid. Could any of your readers simple method by which I could recover the inc.

—**Hardening Tools for Chilled Rolls.**— mechanic tell me the best way to harden the ned tools.—Roll-turner.

]—**Tinned Steel Plate.**—Will someone in- can tinned steel—such as is used for railway e wrought with ordinary tinman's tools? If so, izes are the plates obtainable?—Doctor Med.

]—**Dynamo to Light 56 20c.p. Lamps.** r. Bottone kindly give me the dimensions of – viz., size and quantity of wire on F.M. and F.M., Edison-Hopkinson type, size of armature? much of the circumference of the A. must the race? Also what is the usual voltage of 20c.p. Electric.

]—**Hay-Rakes.**—Perhaps some reader would l me if there is any tool for turning the teeth s of the above. I sometimes turn them in my ; I find it slow work. I have a large plane with urn the handles.—R. A.

]—**Submarine Telegraphy.**—What is the iode of transmitting Transatlantic messages? I at the current employed is of very small quan- high intensity. Is it true that so small a quan- 5 ampère is used? Is it obtained direct from ells or by induction? Is the astatic galvanometer loyed as a receiver?—Cable.

]—**Electric Railway.**—Could any of our indly give me a sketch or where I could get in- of how the locomotives on the City and South lectric railway are geared? Also what H.P. are rs, and how is the current taken off by each I see they are constructed by Mather and Platt. amps in carriages in any way in connection on nit as electro-motor, as they grow dull when the scending an incline? Information on the sub- d much interest a—Frequent Traveller.

]—**Sugar.**—What is the standard work on beet- nufacture, English or foreign?—R. H. Wilkin-

]—**Voltaic Pile.**—I have made a voltaic pile, k I have got tells me that a suspended butterfly ade to hover backwards and forwards for two or rs. Will any kind reader inform me how the m the pile are placed, so as to get this motion?—

]—**Fusible Alloy.**—Will some one kindly he recipe for an alloy to melt in hot water, say, 150° Fahr., or less? I believe most of these lloys contain bismuth. Is this an expensive buy? Where can it be procured?—C. Q. T.

]—**Why an "Unmitigated Nuisance"?** Earlswood Park" kindly explain why a binding a drill spindle is an "unmitigated nuisance"?— lison.

]—**Casting Medals.**—I wish to cast in lead imilar metal small medals resembling sovereigns rtising purposes, as I am a grocer. Would f Paris moulds be suitable? Any information re- he making of the mould and casting would be ly received. Can "Eos" help me?—Puzzled.

]—**Goldfish Breeding.**—Have kept a few of large bell glass aquarium for about twelve There are plants and snails to keep the water out four), and two minnows are heavy in spawn. ny chance of them breeding? Shall be glad of estions.—Fish.

.]—**Lettering on Glass.**—To "Silex."—In swer (letter 31914) to query 73240, you are kind o give details as to lettering on glass. I should if you would give the quantities in pounds or r pints, half-pints, &c. Would you also state s on this subject with which you are acquainted? ch books, are they written in English?—Vitrix.

.]—**Electro-Magnet.**—I wish to construct an agnet to lift 14lb. Would you kindly say the magnet cores, diameter of magnet cores, length ns, diameter of bobbin head, size of wire, and ch distance between the pole-pieces? What ower will be required if chromic-acid cells of one acity are used?—Magnus.

.]—**Induction Coil.**—Would three layers of .c. wire wound upon an iron core, size 6in. ⅜in., ary and 1lb. of No. 36 s.c. wire for secondary, be for a 1in. spark? Would it be best to wind y in sections or not? If the former, how many? rion.

.]—**Fishing Stockings.**—Would any reader nough to tell me how to waterproof a pair of kings (made of linen or calico) for wading in? nseed oil do, used in the same way as for oilskin .? If linseed oil would do, what would be the y to use it? Is there any way of hastening its I believe it takes a considerable time when used ny hints on making wading stockings would very blige.—Sparrowhawk.

.]—**Stopped-up Gun Barrel.**—I have a fle, and put a piece of rag down the barrel the y to clean it out; but it got so tight that I could e it either way, and I fired some bulleted caps with the idea that it would blow out, but I am say I cannot move it ½in. Would some reader ell me how to get it out? I could burn them are wedged in) out, but I do not know how to the barrel again. Boring is not available.—Lal

.]—**Astro. Telescope.**—To "F.R.A.S."—I elescope, of which the o.g. is 2in. plano-convex omatic. The body tube is 11¾in. long, and in this e eyepiece, which consists of two plano-convex aced in a brass tube at the distance apart of 2·3in. est of these lenses is barely 1in., and the smaller diameter. The arrangement of the three lenses .g. convex surface outwards, eyetube (which can ved at pleasure), both convex surfaces away eye. When the instrument is in focus, the total om outside of o.g. to eye is 12in. The magnifying power is very small; in fact, I can barely see a large sun-spot with it. How can it be altered so as to be used in observing sunspots?—Helios.

[73532.]—**To Mr. Bottone or Mr. Askew.**—I want to construct about four batteries (pint size) for lighting a 4-volt lamp for temporary purposes (about five or three minutes at a time), and for coils and general work. I have heaps of old carbon rods. Could I construct a battery thus? Have a pint jar and make a ring of carbons, then a porous pot, and inside a zinc rod like a Fuller battery. Would you mind giving me particulars of chemicals, &c., and how can I cast a lead ring about my carbons, as described in your book, "Electrical Instrument Making"? I want the battery to last a pretty long time (say, one month) with a good current when used.—S. M. B. L.

[73533.]—**To Mr. Bottone.**—Will you kindly tell me how much 36 B.W.G. wire in yards for a telephone with magnet 4 by ⅜? I am constructing it according to your book, "Electrical Instrument Making." Also I am constructing a pair of telephones with magnets exactly the same size as stated in your book. How much of No. 36 B.W.G. must I put on them also in yards? You stated 60 grains, but I should like to know what it equals in yards?—S. L.

[73534.]—**Harmonium.**—Will some kind reader help me in the following? There is in the church I attend an Alexandre harmonium, which has nine half-rows of reeds, of which three are out of order—that is, the stops marked two each side and the celeste. What I wish to know is if I can replace the one-and-half row with American-organ reeds, and if that would be an improvement or otherwise? I thought one row of diapason and half-row flute would improve it; but should like the opinion of some competent person before I begin to alter it. The instrument is nearly half a tone flat, and the new reeds would have to be lowered to it, I suppose. Could an octave-coupler be added, or even pedals? In any case I should like advice, so as to get—More Noise.

[73535.]—**Lathe Bed.**—I am making a wood-turning lathe for a village class. A wood bed is unsatisfactory, a metal one beyond my powers. Can a job be made by using angle iron, say, 1in. by 2in., mounted on wood by countersunk screws? Would the filing into truth be excessive? If it can be done, would the deep flanges be best outside or inside? The narrow ones, of course, would form the bed.—Kittie.

[73536.]—**Skew Gearing.**—Will "J. H." kindly tell me how to set out a pair of skew-wheels of 2⅜in. diam., 2⅜in. between the centres? The shafts are at right angles, and the upper one turns four times to once of the lower. I propose to use a 12-pitch cutter, and have 28 teeth in the under wheel; but that would be to reckon the pitch as in a spur or worm wheel. Is that right, the upper wheel being more like a worm? I propose to use the same cutter to form the thread, and to use the slide lathe as with worm screw, but do not know how to get at the pitch or rake of the thread. Seeing the cutter is not far from the diameter of the wheels, I propose to use it to cut the under wheel by simply inclining it to the proper angle and pressing it into the edge of the wheel, dividing by the division plate. What would be the proper angle?—F. A. M.

[73537.]—**Chemical Action of Light.**—I should be obliged if any reader could inform me of the reason of the difference between the chemical action of light on plants and inorganic substances? In latter case—e.g., silver chloride—the violet rays are most active, whereas in former it is the red rays.—S. S. R.

[73538.]—**Switchback.**—Would any reader kindly give me the exact rises and falls for a model switchback?—Ano Vice.

[73539.]—**Boarhound.**—Will a reader conversant with the habits of dogs tell me the characteristics of the boarhound—viz., its temper, courage, &c?—Canem, Plymouth.

[73540.]—**Bubble.**—The bubble of my 14in. Gravatt level is elongated beyond metal opening in tube. The glass is cracked, but it does not appear to be the cause of elongation. Will some one kindly say what is the cause, and if it can be remedied without new one?—G. W. W.

[73541.]—**Dynamo.**—To Mr. Bottone.—A dynamo is built and wound with wire large enough to carry all the current that it can generate, armature carrying 50yds. wire. This machine is supposed to give about 50 volts; but how can anyone say how many ampères it is capable of producing? Machine driven by an engine. How can anyone know before a machine is built how many ampères you can get out of it? You may estimate the volts by the yards on armature; but what determines the current obtainable? I do not understand at all.—Student.

[73542.]—**Aphengescope for Magic-Lantern.**—I have a magic-lantern and a camera. Can I make an aphengescope of the camera? It has rackwork front lenses and mahogany body. If any scientific reader will give instructions for doing so, they will oblige.—Semloh.

[73543.]—**Giving Motion to Water.**—Can any reader kindly refer me to any experiments or inform me if anything has been done in the way of giving motion to a large body of water by means of a small current of water moving at a high velocity due to a high pressure, in one sense, something on the principle of the injector? Any particulars will much oblige and be esteemed as a great favour.—Water.

[73544.]—**Snow and Frost.**—It was asserted to me recently by a gentleman, who said that his information was received from a thoroughly scientific man, that it is impossible for snow to fall during frost, that the atmosphere would be too dense, and that when snow does fall there must be a temporary thaw. In Switzerland I have seen snow fall during very severe and frosty weather, but have never tested the temperature during the snowfall. Can any reader inform me what grounds there are for the theory advanced, and whether there is any truth in it?—Celt.

[73545.]—**Minimum Deviation.**—If a beam of parallel rays is incident on a prism, does not the emergent beam also consist of parallel rays, whether the prism be in minimum deviation or not? If it does, why is it important to place the prism in minimum deviation in an ordinary spectroscope where a collimator is used, and therefore where the incident beam is parallel?—L.

[73546.]—**Malleable Castings.**—Would anyone kindly say if it is practicable to make small malleable iron castings, say, from ¼oz. up to 6 or 8oz. each in weight, at home with an ordinary fire like brass? What would be the simplest requirements both for casting and annealing, say, for a few dozen castings at a time? Also please say if ordinary sea-shore sand or river sand would do for the moulds, or if there is any great difference in the quality of such for that purpose. The castings would want to be clean and fairly tough, so as not to break easy, for furniture, &c.—Mexicos.

[73547.]—**Initials on Blankets.**—Please say how I can bleach my initials on a pair of good Whitney blankets blankets dyed all over in fancy stripes?—J. H. E.

[73548.]—**Mailcart Wheel Spokes.**—The oil has worked out of the hub into the screws of above through the holes being drilled right through hub to the bore. Consequently spokes come unscrewed and fall out. How can this be remedied, and prevented going further, in the simplest and least expensive way? Two sets of wheels gone in the course of a few months in the same way.—J. H. E.

[73549.]—**Speeds of Drills.**—Would any of your readers kindly give me a rule or table for finding the different speeds at which drills ought to run to drill holes in wrought iron, say, from ¼in. to 1in. diameter?—Hasley.

[73550.]—**Gas Consumption.**—1. What is the number of cubic feet of gas consumed by the five millions of people in London per annum, and the average price per 1,000c.ft.? 2. What is the number of cubic feet of gas consumed by the 38 millions of people in the United Kingdom per annum?—Gas.

[73551.]—**Stamped Metal-Work.**—Will some kind reader give a cheap and effective method of renovating the stamped metal-work on photo. stands, silver colour?—A. D.

[73552.]—**Harmonium.**—Will some friend kindly instruct me how to make a harmonium soundboard for a single set of reeds?—Clement.

[73553.]—**Microscope.**—Would Mr. Davis be good enough to tell me which sort of microscope he considers the best for general analyst's work, for the examination of yeast, germs, &c.?—Analyst.

[73554.]—**Link Motion.**—Will somebody kindly inform me how to find what throw eccentric sheaves should have when used with link-motion to give a given travel of valve, say, 4in. in full gear? I mean when the link has its holes at top and bottom, and not lugs. Also does not the almost opposite motion of the one sheave take some of the effect off the other, and is anything allowed for it? If so, a rule to determine this would oblige.—F. J. B.

[73555.]—**Lenses for Telescope.**—I have three lenses which I bought for making a telescope. The object-glass has a focal length of 40in. The other two are 2in. and 1in. respectively. Both double-convex. I cannot get a sharply-defined image. Will some reader kindly tell me exactly how the lenses must be arranged, distances apart, &c., and, if possible, a little about the optical principles?—P. J.

[73556.]—**Magical Conjuring Trick.**—I have lately seen a gentleman mesmerise an ordinary walking-stick. Sitting on a chair, he places the stick before him, handle end uppermost, either perpendicularly or at an angle leaning from him. He seems to balance the stick at the upper part with his hands at first at the same time commencing to draw long and deep breaths. After about half a minute he very gradually removes his hands, which he will then place behind him or in any other position desired. The stick remains standing, and any one of the audience may pass his hand between the performer and the standing stick, which seems to rock gently backward and forward with the inspirations and expirations of the performer. At the end of the performance the stick is immediately handed round for inspection. I have seen this done in three different houses, on different qualities of carpet—including a thick Turkey—with various sticks, and with any stick chosen or produced by the audience, if not a very heavy one, and I have seen the performer called upon to do it quite unexpectedly. Can anyone say how this trick is done? I am certain it is not done with a hair.—Celt.

[73557.]—**Rain.**—Is air free from any dust particles capable of sustaining moisture in suspension? What is the cause of rain? Am I right in supposing that while the electrical current is passing from the earth into the air that the particles of vapour float, and *vice versâ* that they fall to the earth as rain?—J. H. B.

[73558.]—**To "F.R.A.S."**—Will you help me out of a difficulty? On page 158 of Glazebrook's "Optics" (second edition) is the problem of finding the disturbance at a point P by the light passing through a slit. This disturbance depends on a certain area of a displacement curve. In finding this by the summation of sines the last value of S contains, I think, a misprint (certain dots indicating terms omitted). Even if this is correct, I cannot understand what follows—the expression for the amplitude. What value is to be given to the term ($vt$) which occurs? I take it to be distance PF. I think I understand the general explanation given of the light and dark bands. Again, at the bottom of page 161, ought not wave-length over sin. $\theta$ to be half wave-length over sin. $\theta$?—F. P.

[73559.]—**Apparatus for Cold Room.**—I shall feel obliged for an idea of the best apparatus. It must be capable during summer months of keeping a room or chamber about 15ft. square at a temperature below freezing point, so as to preserve perishable articles.—Carino.

[73560.]—**Microscope.**—I am thinking of starting a street exhibition with four microscopes (two by Beck and two by Watson). Will some kind reader please tell me which objectives I should use to please the public most—¼, ½, 1, 2, or 3in.? Also please tell me of a few good mounted objects that will please them as well, and which objectives I should use to get the best result when examining a frog's foot. And do you think there is a living of, say, 35s. per week by going from town to town? Any information on the above will be gladly received by—Novice.

[73561.]—**Astronomical.**—Can any reader of the "E. M." kindly tell me how to reckon the time at which the various astronomical occurrences (which appear in the Astronomical Notes of the "E. M.") will occur at St. Petersburg, Russia?—AMATEUR.

[73562.]—**Telescope.**—Will any reader of the "E. M." kindly inform me of a good test for a telescope with a 3½in. object-glass (diam.)? What objects ought I to be able to see? I have powers 126, 56, and 86.—AMATEUR.

[73563.]—**Telescope.**—The weather is very cold here, being many degrees below zero. When I take my telescope outside, the o.g. becomes dimmed. Can any reader oblige me by informing me how to avoid it? The eyepiece also becomes dimmed, and it is a very great trouble to keep cleaning it.—AMATEUR, St. Petersburg.

[73564.]—**Right Ascension and Declination.**—Is there any way by which I can find the right ascension and declination without having an equatorial? Any information will oblige.—AMATEUR.

[73565.]—**Electric Calls.**—Will some practical reader give an opinion on two systems (the battery or magneto generator) to ring 20 3½in. bells at intervals, along 1½ miles of bronze or copper line wire? The call to be sent from the middle of wire. If not asking too much, give best way of wiring up of magneto; also the power or size required. The magneto bells would be more expensive.—GENERATOR.

[73566.]—**To "Eos."**—Will "Eos" be so good as to say how those flat, generally triangular in shape, gongs are made, toned, and of what metal? They are imported from India, and, I believe, also from Burmah. They look as if they were cast and then scraped, and the metal appears something between brass and gun-metal.—J. F.

[73567.]—**Wire for Dynamo.**—I have castings and fittings for small dynamo, ready for wire, the dimensions of which are as follows:—Armature (plain ring) built up of charcoal-iron stampings, and is 3¼in. long, 2⅝in. diameter, F.M.'s 9lb. each (all cast-iron), cores 3⅜in. long, 3in. by 2in. Will you kindly tell me what quantity and gauge of wire to wind fields and armature with to get the highest output at a pressure of 15 volts? In how many sections should I wind armature? At what speed should it run, and what power will be required to be connected up as shunt.—AMMETER.

[73568.]—**Microscope Spot Lens.**—I wish to make one for my microscope, and shall be glad to know what will be the best diameter and focus of the plano; also the size of the opaque disc? Does it depend on the focal length and aperture of the objectives?—ARINAS.

[73569.]—**Porous Cell.**—What should be the contents of a porous cell in comparison to the outer cell, so that both liquids are exhausted at the same time? What I mean is, if a p.c. holds, say, half a pint of liquid, how much should the outer cell hold when the p.c. is in its place? It is for a double-fluid chromic; and please say if the rule holds good for all double-fluid cells.—CHROMIC.

[73570.]—**Condenser for 2in. Spark Coil.**—Will Mr. Bottone kindly say whether a condenser containing 100 leaves, each 6½ by 5½, would be suitable for a coil intended to give a 2in. spark? The coil has a full 1in. wire core. The reel is 5in. across the cheeks, and has a space of 7in. between the inside faces of reel. The primary is composed of two layers of No. 16 d.c.c. wire, which is thoroughly saturated in shellac varnish. This is covered with five or six layers of stout brown paper, also soaked in shellac varnish. The secondary is made up with 2lb. of 36 silk-covered wire, which has been thoroughly soaked in paraffin wax previous to winding, which has been done in two sections. The insulation between the layers is a coating of paraffin wax and three turns of paraffined demy paper. Will you also kindly inform me how many bichromate cells, each having 7sq.in. of exposed negative surface, will be required to give the full 2in. spark? I may say, though, that the wire (that is the secondary) where it is joined, is covered by a piece of paraffined paper beneath the join, and a piece on the top to insulate it from the surrounding coils and layers.—H. E. AUSTIN.

[73571.]—**Marine Glue.**—Can anyone advise how to dilute marine glue, so as to make it adaptable to cold use? It is so easily chilled, and will not stick; while for my purpose I cannot use it hot nor thick.—CARPENTER.

[73572.]—**Photo-Micrography.**—Can any of our microscopical friends kindly help me out of the following difficulties? I want to photograph some opaque slides, and have been trying to use a 1-5 objective, illuminating the slide by means of a thin cover-glass placed at an angle of 45° inside the microscope tube, the latter having an aperture to admit the light. But there are so many reflections from the back lens of the objective and other parts of apparatus that the plates are fogged at every attempt. Can anyone suggest a better form of illuminator? Then again, using a 1in. objective with parabolic reflector, I manage very nicely without an eyepiece; but if I try to use the eyepiece, I cannot get a sharp image on the camera screen, no matter how I adjust the draw-tube. If anyone can assist me I shall feel greatly obliged.—T. M.

[73573.]—**Electric Lighting.**—How can I hope to succeed in lighting up two rooms with electric light? Have been very successful with a battery, but wish to give that up, as the trouble is too much. The engine would be below ground floor, say 30ft. away from the centre of ceiling. I should desire to be able to use the existing chandeliers for the means of affixing the lamp brackets, so as to be able to use the light as well as gas. Should like a shunt-wound dynamo (so as to be able to charge accumulators, if desired) to light, say, six 10c.p. lamps 15 to 25 volt. Gas-engine required would, I suppose, have to be ½-horse. What work at present published would give me a good insight into such things as wiring, &c.?—GEORGIUS.

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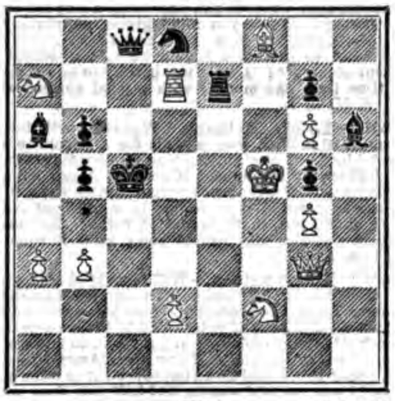
DR. CORPUT, who had been charged by the Belgian Government to examine the sanitary institutions of Germany, states in his report that the annual army death-rate is in Germany 3·97, in Belgium 4·07, in France 6, and in Austria-Hungary 6·94 per cent.

## CHESS.

ALL communications for this department must be addressed to "J. PIERCE, Knollside, Yawl, Lyme Regis, Dorset."

### PROBLEM MCCXXXVIII.

*Black.*



*White.* [11 + 10

White to play and force Black to mate in two moves.

### SOLUTION TO 1236.

| *White.* | *Black.* |
|---|---|
| 1. Q-Kt 3. | 1. Any. |
| 2. Q, R, or Kt mates. | |

### NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1236 by C. P. P., J. Humble, E. Perrin, Biene, G. W. Middleton, J. Kistruck, W. Gleave, W. Jay, H. Fellows, A. Fellows, W. A. Clark, Link, J. H. Eastwood, White Knight, W. L. Martin, and F. W. N. Lambert; to 1235 by W. Jay (key move only), J. Kistruck, W. A. Clark, G. W. Middleton, Link, J. H. Eastwood (key move only), White Knight (very ingenious), D. Mackay, and F. W. N. Lambert; to 1234 by Lieut.-Col. E. H. Ryan.

E. H. RYAN.—The solution was, we find, credited to you. The Tourney will last another three months. Your order at present is 15th.

H. AND A. FELLOWS.—Problems received with thanks.

J. KISTRUCK.—In sui-mates, duals do not count after Black's *second* move, but only after the first.

G. W. MIDDLETON.—Duals do not count in two-movers.

THE *Liverpool Weekly Mercury* is about to start a Problem and Solution Tourney, to commence in March. The entrance fee to the former is one shilling. The latter will be in two divisions—one for two-movers, and the other for three-movers.

THE *British Chess Magazine* for February gives a likeness of T. Taverner, the well-known two-move problem composer, who won his first laurels in our column. The following is given as one of his finest compositions. It will well repay examination. White: K-K Kt 2; Q-K R 5; R's-K B sq and K R 2; B's-K Kt sq and K R 7; Kt's-Q B sq and Q B 7; P's-K 2, K B 3. Black: K-K B 5; R's-K sq and K B sq; B's-Q sq and K Kt sq; P's-Q B 4 and 5. White to play and mate in two moves.

MR. STEINITZ, in his match for the championship at New York with Mr. Gunsberg, is slightly ahead of his opponent, the score at present being, Stenitz, 5; Gunsberg, 4; drawn, 5. The general impression conveyed by the study of the games played so far will be, we think, that Steinitz has hardly done himself justice, through airing his new crotchets, which have in general put him to a disadvantage, and in some cases caused him the loss of the game, especially in the defence of the Evans. We doubt if any of his admirers will dare to follow in his footsteps.

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questions such as are indicated above, which
individual interest, and which, if not adverti
themselves, lead to replies which are. The
Sale Column" offers a cheap means of obta
information, and we trust our readers will a
selves of it.

The following are the initials, &c., of letters
to Wednesday evening, Jan. 21, and unack
elsewhere:—

COIL.—G. C.—W. W.—W. G. Tweedy.—R. H.
—Ch. Robinson, B.A.—James Robinson.
E. B.—E.—J. J. T.—Wilco.—E. A. A.—New
Porcelain Surface.—Caldemone.—H.
S. R. Bottone.—D. Blackburn.—Kymfer.—
ton.—Percy Reid.—J. W. White.—W. H. Yo

C. J. C. (The replies to which we suppose
appeared in the numbers for August 1 and
1890, under the heading "Skin Perforations.
GOW. (There are many recipes for ceme
kind; but marine glue will answer the pu
probably simple shellac.)—EVANS AUSTIN.
course. A notice is in type.)—FORWARD
articles on "How Books are Bound" commer
number for July 11, 1890.)—COMPE. (Wh
mean? Will a steam-engine or a gas-engin
indices for references to motors, and to
similar queries.)—TELEPHONE. (You do n
the page on which the information appears
sibly you can supply the actual date of the te
of the patents on the Blake transmitter, whi
vented in 1877.)—R. THOMPSON. (There a
methods of heating railway-carriages—e.g.,
and steam pipes. They have all been describ
volumes, as has also Ericsson's solar engine.
book on the subject.)—MIXED. (The ink
rubber stamps is generally one of the anilin
ground up with a little glycerine. Several re
been given.)—JAMES RHODES. (The majori
readers who take an interest in astronomic
are quite aware of what you state, and in the
the subject is fully dealt with. There is a w
nised difference between true motion and
motion. See, for instance, Chambers's "Ha
Vol. I. p. 56 of the fourth edition.)—B. J.
probable damage if the trigger of the air-gu
to is pulled before closing the gun is that the
be blown out, and the operator's fingers
caught by the closing of the barrel. From
scription, the gun wants repairing.)—LUZ ELE
far as we know there never was any pate
Planté secondary battery; but, if so, it has e
far as the original battery is concerned. The
in all such matters is to put the question to
agent, who for a small fee will answer the
definitely. If you can make the requisite sea
self, that will cost less.)—JAMES NOCK. (See t
of the last volume and the numbers of the pr
details of several dry batteries. The subject
discussed at considerable length recently.)—T
(Better consult a surgeon. The description yo
not sufficient to enable anyone to offer useful
Send a full account to the Medical Editor of th
*Times and Echo*, and he will then be able to ad
seems a surgeon's case. so far as can be judg
your description.)—ALKALI. (We do not kn
any particular bones of specified animals are m
able for making cupels than others; but it is g
considered that the bones of sheep and horses m
best cupels. They should be boiled before bur
get rid of the organic matter, and should then b
until free from carbon. Too high a temperat
be avoided; but the bones should be burned u
leave a white ash, and that should be washed in
or rain-water if the very best ash for cupel
desired. The harder bones should not be chose
they can be ground into the very finest po
E. G., Matlock. (It is amorphous phosphoru
with gum-water and a little finest emery.)—C
(Do not think there is any book on the subject
carbonic acid be easily liquefied without prop
It liquefies under a pressure of 36 atmosph
temperature of 0deg. C., or freezing-point o
See indices.)—NESCIENCE. (Two or three
copal varnish will help to keep the soles of boo
tight, and the uppers can be dressed either wit
or castor-oil.)—TELEGRAPHIST. (If you want
work than Preece and Sivewright's, try
"Handbook of Practical Telegraphy," pub
Longmans.)—TATTOO. (See indices. Som
marks may be obliterated by the actual caut
blistering and the persistent application of
but it is a difficult matter, and a scar is inva
behind.)—ONE ANXIOUS TO KNOW. (It depen
process employed. Sensitised paper can be
some time if light is carefully excluded. Se
the handbooks of the art; but why not
the paper as it is wanted?)—LUX IN
(Simple method of making a phosphor
or luminous phial is to place, say, 12 grains p
and ½oz. of olive-oil in a phial; cork loosel
into a bath of hot water until the phosphorus

ecurely, and shake until nearly cold. When t will give sufficient light to read a watch l last some time if not too frequently used.) :R. (Better get the blacksmith to do them; an be hardened by heating to a red and in oil. See indices under head "Hardening :. M. H. (The temperature of the exhaust out 400° C.; but as to pressure, that depends things, that only actual trial can answer the -J. G. N. (Any of the works published for e. Choice is only a matter of personal taste. Macmillans, Lockwood all publish text-bl for students, and some are recommended llabus.)—J. G. N., Nottingham. (See above. You will probably be able to find ation required in Prof. Thompson's lectures ectro-magnet, and in some recent Replies. numbers of this volume. To answer your horoughly would occupy a good deal of space p much time. One of the electrical writers umns would no doubt make the requisite s for a moderate fee.)—H. G. DIXON. (Sup-et "Sigma" have his turn. Some corre-are so very impatient.)—W. G. (Kindly WHITTLE. (In type.)

**ster's Opinion of Harness' Electro-**TMENT.—Writing from Haywardsfield, Stonehouse, "Dear Sir, I have only been waiting until my com- give a testimony to the wonderful effect of your Elec-reatment. When I first consulted you my vital energy I was incapacitated for work of any kind. From the lf in your hands my improvement was rapid. I have ll the vigour, both of body and mind, and am com- to health. Yours faithfully, F. Arthur Sibly, M.A., er-at-Law). To C. B. Harness, Esq., President, the Company, 52, Oxford-street, London, W." Sufferers er of the nerves, stomach, liver or kidneys should call e for a belt or particulars. Book of testimonials, consultation free. Note address—52, Oxford-street,

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**y's Ointment and Pills.**—The Oint-erfully healing application, as it cleanses the surface of ulcers, soothes the throbbing and pain in cases of and checks the progress of skin diseases. The Pills d, cleanse the liver, and remove all noxious matter n.

## EXCHANGE COLUMN.

*for Exchange Notices is 3d. for the first , and 3d. for every succeeding 8 words.*

**Pigeons**, the best breed out. To reduce ept any reasonable exchange.—Address A. VARLEY, dleworth.

e **Equatorial**, 12½in. With reflector, slow n. finder, six eyepieces, Barlow's lens, diagonal, set of 2 stamps.—Below.

**Instrument**, 2¾ o.g., silver circles, ollimating eyepieces; photo six stamps. Photometer rometer by Grubb, astronomical books and instru-

ers two aneroid; patterns for **Equatorial** , tricycle, Cromartie lamp, new ebonite Wimshurst ork; lantern photos. List stamp.—Box 20, Liversedge.

s (two), nearly new. **Telescope**, 2¼ Wray, Scientific Apparatus, various. Wanted, Chronometer, also small Transit.—Box 20, Liversedge.

**Coleoptera.** Exchange with collectors, d; also books, papers, on subject, cartoon, and store-89, Elms-road, Clapham, S.E.

cal **Frictional Machine**, with plete, in case, worth 50s. Wanted, Magic Lantern or y to OSSUPIER, 8, Lawson-street, Newcastle-on-Tyne.

**Stamps** for exchange. Anything bric-à-Selections sent on approval.—Address, COLLECTOR, reet, Hull.

h **Mechanic**," ten volumes, commencing ange to half-price for anything useful. Would like e or Dry Batteries.—J. GRAY, 10, Pancras-road, N.

nge for ½H.P. **Vertical or Horizontal Engine**, work by foot.—B. B. BUCK, Frettenham, Norwich.

s for 15ft. **Oxygen Cylinder**, with brass ; patent panoramic lantern carrier, cost 10s. 6d.; and et? All in perfect order. Together or separate.—T. g's Langley.

ectric **Arc Light**, with globe and re- e for drawing-room. Exchange for anything useful or , 45, Church-road, Homerton, London.

centre screw-cutting treadle **Lathe**, by gap bed and back gear, Whiton's Universal chuck, entric rests, wood and metal turning tools, change l quite new; cost £25; part cash wanted.—Seen after Stroud Green-road, N.

e's **Elements Mechanism**," "Twis-l Mechanics," "Tomkin's Machine Drawing," mpson's Electricity, Magnetism," "Chambers' Tables," Conic Sections."—GROSE, 33, Bird-in-Bush-road, lon.

**Double Dark Slides**, best make, polished mahogany hinged shutters, ¼-plates, ½-plates, 1-1 plates, and 12 by 10. Offers.—F. MOORE, 1, Canning-crescent, Wood-green.

Quarter-plate **Camera**, bellows body, stand, and three double slides; Studio Camera, 2½-plate, metal slides, tripod. Offers.—F. MOORE, 1, Canning-crescent, Wood-green.

Wanted, **Model Printing Press** and complete Outfit. Exchange B flat, plated CORNET (Besson's), and 68 numbers of ENGLISH MECHANIC.—M., 17, Ely-place, E.C.

Wanted, small **Circular Saw**, to work with treadle, with saws for fine work. Exchange MUSICAL Box or Photographic Apparatus.—C. C. VEVERS, 12, Market-street, Leeds.

Splendid double-barrelled walking-stick **Air-Gun**, almost new. Exchange for double-barrel centre-fire Gun.—JAMES SHARP, Sanquhar, Dumfriesshire.

Splendid **Oboe**, cocus-wood, 13 German-silver keys, rings, tips, perfect condition, in walnut case complete. Exchange Electric Motor.—55, Fisherton, Salisbury.

Good silver keyless **Watch**, quite new, cost £3. Exchange Model Engine and Boiler, or small Lathe, or Drilling Machine. —CHAS. ADAMS, Beverley-road, Colchester.

9in. **Burnishing Machine**, new, value 15s.; "Cassell's Technical Educator," 24 numbers complete; and good Violin. Exchange small Harmonium or offers.

**American Cake-Mixing Machine** (new), and Vegetable Slicing Machine, new. Exchange the two for a Knife Cleaning Machine.—T. BURDEN, 8, Birchett-road, Aldershot.

270 **Corrugated Carbons**, 500 others for batteries. 24-cell Daniell Battery, 27 Incandescent Lamps, pair Galvo. Coils, also some Ebonite. What offers?—HUDDLESTON, below.

Willen's high-speed **Steam Engine**, will work 8 to 20H.P.; McNaught's Steam Indicator; Steam Gauge, 120lb. What offers?—HUDDLESTON, below.

Two **Morse Sounders**, with relay, one with galvo., two local sounders, five S.N. Keys, three relays, galvo. in case. What offers?—HUDDLESTON, below.

Quarter-plate **Camera**, with 13-plate changing box. Exchange half-plate Camera, with six double slides, or offers.—HUDDLESTON, 21, Upham Park-road, Chiswick.

**Electrical Machine**, cylinder 14 by 25 inches, all complete, with Leyden jar, good as new. Exchange Mechanical or Electrical.—H. P. SAUNDERSON, Kempston, Bedford. Also

**Sleigh** (American cutter), to carry four, only run for two weeks on the Ouse. No reasonable offer refused.—Above.

"**English Mechanic**," 15 volumes to date. Wanted, Watchmaker's Lathe, old Clock Movements, Model Engines, or any offer entertained.—FRENCH, 346, Hawthorne-road, Bootle.

**Instantograph**, half-plate, three double backs, tripod complete, value £4. Offers in Tools. Shafting, Vices, anything useful engineer.—D., 89, Elms-road, Clapham.

"**English Mechanic**," 16 volumes, six volumes bound; 40 numbers "Electrician," small Arc Lamp. Offers. Telephones or electrical.—J. S., 4, Oak-street, Radcliffe, near Manchester.

Wanted, **Surface Plate**, true, about 12in., and Screw-cutting Lathe about 5in. Exchange new Safety, cushion tyres, ball bearings. Send lowest price.—L., 188, Great Dover-street, London, S E.

**Engine and Steel Boiler**, half man-power, works 80lb. Exchange.—HALMSHAW, 182, Barker-end, Bradford.

New **Copper Boiler**, size 19 by 8, five cross tubes. Exchange.—HALMSHAW, 182, Barker-end, Bradford.

Quarter-plate **Pocket Camera** or Detective, and best oil lantern, 4in. condensers, photographic objective, wanted. Exchange Diamond Camera and half-plate set. — WILLIAM M'CULLOUGH, Newtownards.

**Steam Pressure Gauge**, gunmetal, Bourdon's patent, 5in. dial; also several Circular Saws, from 16in. to 26in. dia., all perfect. Offers.—TAYOR, Wakefield-street, Warrington.

**Steam Engine**, 4½in. bore, 6in. stroke, professionally made, Safety Bicycle and cash for 4in. or 6in. Screw-cutting Lathe.—74½, Temple-street, Wolverhampton.

**Electric Bell Set**, complete with wire, push, and No. 2 Batteries, never been used, cost 15s. Exchange to value of 6s. or anything useful.—Above.

Six-hole **Indicator**, with mechanical replacements, good as new. Exchange to the value of 12s., or anything useful.—Above.

One 1in. **Twist Drill**; two ¾in. ditto; two 7-16in. ditto; one ½in. ditto; one ⅜in. ditto; one ⅝in.; also about 40 small ones from 1-16 to ¼ of inch. Offers.—Above.

A **Pair of Rubbers** for safety bicycle, for 30in. wheel by ¾in. Offer.—R. G. LOOTE, 117, Fore-street, Edmonton.

**Forth Bridge Brooch**, hall-marked silver brooch, with correct view of the Forth Bridge engraved thereon; an interesting novelty. What offers in exchange to 7s. value?—E. GOODYEAR, Granville terrace, Radnor Park, Dalmuir, Glasgow.

**Binocular Microscope**, equal to new. Particulars on application. Value £70. Want Gas Engine.—Below.

5H P. **Steam Engine** and horizontal tubular boiler, in good condition. Want Gas Engine.—HODGSON, Stonegate, York.

What offers for **Vertical Engine**, brass, weight 7lb., in good order.—BYATT, 61, Oakfield-road, Stroud-green, N.

What offers for horizontal slide-valve **Engine**, 1¾ bore, 3¼ stroke, only wants connection rod to complete, iron bed and feed pump.—BYATT.

Will exchange vertical **Engine and Boiler Shell**, for good loco. type Boiler, 20in. long.—Apply A. S., 4, Broseley Villas, Wood-green, N.

Model Engine and Boiler wanted, not less than 2½in. stroke. Must be good. Offer SOCIABLE TRICYCLE, by Singer, splendid machine.—H. COUNSELL, Faringdon, Berks.

Exchange 3in. centre **Lathe**, back-gear, 4ft. bed, and 54in. Bicycle, balls throughout, for Safety, or offer.—W. S., 8, Gladstone-street, Battersea.

Marble **Mantel Clock**, goes three weeks, strikes hours and half hours, ruby pallets, value £5. What offers in exchange.—SMART, 26, Queen Anne-road, Maidstone.

"**English Mechanic**," Feb., 1885, to date, for good Lathe Heads, not under 4½in.; Leg Vice, about 3½in.; Microscope, or offers.—J. PERRIN, 15, Vale-road, Silverhill, Hastings.

Wanted, Stanley adjustable **Jack-Plane**, Disston's Cross-cut Saw, Thompson's Flexible Back Hack Saws, with frame. Exchange.—S. J. WESTLAKE, Woodhall, Exbourne, Devon.

**Hot-Air Engine**, by Hayward Tyler, with pump, ¼ horse-power. Exchange Magic Lantern and Apparatus, Jewellery, or useful offers.—MANAGER, Gas Works, Ringwood.

½H.P. **Horizontal Boiler**, with fittings for brickwork, and Vertical Engine, 2½ by 4in. What offers?—PINKNEY, William-street, Sunderland.

Three-terminalled **Detector Galvanometer**, large Electro-magnet, five 3in. Electric Bells, with batteries. Chemical Apparatus preferred, or offers.—HOWARTH, Lilly Bank, Tottington, Bury.

Exchange small **Engine and Boiler** for good Stamp Collection, Tools, Electrical Apparatus, to value £7 10s.—Write to HAWTHORNDEN, Clifton, Bristol.

Wanted, Spon's "Mechanics' Own Book." Also following for 1890:—"Gardeners' Chronicle," "Journal Horticulture," "Illustrated London News," "ENGLISH MECHANIC." Exchange.—S. J. WESTLAKE, Woodhall, Exbourne.

Wanted, Molesworth, Templeton, Unwin, Hamblin Smith's "ELEMENTARY TRIGONOMETRY"; also other books. Exchange. Fine Bamboo Walking Stick, Running Costume, Shoes, Blue Serge Coat, Vest. Offers.—W. P. WOODS, Stowmarket.

Exchange **Electric Lamp**, 16c.p., and 3 yards of covered wire, for Slide-valve Cylinder, 1¼ bore and 3¼ long, for horizontal.—E. SUTTON, Shifnal, Salop.

Wanted, Vertical Boiler, to steam timber, to carry 10lb. steam. Exchange. Full particulars by letter.—W. SMITH, Bilston-road, Wolverhampton.

**Gas-Engine**, one-man-power, Bisschopp, in perfect order; can be seen running. Exchange. Wanted, large Drilling Machine or Shaper.—17, Pitlake Bridge, East Croydon.

One 7in. **Gap Lathe**, for power, back-gear, and sundries, as supplied from manufacturers, nearly new; one 5in. ditto, two Slide-rests, Hand Drilling Machine. Exchange old lead or brass. —HENRY BOX, Chester.

¾in. **Throttle-Valve** and 8in. Pressure-gauge, with silvered dial, new, cash 21s., or exchange Forge. Two 1,000c.p. Arc Lamps, new. Exchange for 1H.P. Boiler, or Lathe with slide-rest.—W. N. NAYLOR, 36, Lower-road, Rotherhithe.

Wanted, offers in exchange, Jewellery preferred, for (as new) 35-guinea AMERICAN ORGAN, 14 stops, including swells; also good Grand Pianoforte, cost recently £12; both are really good. Must dispose.—THOMAS BIBBY, Yeadon.

Amateur Organ Makers. — Rare Chance. — Bailey Hamilton's ORGANS, eight sets reeds, everything new, only wants case making to finish, then worth £70 to £80. Will exchange any thing value £20.—JOHN WOOD, Yeadon.

**Galvanic Battery**, 120 zinc and copper cells, handles and interrupter complete, handsomely gilt, cost 45s. Offers in exchange to value of 26s. Printing type preferred.—P. GANNON, Chelmsford.

**Model Engine**, with tubular boiler, whistle, safety-valve, taps, &c, all brass. Photo 2d. Exchange offers to value of 16s. Also Vertical Engine; offers to value of 63s.—GANNON, Chelmsford.

Wanted, small Astronomical Telescope, on tripod. Exchange only, good SILVER WATCH, excellent timist, second-hand, value 25s., and Quackenbush Air Gun, almost new, cost 40s.—Mr. E., 344, Caledonian-road, London.

Metcalf and Davies' No. 4 **Exhaust Injector**, Gresham's No. 2 Injector, 1H.P. Horizontal Launch Engine, link motion and feed pump. Offers.—SNOWDON, Nobel's Bank, Sunderland.

Two **Vertical Engines**, ½H.P. Exchange for Safety.—H. COOPER, 3, Haynes-lane, Upper Norwood.

Wanted, pair 3½in. or 4in. Back-geared Heads. No objection not quite finished. Also old brass or copper. Good exchange offered.—TIPPING, Painswick, Gloucestershire.

**Monocular Microscope**, 2 achromatic objectives, wheel of diaphragms, &c., in mahogany cabinet; also 72 best Slides, in pine cabinet. Offers requested.—As below.

Beautifully finished **Horizontal Steam-Engine**, ¾in. bore, 1½in. stroke; also strong brass Boiler for same, with safety valve, &c. Offers.—W. WHITE, 17, York-street, Nottingham.

**Violin**, over 100 years old, beautiful tone, lock-up case, and Bow. Exchange to value £5.—CHAS. DAVIES, Madley, Hereford.

American **Steam Motor and Boiler**, complete as new, for driving sewing machines or fret-saw. Cost £7 10s. Exchange to value of £6 6s.; anything useful.—J., 154, Victoria-street, Grimsby.

C.F. double breech-loading 10-bore **Gun**, made by Moor, London, being converted from muzzle-loader. Exchange to value of £5; anything useful. The above no use to owner.—J., 154, Victoria-street, Grimsby.

**Ventriloquial Knee Figures**, old man and woman, 40in. high, 30s. Simplex Typewriter, perfect, 7s. 6d. Moldacot Hand Lockstitch Sewing Machine, perfect, 10s. Exchange for Lantern and Slides, Detective Camera, or anything to above values.—40, Rockbourne-road, Forest-hill, Kent.

"**English Mechanic**," about 15 years, unbound, more or less perfect. Want Violoncello, Harmonium, or offers.—A. WOOD, 92, Minford-gardens, Shepherd's Bush, W.

## THE SIXPENNY SALE COLUMN.

*Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.*

**New Illustrated Price List of Screws, Bolts and** Nuts for Model Work, drawn to actual size, sent on receipt of stamp. —MORRIS COHEN, 132, Kirkgate, Leeds.

**Millar's Electric Depot, 14,** Deansgate, Manchester.—Best of everything electrical. Large stock. Low prices. Catalogues 3d.

**Wheel-cutting and Dividing** to 12 inches diameter, in brass only.—CLEGG, Belinda-street, Hunslet, Leeds.

**Tam o' Shanter Hones.**—Fine, medium, sharp qualities—razor, knife, joiner's—1s. 3d, 1s. 6d., and 2s., according to size, post free. Try these famous hones.—TAM O' SHANTER HONE Co. Dalmore, Stair, Ayrshire.

**Glaziers' Diamonds**, 6s. 6d., upwards. Re-setting and postage, 2s. 8d. Circular and Tube-cutting Diamonds. —Below.

**Diamond Points** for all kinds of engraving, writing, ruling, and scratching, from 2s. 6d.—Below.

**Diamond Turning Tools** for truing emery wheels and turning hard steel, &c., from 6s.—Below.

**Diamond Drills** from 1s. Drill Stock and postage, 1s. 3d.; Bob ditto., 1s. 10½d., and 2s. 10½d.—Below.

**Diamond** for lapidaries, Diamond Sparks for china riveters.—WOODS and TOUSSAINT, 64, Spencer-street, Clerkenwell, London.

**Dr. Allinson writes**:—"Consult Fournet re Eyesight and Spectacles." Fee 5s.—18, Bentinck-street, Manchester-square.

"**Heat: the True Solution of the Problem,**" by Humphreys, post 2d.—11, Cambria-street, Fulham, S.W.

**Umbrellas Re-covered** equal to new, from 2s. each. Splendid value. List free.—HOWARTH, Umbrella Maker, Burnley.

**Inks** for Cyclostyle, &c. Black, 2s. 3d.; blue purple, 2s. 3d. ½lb. tube, post free.—JONES, 106, Adelaide-road, N.W.

**Mackies, Limited**, Sole Manufacturers of Mackie's Patent Spring Pulleys, 70,000 in use, Berks Iron Works Reading.

**Microscopic Objects**, first-class, 3,000 varieties to select from.—Norman 178 City road, E.C. Established 1840.

**Astronomical Object-Glasses**, in brass cells, of first quality. Optical planes and prisms.—Clarkson.

**Astronomical Telescopes**, Apparatus, Stands, Racks, Finders, made to order.—Clarkson, 28, Bartlett's-buildings, Holborn-circus, London.

**Astronomical Eyepieces**, any power, 15s. each. Barlow lens to increase power of eyepieces, 20s.—Clarkson.

**Revolving Diagonal Eyepiece**, forming either sun or star diagonal, arranged for four rotating eyepieces, £5.—Clarkson.

**Transit Instrument**, on iron stand, complete, and in perfect adjustment. Also Ross Transit Instrument.—Clarkson.

**Astronomical Telescope**, Calver's, 6½in. finder, four eyepieces, slow motion, stand, £15.—Clarkson.

**Astronomical Telescope**, 2½in. Lancaster's, Wray object-glass, two eyepieces, £5 10s.—Clarkson.

**Astronomical Telescope**, 6in. equatorial and driving clock, Cooke, York, from Buckland Observatory, £110.—Clarkson.

**Astronomical Telescopes**.—3in. Cooke, 3in. and 3½in. Wray, 4in. Cooke, 3½in. Negretti and Zambra.—Clarkson.

**Universal Equatorial**, Cooke's best series, with driving clock, to carry 4½in. telescope, silver circles and pillar.—Clarkson.

**Universal Equatorial**, to carry 3in. telescope, with circles (Grubb, Dublin), £3 10s.; new price, £8.—Clarkson.

**Astronomical Telescopes**. — Sales effected, several on books, also on stock.—Clarkson, 28, Bartlett's-buildings, Holborn-circus, London.

**Theodolites and Levels**, several by Troughton and Simms on stock, perfect adjustment.—Clarkson.

**Microscopes**, binocular and students', several by Beck, Swift, and objectives and apparatus.—Clarkson.

**W. Canning and Co.**, Birmingham, make every requisite for Electro-platers and Polishers. Catalogue, illustrated, 2d. stamps.

**Dynamos**, Polishing Lathes, Vats, Solutions, Connections, Chemicals. Bobs, Compo, Mops, Lacquers, and complete outfits for export.

**Practical Instruction on Electro-Plating**. Twenty years' practical experience. All should read it. 13 stamps.—Canning's.

**Electro-Tinning Plants**. We are the only makers. Improved process. Success guaranteed.—Canning, Birmingham.

**Dancer's Micro.-Photos.**—Sample and list, 500, free 1s. 2d.—22, Greame-street, Moss-side, Manchester.

**Lathes**, plain and screwcutting, for machinists and amateurs. See list, 2d.

**Slide-Rests**, with surfaced slides, swivelled for taper turning and boring. Illustrated list, 2d.—Jarratt, Leicester.

List of **Lathe Heads**, Dog Chucks, Drill Chucks, Face-plates, Angle-plates, Fans, &c., 2d.—Jarratt.

**Lathes or Parts** made to order. Send specification and stamp for prices.—Jarratt, Queen-street, Leicester.

**Lamps**, paraffin, 100c.p., 22in. iron shades, 16s., suit shops.—Watkin, Stanley-road, Mortlake.

**Lucas and Davies have Removed**, owing to increase of business, to larger premises.—67, Farringdon-road, E.C.

**Model Engines.**—Lucas and Davies' Enlarged and Illustrated Catalogue, castings, finished parts, &c., post free, 4d.

**The Above** contains all information, and is illustrated from photographs of the finished engines.

**Two New Features** introduced.—Triple-expansion Engines and Bent Steel Crankshafts are entirely original novelties.

**Photos.** of these Triple Expansion Engines can be had, price 6d., post free 7 stamps.

The **Designs** are all new, and are not copies of the stereotyped models of other firms.

**We Court Comparison** for novelty of design, finish of engines, and quality of castings.

**Models** of every description repaired and put in working order.

**Lucas and Davies**, Mechanical and Scientific Model Makers, 67, Farringdon-road.

**H. Thorpe**, 59, Theobald's-road, W.C., manufacturer of all kinds of small machine work in brass or iron, French press tools and stampings. Bell telephones 6s. 6d. each. Special cheap electric bell, 2s. 4d. each. Bell and lighting fitted for the trade.

**Silvered Glass Specula** and Plane Mirrors of perfect figuring. Eyepieces, fittings, mountings, and stands.—Linscott, Ramsgate.

**Billiard, Bagatelle Tables**, and Requisites for ditto. Best and cheapest.—Hennig Bros., 29, High-street, W.C.

**Ornamental Cutters**, Oval Chucks at **Frame** about half-price.—Britannia Co.

Our **Monthly Register** of Engines, Engineers', Mechanics' Tools, Woodworkers' Tools, free by post four stamps.

**December Register** contains upwards of 2,000 entries, wanted and for sale.—Britannia Co., Colchester.

**Immense Stock** at 100, Houndsditch, London. All letters Britannia Works, Colchester.

**Engineers' Shapers**, Milling Machines, Lathes, &c., as supplied to the British Government, in stock.—Britannia Co.

**Slade's Universal Glass Micrometer**, described in English Mechanic, Oct. 24, 1890; with it a variety of celestial measurements can easily be made, with Ramsden and Sunshade, 25s.; approval.—Slade, Westcott-street, Hull.

**Lathes and Benches**, several second-hand. Send for list to Sibe and Co. 45, Wilson-street, E.C.

"**Electric-Bell Construction**," by F. C. Allsop, now ready, post free, 3s. 6d., with 177 illustrations drawn to scale.

"**Practical Electric-Bell Fitting**," by F. C. Allsop, post free, 3s. 6d.—F. C. Allsop and Co., 165, Queen Victoria-street, E.C.

Oppermann's **Dynamos** for nickel and silver-plating, coppering, brassing, electric lighting; prices from £6. Lists free.

Complete **Plating and Enamelling Outfits** Supplied, cash or deferred payments.—Carl Oppermann, 2, Wynyatt-street, Clerkenwell.

**American Organ**, large £18 instrument, numerous stops, swell, vox-humana, sacrifice £7 15s.—Mechanic, 201, Ashmore-road, Westbourne-park.

Air-cushion tyred **Safety Bicycle**, best makers, balls throughout, ball pedals, £8 10s.—201, Ashmore road, Westbourne Park.

**To Earn Money.**—Particulars, specimens, and sample Pen and Pencil Stamp free to agents. Best paying agency going. Liberal remuneration, steady demand, no risk.—Richford's Stamp Factory, 44, Snow-hill, London.

**Insulated Copper Wire**, single or double cotton-covered. Sample, 1d.—F. E. Holloway, 35, Summerfield-crescent, Birmingham.

**Brass Name Plate**, 9 by 4½in., engraved complete, 4s. 6d. Other sizes to order. Style and price unsurpassed. See testimonials.—Gilkes' Engraving Works, Reading.

**Memorial Brasses** of every description and size, engraved to order, 50 per cent. under London prices. Drawings prepared for customers free.—Gilkes' Engraving Works, Reading.

**Brass Window Plate Manufacturers.**—Straight, half-round, or O.G.-shaped plates, mounted and engraved complete. Lowest prices.—Gilkes' Engraving Works, Reading.

**Zinc Stencil Plates**, for sack, box, and ticket marking. Price lists free. Small brass Name-plate Engraving.—Gilkes' Engraving Works, Reading.

**Catapults**, 7d., 1s., 1s. 2d. free. Elastic, 3d., 4d., 6d., 9d. yard.—Bell, Belleville, St. Mark's, Cheltenham.

**Model Boiler**, vertical steel tubular, size 6½in. by 13½in., tested to 50lb. pressure, brass fittings, perfect order, nearly new, price 17s.—Lawn, Nailsworth, Gloucestershire.

Write for **King, Mendham, and Co.'s** (Bristol) new Illustrated Catalogue, 4½d. Acknowledged to be invaluable to amateurs.

"**The Wimshurst Machine**," by W. P. Mendham, gives theory of action and many experiments. Post free, 18d.—King, Mendham, and Co.

**Microscopic Objects for Students.**—Full instructions for mounting; nine double-stained botanical sections, six beautiful coleoptera, 18 miscellaneous specimens. List and specimen, 2 stamps. 1s. 1d. each series.—Mason, 69, Park-road, Clapham.

**Launch** (steam), new, 24ft. long, 4½ by 5in. Engine, complete, good river or sea-boat.—Apply below.

**Launch Engine**, 4 by 5, new, price £12. Injector Force Pump Propellers.—C. Williams, The Limes, Wooburn, Bucks

**Organ Pipe Decoration.** Copies of coloured designs in gold and colours, 2s. 3d. post free.—Ingram, Decorator, Kettlebrook, Tamworth.

Your **Dog's Collar Engraved** with name and address, and returned post free 1s. 3d.—Deacon, Ramsgate.

Brass **Door Plate**, 9 by 4, any style, sent free, 4s. 6d.—Deacon and Son, Ramsgate.

The Special **Gas Engines**, silent, ½H.P., from £25. State requirements to—A. Ashby, 11, St. John's-terrace, Dawes-road, Fulham.

**Fur Boa**, very dark brown, real Russian tail, 10ft. long, very full and soft, perfectly new, value, 55s.; sacrifice 18s. 9d. Rare chance. Genuine fur.—Mrs. A. C. Jameson, 73, Victoria-road, Kilburn, N.W.

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e English Mechanic
WORLD OF SCIENCE AND ART.
*FRIDAY, JANUARY* 30, 1891.

## LATHE APPLIANCES.—VI.

(*Continued from page* 390.)

### The Metal-Turning Slide-rest.

IDE-RESTS are made in very many designs, ranging from very light ones rnamental work in wood, ivory &c., to massive ones for shaping metals. The which forms the subject of this paper uited for the general heavy work can be done on a foot lathe. This of slide-rest is the one commonly made se on the better class of amateurs' foot s, which do not have a saddle fitted to ed, and it is modelled somewhat after lesign of the orthodox ornamental slide- and it has the lower slide parallel with athe-bed. The slide-rests of heavy self- g lathes have this lower slide at right es with the bed.

e whole of the drawings shown on the of illustrations are reduced to the same , and it will not be difficult to see how slide-rest is constructed if a careful ection is made; the parts are named on lrawing to facilitate references. Anyone may wish to build such a slide-rest to a lathe of given size, has only to draw a to suit, and by measuring the drawings this scale he will see what the actual nsions should be. The drawings have made from a side-rest fitted to a 5in. re lathe, and they are shown reduced to t one-third full size. The main slide sures just 14in. long in the original -rest, and a scale can be readily con- cted from this.

rhaps it is not amiss to mention that the tation of these drawings to suit any ired dimensions is a most simple process. side view of the complete slide-rest s the under side of the tool-gripping exactly 5in. above the base of the side- ; that is to say, the under side of the is precisely on a level with the lathe- ces. To get the relative dimensions of all parts to suit a side-rest for a lathe of size, carefully take the distance from ase to the under side of the jaw, as shown he printed illustration on the adjoining , and let this distance represent the ht of centres of the lathe for which the -rest is to be made. Now divide this nce into a number of parts representing number of inches in the height of centres, with these divisions construct a scale which to measure all parts of the ings, and thus obtain the dimensions of detail. It is as well to somewhat ify the dimensions so as to get them out fractions. For example, the main , being 14in. long in the slide-rest for lathes, would be 11⅕in. for 4in. and . for 6in. lathes if strict proportion were e observed; but in practice it will be r to make the former 11in. long and the r 17in. long. The same reasoning holds l for all other details; but it is especially licable to the screws, which must always ade to a regulation thread size, selecting one which most nearly agrees with the surement shown by the scale. In short, n measuring the illustrations with the ially-constructed scale, the dimensions uld be read to the nearest whole numbers, any attempt to call a part "bare" or ll" must be repressed.

he traversing screws used in these slide- s are almost without exception square- aded, and are commonly cut with ten ads per inch, which gives ⅒in. traversing on for each complete rotation of the w. This same rate of thread is often preserved even when the diameters of the screws differ considerably. Eight threads per inch often suits equally well, and is sometimes even more convenient in use, and the coarser thread is preferable in practice, unless there is some cogent reason for using another thread rate.

The slide-rest illustrated is shown complete in three views, the side, the front, and the top, and from these the general construction is apparent. The whole is made of cast iron, with the screws, etc., of steel, and the nuts of the traversing screws, the jaw, and the plate, etc., are of wrought iron.

The sole or base-plate has a dovetailed groove running from end to end in the bottom. One end is circular, and on this the round base of the main slide rests. The drawing marked "main slide" shows a section at this part. The bottom of the sole must be made flat and smooth, and the dovetailed groove must be got out straight and smooth also. This is conveniently done by milling it, which makes much better work than by planing it. This sole is conveniently worked by chucking it on a face-plate and facing the bottom; after this the dovetailed groove is made true with a circular cutter, operated by a strong spindle driven from the overhead.

The sole is turned over, and fixed to the face-plate with the middle of its circular end true. The top of this is turned level, and a small hole is made exactly in the centre, and the T-groove is turned as shown in the sectional view of the main slide. This T-groove is to take the heads of two bolts, one of which is shown in the top right-hand corner of the sheet. These bolts have hexagon nuts, shown in the side and front views, and hold the main slide to the sole. When these nuts are slack, the main slide can be turned completely round on its base. It is much better to have the T-groove than to have curved slots in the round base-plate of the main slide. These curved slots would allow only a moderate angular motion, whilst the T-groove allows the main slide to be placed at any angle: and it is often very handy to place it parallel to a face-plate; that is, at right angles to the position shown in the drawings. When placed this way, a tool can be traversed across the full diameter that the lathe will admit. Two round holes are made in the base-plate of the main slide to allow the bolts to pass through, and of course a hole must be made in the sole, into the T-slot, large enough to admit the heads of the bolts. These heads are somewhat flattened on opposite sides, as shown in the drawing, to admit them to the T-slot, and yet not allow them to rotate under the action of screwing up the nut.

The small hole in the centre of the circular part of the sole is fitted with a steel pin—this has a slight shoulder, as shown in the section of the main slide, and is driven tightly into the sole. The main slide has a hole bored in the centre of its base to fit this pin, and it should do so without shake for angular adjustment to be made easily and accurately.

The main slide is an iron casting, and the shape of it may be seen from the several views given in the drawings. It stands on a circular base-plate, and the dovetailed sides for the saddle to fit upon are undercut to form an angle of about 55° with the top. For a 5in. lathe this main slide is 14in. long, and to make it straight, smooth, and parallel on all its bearing surfaces needs good workmanship. No doubt it is quite possible to accomplish this by filing, but this process is very tedious.

The hole in each end, which form bearings for the traversing screw, must be made quite true with the slide, or the nuts will bind on the screw as the saddle is moved along the slide. One way of getting these holes true is to bore them before surfacing the slide, and to chuck the slide by the boring when surfacing the top and edges, the bottom being turned true and flat after. A better way is to defer boring these holes till after the saddle has been fitted. Then to make an iron templet, about ⅛in. thick will suit very well, to wedge in the dovetails of the saddle. Bore a hole about the middle of this templet to correspond with the required position of these traversing screws' bearings. The saddle is placed slightly overhanging one end so as to hold the templet, and the hole in the templet is used to guide a rose-bit, which cuts the hole in the main slide for the traversing screw. By shifting the saddle to the other end of the main slide, and using the same templet, placed inside out relatively to its former position, the rose-bit will cut a hole in that end, which will exactly correspond with the one first made. Though both holes may be more or less out of the middle of the main slide, this will not affect the working of the saddle, provided both holes are out the same distance and in the same direction, which they will be if the templet has been properly used.

The saddle for the main slide is made in one piece with the top slide. It is always advisable to have as few parts as possible, so as to give the greatest rigidity to the structure. The top slide is 9in. long for a 5in. lathe. It is also of cast iron, and a section of it is drawn just above the main slide. The top slide requires to be got up true, on the top and on the dovetailed edges, after the same manner as the main slide. The saddle is fitted to the main slide so that the two sides are precisely at right angles one to the other. At the back end of the top slide a strip is cast solid with the saddle, and this strip is undercut to fit the dovetailed edge of the main slide. Opposite this strip a small fillet is cast, and the loose strip, shown on the left, bears against this fillet, and is held on by four binding screws, one of which is shown above the end section of the strip. This loose strip does not need any adjusting screws, as it is fitted to bear against the fillet with which it is intended to remain in close contact after it has once been fitted.

Though three binding screws would be amply powerful to fix this strip, yet four must be used, so that they may be spaced about equally. At the middle of the strip there is not any metal, or, at most, only a very thin sheet of it, in the top slide to screw into. By using four screws the two middle ones screw into the bearers of the slide. This strip should fit quite snug, and at the same time allow the saddle to move along the slide without shake, when the screws are finally tightened up. The holes in the strip, through which these binding screws pass, are elongated to allow some lateral motion to the strip during the process of fitting, and the ultimate bearing of the strip should be with its back edge against the fillet. The screws are only intended to draw the strip close against the saddle, and they must not impede the slight lateral motion necessary for adjustment.

The traversing screw of the top slide is commonly made the same pitch and diameter as the screw of the main slide; but it is not unusual to make the former right-handed and the latter left-handed. This reversal of the threads being adopted to give the same effect, as to direction of traverse in the saddles, by the same apparent motion of the handles. The comfort of using either a right-handed or a left-handed traversing screw becomes simply a matter of habit, and when one has become accustomed to either one, the other seems awkward to manipulate. Persons who use various lathes intermittingly, frequently notice and complain of the change in the direction of the traverse with the same direction of rotating the screws. This bothering alteration is caused by the indiscriminate use of right-handed or left-handed screws for traversing. This is

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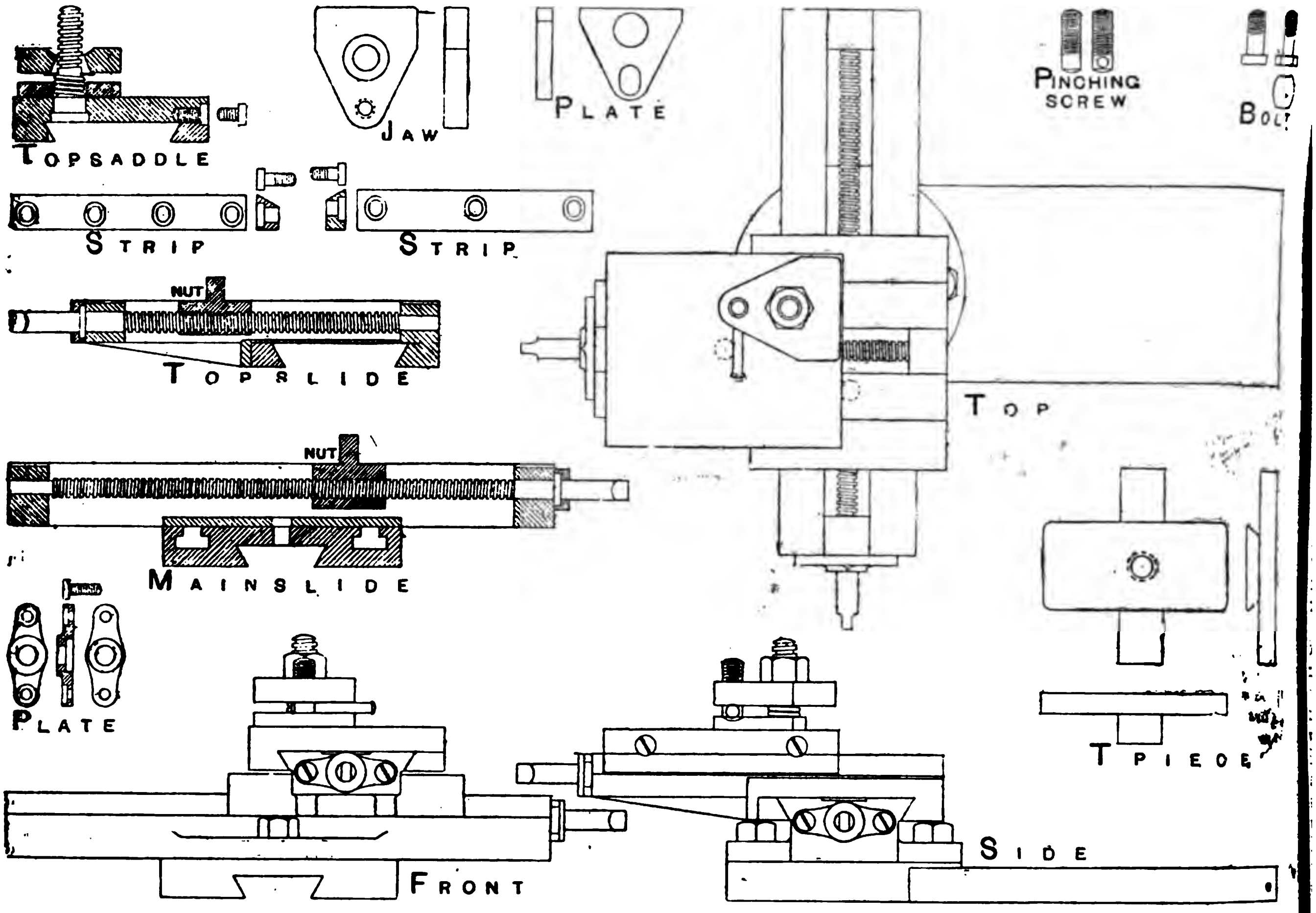

METAL-TURNING SLIDE-REST.

especially apparent in the traversing screws in the poppet barrel of lathes: some are right and some are left. The screw in the poppet and the one in the slide parallel to the line of centres should always be made to correspond in direction of thread.

The top saddle is a rectangular plate of cast iron, as shown in the top view of the complete slide-rest. It has a strip, cast solid with it, running the entire length of one side, as shown in the section of the top saddle. The other strip is separate, and is attached by three binding-screws. It is held up to the dovetail bearing by two adjusting-screws, which are tapped into the edge of the saddle, and recesses are countersunk to admit their heads. The right-hand one of the two strips shown on the drawing illustrates the one belonging to the top saddle; a section is shown at the left-hand end, and a binding-screw is shown above it. At the right-hand edge of the top saddle one of the adjusting screws is shown, and also the hole into which it screws.

The top saddle is finished bright all over. It can be filed up flat and true; but milling or planing is a much easier way of working it. Near one corner, on the side where the solid strip is, in the position shown by the top view, a hole is made to take the main stud-bolt for the tool-holder jaw. This stud-bolt is made of steel, and its shape is shown in the top left-hand corner of the page of drawings. It has a square thread, which is, in some important respects, greatly superior to a V-thread for this purpose. This thread has to withstand severe strains, and wears badly if not carefully treated. The stud-bolt is driven into the top saddle from the under side up to a shoulder, and it is necessary to cut away a small arc from the solid strip, at its most prominent part, under the hole to allow the head of the stud-bolt to pass. The diameter is kept large, especially near the head, for strength. If the shank of the bolt is turned away under the head it is likely to bend under usage. Before the slide-rest is put together finally, a small hole must be drilled, and a steel pin inserted to prevent the stud-bolt rotating in the saddle under the screwing action of the nut. This small hole is drilled half in the cast-iron and half in the steel bolt-head; it is not shown in the drawings. If this is not done, the bolt will at some time work loose and rotate in the saddle with the hexagon nut jammed upon the thread. Should this occur it is generally necessary to destroy the stud-bolt in order to get it out of the saddle—a costly penalty to pay for neglecting proper precaution.

The tool-holder shown on the slide-rest is an adaptation of Willis's pattern. The jaw is of the form illustrated; it is made of wrought-iron, and should be case-hardened. The plain, flat underside of the jaw is sometimes an unsatisfactory gripper, especially when it is called upon to grip anything that is lumpy, because then the flat surface of the jaw will bear only upon protuberant spots, and these may afford a very insecure hold. It is well to put two small steel pins, with round heads just like common snap rivets, in the corners of the jaw. The heads of these two pins, which should be hardened and tempered, form teeth which are always sure to bite on whatever tool may be put under the jaw, even though it may be slightly uneven, and the heads being smooth and rounded will not injure tool stems that are finished smooth, as that of a drilling spindle, for example. These suggested teeth are not shown in the drawings. Sometimes that part of the jaw which grips the tools is made with chequered teeth, like those on the jaws of a vice; but this does not give the certain grip at two far distant points like the teeth afford. The jaw is shown apart, top and edge views being given. The hole which passes over the stud-bolt is first drilled through, and is then tapered from the under side, as shown in the section. The top side is then hollowed to a circular curve, and the under side of the hexagon nut, which fits the stud-bolt, is rounded to the corresponding radius. This arrangement allows the jaw to move quite freely, with a species of ball-and-socket joint, to a certain extent from its normal horizontal position, and still to maintain sufficient bearing surface against the hexagon nut, and all round it. Thus the jaw accommodates itself to any small unevenness in the heights of its three corners. The corner of the jaw, shown lowest in the drawing, is tapped to take the steel pinching-screw shown near the right-hand top corner of the page of illustrations.

An iron plate is used under the jaw. It is illustrated on the right of the latter. This plate is bored to go over the stud-bolt sufficiently large to allow a steel spiral spring between them. This spiral spring is to keep the jaw lifted against the hexagon nut, so that space for the tool is always clear. A very thin washer, shown only in the section of top saddle, is placed between the under-side of the jaw and the spiral spring to prevent this latter from entering the tapered hole in the jaw, and so jamming it. That part of this iron plate that comes under the head of the pinching screw is hollowed out to receive it. This plate is shown in several views, and needs no special further description. It should be case-hardened.

The details connected with fitting up the slide-rest may now be noted.

The traversing screws for the slides ar both shown in the sectional views. The en motion in each of these is confined by collar near the handle end; this collar butt against the casting on its inner side, and it outer side is confined by a plate. The plates are alike for both screws, and one illustrated near the lower left-hand corn ıe drawings. Front, section, and back shown; also one of the two binding ws for fixing the plate to the cast-iron . These plates may be made of wrought preferably for use; but as brass gun-metal look prettier, they are ı employed. The two plates should be ɜ together. First bore the large central in each, then turn the collars and mark crew holes. Pin the two plates together ıese holes and file up the edges, reversing lates to see that both edges are uniform ntour, and correcting by filing where sary. The central hole is countersunk a flat pin drill to admit the collar of the sing screw, and also the holes for the ıg screws are similarly countersunk, rom the opposite sides, to admit the of these binding screws. The cast-lides are tapped to receive the screwed n of these screws, and their positions ıown on the front and side views of the ete slide-rest. A plan for confining ıd motion of the traversing screws, by s of nuts on the small ends instead of plates, is shown on page 391, Vol. LI., nnection with the spherical slide-rest illustrated.

nuts for the traversing screws are hown in section on the screws in the slide and in the top slide. The word " printed near each renders them easy ntify. These nuts should be made of ght iron for wear with steel screws. nut has a round stalk, by which it is hed to its saddle. A hole of suitable bored in the saddle receives this stalk, h is fitted to it and driven in tightly. ıe top view of the complete rest, dotted ɜs show the positions of the holes in the les. One is in the middle of the top e, and the other is in the bearer of the slide. Neither hole needs to be bored ıgh, and the top surfaces of the castings ook better if these holes do not show. ing these nuts after they have been . is a process that demands care. The s first fitted by its stalk to the hole in addle, and then the projecting part is ɜd to pass freely in the groove of the

The position of the hole, through ı the traversing-screw is to pass, is ed by scribing with a needle through oles in the castings. Each end of the s marked, and a hole is drilled through The tapping of this hole should be done a special tap made after the plan men-d in connection with tapping the ıs in the ring for an oval chuck, in the r on "Lathe Appliances," p. 388. Unless precaution is taken, the nut will not l smoothly along the screw, and the le will be fast in some places and slack hers—always an annoyance.

e method of securing the handles on traversing screws is simple and con-nt. The screw-shank is turned true, has its end flattened by cutting away opposite sides, as shown in the draw-

The handle has a pipe-stem drilled lepth equal to the length of the screw-k, less the flattened part, and a mortise is cut through the pipe-stem to admit lattened part, which is in this way held. e steel pinching screw for the tool-r is shown in the drawings. This screw no enlarged head. A hole is drilled ɜtrically through it near one end, and ıole is fitted with a steel rod to act just he ordinary handle of a common vice. is shown in the front and top views of omplete rest. The lower end of the ing screw is rounded off very freely, t bears in the hollow of the under-plate ioned before. The usual way of putting crew in its place is with a head on the ısually hexagonal, to be turned with a ıer; but by turning it upside down, as ı here, space is saved, and the parts are nore snug.

method of gripping any tool with this Willis' pattern tool-holder is apparently not generally understood, as frequently a large spanner is applied to the hexagon nut on the main stud-bolt to cause the jaw to bite. This is a wrong method. The tool having been laid in its place, the hexagon nut should be screwed up or down with the fingers to bring the jaw approximately level. The smaller pinching screw is then brought into use, and the final grip given by means of the "tommy" bar in this screw. Very little brute force is necessary if the principle of the tool-holder is understood.

A spiral spring made of steel wire, and hardened and tempered, is put on the main stud-bolt, with a thin sheet washer on the top, to lift the jaw, which, if not supported, would always fall, and would require to be lifted by hand each time it were necessary to put a tool under it. The plate under the jaw is bored out sufficiently large to allow the spiral spring to go between it and the stud bolt.

The drawing marked "T-piece" has yet to be explained: this is a piece which fits the groove in the sole of the slide-rest, and also the space between the cheeks of the lathe-bed. Its purpose is to hold the slide-rest on the bed, and at the same time to keep it truly at right angles to the bed. Side, top, and end views are shown; the T-piece is made of cast iron. The circle on the top view represents the hole in which the holding-down bolt is screwed. One of the cross arms, shown dovetailed shape in the end view, fits in the dovetail groove in the sole of the rest. The other cross arm, shown rectangular in the side view, fits between the cheeks of the lathe-bed.

This finishes the description of the page of drawings of the metal-turning slide-rest. An appliance of the same kind, but suited for much heavier work, and also one suited for much lighter work, may be treated upon in future papers.

# ASTRONOMICAL NOTES FOR FEBRUARY, 1891.

### Occultations of (and a Near Approach to) Fixed Stars by the Moon.

| Day of Month. | Star's Name. | Magnitude. | Disappearance. | Moon's Limb. | Angle from N. Point. | Angle from Vertex. | Reappearance. | Moon's Limb. | Angle from N. Point. | Angle from Vertex. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | h. m. | | ° | ° | h. m. | | ° | ° |
| 1 | 96 Virginis | 6½ | 6 56 a.m. | Bright | 99 | 82 | 8 8 a.m. | Dark | 319 | 293 |
| 2 | μ Libræ | 6 | 1 59 ,, | Bright | 105 | 138 | 3 5 ,, | Dark | 315 | 341 |
| 12 | 29 Ceti | 6½ | 6 8 p.m. | Dark | 84 | 57 | 7 7 p.m. | Bright | 215 | 182 |
| 12 | 33 Ceti | 6 | 7 37 ,, | Dark | 71 | 36 | 8 36 ,, | Bright | 234 | 196 |
| 12 | 35 Ceti | 6½ | 8 42 ,, | Dark | 125 | 87 | 9 10 ,, | Bright | 184 | 146 |
| 17 | 121 Tauri | 6 | 7 2 ,, | Dark | 47 | 59 | 8 12 ,, | Bright | 290 | 279 |
| 18 | B.A.C. 2154 | 6½ | †11 53 ,, | S. | 185 | 143 | | | | |

†A near approach. An illustrated description of the above table will be found on p. 367.

### The Sun.

| Day of Month. | Souths. | At Greenwich Mean Noon. | | |
|---|---|---|---|---|
| | | Right Ascension. | Declination South. | Sidereal Time. |
| | h. m. s. | h. m. s. | ° ′ ″ | h. m. s. |
| 1 | 0 13 48·12 P.M. | 20 59 25 | 17 5 45 | 20 45 37·26 |
| 6 | 0 14 17·85 ,, | 21 19 38 | 15 36 41 | 21 5 20·04 |
| 11 | 0 14 27·69 ,, | 21 39 31 | 14 0 57 | 21 25 2·82 |
| 16 | 0 14 18·04 ,, | 21 59 4 | 12 19 26 | 21 44 45·59 |
| 21 | 0 13 50·18 ,, | 22 18 19 | 10 33 2 | 22 4 28·36 |
| 26 | 0 13 6·04 ,, | 22 37 17 | 8 42 37 | 22 24 11·14 |

Spots continue to appear upon the sun's disc, though not very frequently. They are chiefly in high latitudes.

The Zodiacal light now begins to be perceptible after sunset.

The method of finding the Sidereal Time at local mean noon at any other station is described on p. 376.

### The Moon

enters her Last Quarter at 4h. 42·2m. a.m. on the 2nd, and is New at 2h. 12·2m. in the early morning of the 9th. She will enter her First Quarter at 6h. 29·5m. p.m. on the 15th, and be Full on the night of the 23rd at 7h. 18·4m. Pretty high tides may be looked for in southern latitudes about the 9th.

The moon will be in conjunction with Venus at 5h. p.m. on the 5th (Venus 5° 27′ N.); with Mercury at 6h. a.m. on the 7th (Mercury 3° 47′ N.); with Jupiter at the same hour on the 9th (Jupiter 4° 12′ N.); with Mars at 11h. a.m. on the 12th (Mars 4° 38′ N.); and with Saturn at Noon on the 24th (Saturn 3° 4′ S).

| Day of Month. | Moon's Age at Noon. | Souths. |
|---|---|---|
| | Days. | h. m. |
| 1 | 21·9 | 5 15·5 a.m. |
| 6 | 26·9 | 9 38·4 ,, |
| 11 | 2·4 | 2 36·4 p.m. |
| 16 | 7·4 | 6 47·2 ,, |
| 21 | 12·4 | 11 1·0 ,, |
| 26 | 17·4 | 1 52·1 a.m. |

When our notes begin the Moon is in the confines of Virgo and Libra, into which last-named constellation she passes about 3 o'clock in the afternoon of the 1st. Having traversed Libra, she arrives at noon on the 3rd at the western edge of the northern spike of Scorpio; by 11h. 30m. the same night she has crossed this and come out in Ophiuchus, through which she is journeying, until 9h. 30m. a.m. on the 5th, and then she enters Sagittarius. She remains in Sagittarius until 5 p.m. on the 7th, when she quits it for Capricornus, leaving Capricornus in turn for Aquarius at 7h. 30m. a.m. on the 9th. She is travelling through Aquarius until 5h. a.m. on the 11th, at which hour she passes into Pisces. In the course of her passage across Pisces, she arrives at 6 p.m. on the 11th at an outlying portion of Cetus, which she enters. She remains in this just about 24 hours, and then re-enters Pisces; only, however, to plunge into another outlier of Cetus at 5h. 30m. p.m. on the 13th. When she finally quits Cetus at 1h. a.m. on the 14th, she emerges in Aries. At 8h. 30m. a.m. on the 15th she passes from Aries into Taurus, as she does from Taurus into Gemini at 8h. a.m. on the 18th. She is travelling across Gemini until 11h. a.m. on the 20th, when she leaves it for Cancer. She is in Cancer until 3h. 30m. a.m. on the 26th, at which hour she enters Leo. She completes her journey through Leo by 4h. a.m. on the 25th, and then crosses into Virgo. Her passage across this great constellation finishes at 9h. p.m. on the 28th, and she has of course not advanced far in Libra by midnight.

### Mars

is above the horizon, but is, as we explained last month, invisible for the purpose of the observer with the telescope; while

### Jupiter

comes into conjunction with the sun at 2 p.m. on the 13th, and is actually invisible for any purpose whatever.

### Mercury

is a morning star throughout the month, attaining his greatest elongation West of the Sun (25° 40′) at 10 a.m. on the 5th. He is but poorly placed for the observer, as at this date his South Declination exceeds 21°. Moreover, his angular diameter dwindles from 7·4″ on the 1st to 5·2″ by the 28th.

| Day of Month. | Right Ascension. | Declination South. | Souths. |
|---|---|---|---|
| | h. m. | ° ′ | h. m. |
| 1 | 19 14·3 | 20 48·7 | 10 28·9 a.m. |
| 6 | 19 33·5 | 21 3·7 | 10 28·4 ,, |
| 11 | 19 57·6 | 20 51·9 | 10 32·7 ,, |
| 16 | 20 24·6 | 20 10·1 | 10 40·1 ,, |
| 21 | 20 53·7 | 18 56·8 | 10 49·4 ,, |
| 26 | 21 24·0 | 17 11·1 | 11 0·0 ,, |

Hence it will be seen that Mercury traverses a considerable part both of Sagittarius and Capricornus, though without approaching any conspicuous stars.

### Venus

Is a Morning Star, too, all through February, and is practically in as bad a position for observation as Mercury is, though she rises between 1 and 2 hours before him. Her angular diameter diminishes from 28·4″ on February 1st to 21″ on the last day of the month. By the middle of the month she presents the figure of the Moon at the time of the last quarter.

| Day of Month. | Right Ascension. | Declination South. | Souths. |
|---|---|---|---|
| | h. m. | ° ′ | h. m. |
| 1 | 17 43·5 | 19 12·6 | 8 58·4 a.m. |
| 6 | 18 3·2 | 19 34·9 | 8 58·4 ,, |
| 11 | 18 24·0 | 19 49·1 | 8 59·4 ,, |
| 16 | 18 45·5 | 19 53·7 | 9 1·2 ,, |
| 21 | 19 7·6 | 19 47·2 | 9 3·6 ,, |
| 26 | 19 30·2 | 19 28·7 | 9 6·5 ,, |

The path indicated in the above ephemeris commences in the confines of Ophiuchus, Serpens, and Sagittarius, and extends over nearly the whole width of the last-named constellation. It lies through a region quite destitute of bright stars.

### Saturn.

In so far as his meridian passage is concerned, is a morning star, as he does not South until after midnight, even at the end of the month; but as he rises before 8h. p.m. at the beginning of February, and about 5h. 45m. p.m. at the end of it, he is now fairly well visible throughout the working night of the amateur astronomer. The angular equatorial diameter of the planet increases imperceptibly from 19·1″ on February 1st to 19·5″ on the 28th. The closing up of the rings is now very notable, the minor axis of their elliptic outline being only about $\frac{1}{23}$nd of its major axis.

| Day of month. | Right Ascension. | Declination South. | Souths. |
|---|---|---|---|
| | h. m. | ° ′ | h. m. |
| 1 | 11 12·1 | 7 25·2 | 2 28·0 a.m. |
| 6 | 11 11·0 | 7 33·3 | 2 7·3 ,, |
| 11 | 11 9·7 | 7 42·0 | 1 46·4 ,, |
| 16 | 11 8·4 | 7 51·0 | 1 25·4 ,, |
| 21 | 11 7·0 | 8 0·4 | 1 4·4 ,, |
| 26 | 11 5·6 | 8 9·9 | 12 43·3 ,, |

So that Saturn will describe the short retrograde arc thus shown in Leo, and will be travelling approximately towards the 5th-magnitude star $\chi$ in that constellation.

The greatest eastern elongations of Saturn's great satellite Titan will occur on the 3rd at 3h. 6m. a.m., and again on the 19th at 1h. 5m. a.m. Titan will also be in Inferior Conjunction with Saturn (10″ N.) at 9h. 2m. p.m. on the 6th, in Superior Conjunction at 2h. 6m. a.m. on the 15th (12″ S.), and, once again, in Inferior Conjunction on the 22nd at 6h. 9m. p.m. (12″ N.) Japetus will be at its greatest *western* elongation (and at its brightest) at 2h. 7m. a.m. on the 5th, and in Superior Conjunction at 2h. 3m. a.m. on February 25th.

### Uranus

Does not even rise until after midnight at the beginning of February, nor South before 3h. 26m. a.m. at the end of it, so that we must defer our ephemeris of him until he comes into a better position for the observer; but

### Neptune

Is still very fairly placed, indeed, for telescopic observation; though he comes into quadrature with the Sun at 10 p.m. on the 22nd.

| Day of Month. | Right Ascension. | Declination North. | Souths. |
|---|---|---|---|
| | h. m. | ° ′ | h. m. |
| 1 | 4 9·5 | 19 22·0 | 7 22·6 p.m. |
| 6 | 4 9·4 | 19 22·0 | 7 2·9 ,, |
| 11 | 4 9·3 | 19 22·2 | 6 43·2 ,, |
| 16 | 4 9·3 | 19 22·5 | 6 23·5 ,, |
| 21 | 4 9·4 | 19 23·0 | 6 3·9 ,, |
| 26 | 4 9·5 | 19 23·6 | 5 44·4 ,, |

The almost imperceptible pendulum-like path, indicated above, lies a very little to the south and west of the 5½-mag. star $\omega^2$ Tauri.

### Minima of the Variable Star Algol

will occur at 4h. 35m. a.m. on the 12th, at 1h. 48m. a.m. on the 15th, at 10h. 13m. p.m. on the 17th, and at 7h. 2m. p.m. on the 20th, as well as on other occasions, when they will be invisible.

### Shooting Stars

may be looked for about the 4th, the 15th, and the 20th; but no very notable showers occur during this month.

### Greenwich Mean Time of Southing of Thirteen of the Principal Fixed Stars on the Night of February 1st, 1891.

| Star. | Souths. h. m. s. |
|---|---|
| α Ceti .. .. .. .. | 6 9 56·19 p.m. |
| α Persei . .. .. .. | 6 29 50·38 ,, |
| Aldebaran .. .. .. | 7 42 46·51 ,, |
| Capella .. .. .. .. | 8 21 38·63 ,, |
| Rigel .. .. .. .. | 8 22 18·35 ,, |
| α Leporis .. .. .. | 8 40 52·83 ,, |
| α Orionis .. .. .. | 9 2 10·16 ,, |
| Sirius .. .. .. .. | 9 53 6·47 ,, |
| Castor .. .. .. .. | 10 40 16·94 ,, |
| Procyon . .. .. .. | 10 46 12·88 ,, |
| Pollux .. .. .. .. | 10 51 15·18 ,, |
| α Cancri . .. .. .. | *12 4 55·85 a.m. |
| α Hydræ. .. .. .. | *12 34 33·30 ,, |

* Early morning of 2nd.

The method of ascertaining the Greenwich Mean Time of Southing of either of the stars in the above list for any other night in February, as also that of determining the Local Instant of its Transit at any other station, will be found on p. 368.

### Approximate Times of the Greatest Eastern Elongations of Saturn's Five Inner Satellites, visible at Greenwich.

| Day of Month. | Satellite. | H. | Day of Month. | Satellite. | H. | Day of Month. | Satellite. | H. |
|---|---|---|---|---|---|---|---|---|
| 1 | Mimas | 12·8 a.m. | 10 | Tethys | 9·0 p.m. | 18 | Enceladus | 11·8 p.m. |
| 1 | Enceladus | 4·2 ,, | 11 | Dione | 1·4 a.m. | 19 | Mimas | 9·3 ,, |
| 1 | Mimas | 11·4 p.m. | 12 | Enceladus | 3·3 ,, | 21 | Dione | 12·0 ,, |
| 2 | Dione | 10·0 ,, | 13 | Dione | 7·0 p.m. | 22 | Tethys | 4·8 a.m. |
| 2 | Mimas | 8·4 ,, | 14 | Mimas | 5·5 a.m. | 23 | Enceladus | 2·4 ,, |
| 3 | Mimas | 8·6 ,, | 14 | Enceladus | 9·1 p.m. | 23 | Rhea | 10·9 p.m. |
| 3 | Enceladus | 10·0 ,, | 14 | Rhea | 10·1 ,, | 24 | Tethys | 2·0 a.m. |
| 4 | Mimas | 7·2 ,, | 15 | Mimas | 4·1 a.m. | 25 | Enceladus | 8·2 p.m. |
| 5 | Tethys | 5·1 a.m. | 16 | Mimas | 2·7 ,, | 25 | Tethys | 11·4 ,, |
| 5 | Rhea | 9·4 p.m. | 16 | Enceladus | 6·0 ,, | 27 | Enceladus | 5·0 a.m. |
| 7 | Tethys | 2·4 a.m. | 17 | Mimas | 1·4 ,, | 27 | Tethys | 8·7 p.m. |
| 8 | Enceladus | 12·7 ,, | 18 | Mimas | 12·1 ,, | | | |
| 8 | Tethys | 11·7 p.m. | 18 | Mimas | 10·7 p.m. | | | |

The above table is described on p. 368.

## THE LANTERN.*

By E. M. NELSON.

MR. E. M. NELSON stated that while the optical principles of the microscope had made great advances during the past few years, those of other optical instruments had remained more or less *in statu quo*. He thought that in mechanical details the lantern had made a great step by the adoption of mineral oil as an illuminant. As far as oxyhydrogen was concerned, the light is hardly more powerful to-day than it was twenty-five years ago. But there could be no comparison between a good paraffin light of to-day and the sperm-oil lamp of twenty-five years ago. A paraffin-lighted lantern was of the highest value for scientific demonstrations to ordinary classes of about fifty students. In his own microscopical work he used it with a screen distance as short as 4ft. when demonstrating to two or three persons, so that he could point out the details with one hand and work the carrier with the other. A properly constructed lamp was as little trouble to light as a common gas-lamp, neither did it give off unpleasant fumes so long as it was of a proper construction, and kept clean. The wicks did not require cutting once in six months. The main fault to be found in paraffin lamps was that there were not large enough inlets for the air. The burners, instead of being in the middle of the lamp, might be placed nearer the front, so that they might be closer to the condenser, when a condenser of shorter focus might be used, and so more light secured. With regard to oxy-hydrogen, the bottles were a great convenience; but it was a pity that some better method was not employed for connecting the regulators. He had known half the gas to leak out at the junction. The attachment of a pressure-gauge was, in his opinion, only another source of leakage. With regard to the lamp itself, he said he preferred one as simple as possible; but it should have four taps—two for the regulation of the light, which would seldom require alteration when a uniform pressure of gas was used; the other two were for cutting off the gas entirely. For a by-pass he used a separate derived circuit with a tap in it. This enabled the amount of by-pass to be regulated with varying pressures. With regard to the lime, he was inclined to think that the old-fashioned disc form, used largely by Dancer, was preferable to that universally employed now, because there was no doubt, in his opinion, that the hole through the centre of the lime weakened it, and caused it to fly, especially when high pressures were used. A 2in. disc ⅜in. thick was, he thought, a useful size, the flame to play on the face of the disc half-way between the centre and periphery. The form of the condenser was a very important feature in the lantern: the larger its angular aperture, the more light it collected. With regard to angular aperture, he said it was to be feared that outside the microscopical world very erroneous notions were held, and on that account perhaps he might be excused for going into this matter at some length. For instance, the light collected by three different condensers, such as one of 60°, one of 120°, and one of 180°, is not proportional to their angles—that is, a condenser of 120° does not collect twice, or the condenser of 180° three times, the amount of light of that of 60°. Prof. Abbe has shown that the aperture of any lenses—be they microscope, photographic, or lantern—is not proportional to the angles themselves, but to the *sines* of the semi-angles. Thus the apertures of the above-mentioned condensers is not 1 : 2 : 3, but as ·5 : ·87 : 1·0. The amount of light collected is, of course, proportional to the squares of those figures—viz., to ¼ : ¾ : 1. He then explained that the standard apertures for photographic lenses adopted by the Photographic Society, although correct for all practical purposes, were theoretically wrong, because in their formation they depended on the *tangents* of the angles instead of on the *sines*. They happen to be practically correct, because photographic lenses deal with small apertures, and for small angles the tangent is proportional to the sine; but as the angle increases, the error increases also. It would, therefore, be quite impossible to apply the photographic standards to microscope lenses. But he saw no objection to the application of microscopic standards to photographic lenses, for by doing so photographic

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* Paper read on January 12th, at the meeting of the Lantern Society, as briefly mentioned last week.

vould be made theoretically as well as prac-
accurate. It would, moreover, point to
ntinuity of optical principles running
a all optical instruments, and at the
ime afford a uniform nomenclature. A
raphic lens with an aperture of U.S. 1
as an angular aperture of 14° 15′ 0″. If a
required of double this speed, according to
S. tangent system, ·5 must have an aper-
$\frac{f}{2\cdot8284}$. This corresponds to an angular
e of 20° 3′ 0″. But this angle is, in reality,
oo small: it should be 20° 12′ 18″, or $\frac{f}{2\cdot8062}$
according to Prof. Abbe's microscopical
n, $\frac{f}{4}$ will be ·124 the light collected by a
will be $(\cdot124)^2 = \cdot01536$. If a lens is re-
to collect twice as much light, or ·01536 × 2
7, its aperture will be in microscopical nota-
·0307, or ·17541; this is the sine of 10° 6′ 9″,
the angular aperture. The whole aperture
12′ 18″, or $\frac{f}{2\cdot8062}$. He had worked out all
ps from U.S. ·25 to 256 both by the tangents
the sines, starting from U.S. 1, or $\frac{f}{4}$ as a
If, therefore, apertures were required, each
double of the exposure of the one pre-
with $\frac{f}{4}$ as a base, the stops must be cut
ng to the figures given in his table, and not
generally accepted U.S. table. Of course,
h tables absorption by the glass and re-
from the surfaces are not taken into
ration. He next explained that, if more
enses were required, they could be obtained
reasing the density of the medium between
ns and the photographic plate. The
f any lens being proportional to $(\mu \sin. \phi)^2$
$\mu$ is the refractive index of the me-
and $\phi$ half the angular aperture, it fol-
that if $\mu$ were increased from 1 (for air) to
r oil of cedar) the speed of any given lens
be increased as $(1)^2 : (1\cdot52)^2$, or as 1 : 2·3,
re any camera lens might be made 2·3 times
pid than it is at present. He next discussed
forms of condensers, which were illustrated
nples on the screen, and explained that one
of angle should have three times the illu-
g power of one of 50°. He then exhibited a
form of triple condenser which he had de-
and which gave double the illumination of
forms (viz., three places on Wernicke's
meter). It also gave crisper definition.
d there was no reason why a cheap three
romatic should not be made, and he believed
t only would more light be secured, but also
definition. It should be remembered that
g the illumination by the form of the con-
meant halving the gas bill, and was the
medy for hissing. Speaking of carriers, he
at he must really say a word in condemna-
the modern form now so much in vogue,
darkens the screen while the slide is being
d. Great ingenuity and admirable work-
p were displayed in obtaining this result, but
y effect it produced on him was to spoil the
lantern exhibition by giving him a splitting
he, and he knew he was not singular in this
. In his ordinary "push through" carrier
cut out most of the wood from the middle
n, so that the darkening of the screen
he slide was pushed through was as little as
. In reply to some questions, he said that
denser should be adapted to the lens used in
ion; but a condenser in which the lenses
e separated, as in a microscope objective,
be very suitable. The components of the con-
would have to be separated for a short-
rojection lens, and closed for a long one.
retted that time did not permit him to en-
pon the subject of projection lenses. With
ce to the relative position of photographic
o microscope lenses, he said that a micro-
ns was made having 6° more aperture than
5, whose initial image at 10in. would bear
argement of twenty times, without the
t perceptible woolliness; but he doubted if
as any photographic lens working at U.S. ·25,
reduced image would bear enlarging four
In the following table the first column con-
e U.S. numbers; the second, the apertures in
of the focus on the tangent system; the
olumn contains the angles corresponding
e apertures; the fourth, the apertures in
f the focus, calculated from the sines of the
gles of aperture; the fifth column the
corresponding to these apertures; the sixth,
es of the semi-angles; the seventh, the
of these sines. The angles are computed to
rest second of arc. If apertures are required
exposures exactly proportional to the U.S.
s in the first column, the stops must be cut
ng to the figures in the fourth column, and

not according to those in the second. The illuminating power of the apertures, which is inversely proportional to the exposure, is proportional to the figures in the last column, each being half the value of the one preceding.

| U.S. Notation. | | | True Notation | | N.A. | (N.A.)² |
|---|---|---|---|---|---|---|
| | | ° ′ ″ | | ° ′ ″ | | |
| ·25 | $\frac{f}{2}$ | 28 4 20 | $\frac{f}{1\cdot9525}$ | 28 43 36 | ·24807 | ·061538 |
| ·5 | $\frac{f}{2\cdot8284}$ | 20 3 0 | $\frac{f}{2\cdot8062}$ | 20 12 18 | ·17541 | ·030769 |
| 1· | $\frac{f}{4}$ | 14 15 0 | $\frac{f}{4}$ | 14 15 0 | ·124035 | ·0153846 |
| 2· | $\frac{f}{5\cdot6568}$ | 10 6 8 | $\frac{f}{5\cdot6788}$ | 10 3 48 | ·087706 | ·0076923 |
| 4· | $\frac{f}{8}$ | 7 9 10 | $\frac{f}{8\cdot0468}$ | 7 6 40 | ·062017 | ·0038461 |
| 8· | $\frac{f}{11\cdot31368}$ | 5 3 40 | $\frac{f}{11\cdot3905}$ | 5 1 36 | ·043853 | ·0019231 |
| 16· | $\frac{f}{16}$ | 3 34 48 | $\frac{f}{16\cdot117}$ | 3 33 14 | ·031009 | ·00096154 |
| 32· | $\frac{f}{22\cdot627}$ | 2 31 56 | $\frac{f}{22\cdot798}$ | 2 30 46 | ·021926 | ·00048077 |
| 64· | $\frac{f}{32}$ | 1 47 26 | $\frac{f}{32\cdot245}$ | 1 46 36 | ·015504 | ·00024038 |
| 128· | $\frac{f}{45\cdot2547}$ | 1 15 58 | $\frac{f}{45\cdot607}$ | 1 15 23 | ·010963 | ·00012019 |
| 256· | $\frac{f}{64}$ | 0 53 42 | $\frac{f}{64\cdot498}$ | 0 53 18 | ·0077522 | ·000060096 |

# THE ELECTRO-MAGNET.—XII.*

## Polarised Mechanism: Uses of Permanent Magnets.

WE must now turn our attention to one class of electro-magnet mechanism which ought to be carefully distinguished from the rest. It is that class in which, in addition to the ordinary electro-magnet, a permanent magnet is employed. Such an arrangement is generally referred to as a *polarised mechanism*. The objects for which the permanent magnet is introduced into the mechanism appear to be in different cases quite different. I am not sure whether this is clearly recognised, or whether a clear distinction has ever been drawn between three entirely separate purposes in the use of a permanent magnet in combination with an electro-magnet. The first purpose is to secure unidirectionality of motion; the second is to increase the rapidity of action and of sensitiveness to small currents; the third to augment the mechanical action of the current.

(*a*) *Unidirectionality of Motion.*—In an ordinary electro-magnet it does not matter which way the current circulates; no matter whether the pole is north or south, the armature is pulled, and on reversing the current the armature is also pulled. There is a rather curious old experiment which Sturgeon and Henry showed, that if you have an electro-magnet with a big weight hanging on it, and you suddenly reverse current, you reverse the magnetism, but it still holds the weight up; it does not drop. It has not time to drop before the magnet is charged up again with magnetic lines the other way on. Whichever way the magnetism traverses the ordinary soft iron electro-magnet, the armature is pulled. But if the armature is itself a permanent magnet of steel, it will be pulled when the poles are of one sort, and pushed when the poles are reversed—that is to say, by employing *a polarised armature* you can secure unidirectionality of motion in correspondence with the current. One immediate application of this fact for telegraphic purposes is that of diplex telegraphy. You can send two messages at the same time and in the same direction to two different sets of instruments, one set having ordinary electro-magnets, with a spring behind the armature of soft iron, which will act simply independently of the direction of the current, depending only on its strength and duration; and another set having electro-magnets with polarised armatures, which will be affected not by the strength of the current, but by the direction of it. Accordingly, two completely different sets of messages may be sent through that line in the same direction at the same time.

Another mode of constructing a polarised device is to attach the cores of the electro-magnet to a steel magnet, which imparts to them an initial magnetisation. Such initially-magnetised electro-magnets were used by Brett in 1848, and by Hjorth in 1850. A patent for a similar device was applied for in 1870 by Sir William Thomson, and refused by the Patent-office. In 1871 S. A. Varley patented an electro-magnet having a core of steel wires united at their ends.

Wheatstone used a polarised apparatus consisting of an electro-magnet acting on a magnetised needle. He patented, in fact, in 1845, the use of a needle, permanently magnetised to be attracted one way or the other between the poles of an electro-magnet. Sturgeon had described the very same device in the *Annals of Electricity* in 1840. Gloesner claims to to have invented the substitution of permanent magnets for mere armatures in 1812. In using polarised apparatus it is necessary to work, not with a simple current that is turned off and on, but with reversed currents. Sending a current one way will make the moving part move in one direction; reversing the current makes it go over to the other side. The mechanism of that particular kind of electric bell that is used with magneto-electric calling apparatus furnishes an excellent example of a polarised construction. With these bells no battery is used; but there is a little alternate-current dynamo, worked by a crank. The alternate currents cause the pivoted armature in the bell to oscillate to right and left alternately, and so throw the little hammer to and fro between the two bells.

(*b*) *Rapidity and Sensitiveness of Action.*—For relay work polarised relays are often employed, and have been for many years. Here on the table is one of the Post Office pattern standard relay, having a steel magnet to give magnetism permanently to a little tongue or armature which moves between the poles of an electro-magnet that does the work of receiving the signals. In this particular case the tongue of polarised relay works between two stops, and the range of motion is made very small, in order that the apparatus may respond to very small currents. At first sight it is not very apparent why putting a permanent magnet into a thing should make it any more sensitive. Why should permanent magnetism secure rapidity of working? Without knowing anything more, inventors will tell you that the presence of a permanent magnet increases the rapidity with which it will work. You might suppose that permanent magnetism is something to be avoided in the cores of your working electro-magnets, otherwise the armature would remain stuck to the poles when once they had been attracted up. Residual magnetism would, indeed, hinder the working unless you have so arranged matters that it shall be actually helpful to you. Now for many years it was supposed that permanent magnetism in the electro-magnet was anything but a source of help. It was supposed to be an unmitigated nuisance, to be got rid of by all available means, until, in 1855, Hughes showed us how very advantageous it was to have permanent magnetism in the cores of the electro-magnet.

(*c*) *Augmenting Mechanical Action of Current.*—The third purpose of a permanent magnet to secure a greater mechanical action of the varying current is closely bound up with the preceding purpose of securing sensitiveness of action. It is for this purpose that it is used in telephone receivers; it increases the mechanical action of the current, and therefore makes the receiver more sensitive. For a long time this was not at all clear to me—indeed, I made experiments to see how far it was due to any variation in the magnetic permeability of iron at different stages of magnetisation, for I found that this had something to do with it, but I was quite sure it was not all. Prof. George Forbes gave me the clue to the true explanation; it lies in the law of traction, with which you are now familiar, that the pull between a magnet and its armature is proportional to the square of the number of magnetic lines that come into action. If we take $N$, the number of magnetic lines that are acting through a given area, then to the square of that the pull will be proportional. If we have a certain number of lines, $N$, coming permanently to the armature, the pull is proportional to $N^2$. Suppose the magnetism now to be altered—say, made a little more; and the increment be called $dN$; so that the whole number is now $N + dN$. The pull will now be proportional to the square of that quantity. It is evident that the motion will be proportional to the difference between the former pull and the latter pull. So we will write out the square of $N + dN$, and the square of $N$, and take the difference.

Increased pull, proportional to $N^2 + 2N \cdot dN + dN^2$
Initial pull, proportional to .. $N^2$

Subtracting; difference is .... $2N \cdot dN + dN^2$

We may neglect the last term, as it is small compared with the other. So we have, finally, that the change of pull is proportional to $2N \cdot dN$. The alteration of pull between the initial magnetism and the initial magnetism with the additional magnetism we have given to it, turns out to be proportional, not simply to the change of magnetism, but also to the initial number, $N$, that goes through it to begin with. The more powerful the pull to begin with, the greater is the change of pull when you produce a small change in the number of magnetic lines. That is why you have this greater sensitiveness of action when using Hughes's electro-magnets, and greater mechanical effect as the result of applying permanent magnetism to the electro-magnets of telephone receivers.

### Magnetic Adherence.

There are a few curious pieces of apparatus devised for increasing adherence electro-magnetically between two things. Here is an old device of Nicklès, who thought he would make a new kind of rolling gear. Whether it was a railway wheel on a line, or whether it was going to be an ordinary wheel gearing, communication of motion was to be made from one wheel to another, not by cogs or by the mere adherence of ordinary friction, but by magnetic adherence. In Fig. 39 there are shown two iron wheels rolling on one another, with a sort of electro-magnetic jacket around them, consisting of an electric current circulating in a coil, and causing them to attract one another and stick together with magnetic adherence. In Nicklès' little book on the subject there are a great number of devices of this kind described, including a magnetic brake for braking railway waggons, engines, and carriages, applying electro-magnets either to the wheels or else to the line, to stop the motion whenever desired. The notion of using an electro-magnetic brake has been revived quite recently in a much better form by Prof. G. Forbes and Mr. Timmis, whose particular form of electro-magnet, shown in Fig. 40, is peculiarly interesting, being a better design than any I have ever seen for securing powerful magnetic traction for a given weight of iron and copper. The magnet is a peculiar one; it is represented here as cut away to show the internal construction. There is a sort of horse-shoe made of one grooved rim, the whole circle of coil being laid embedded in the groove. The armature is a ring which is attracted down all round, so that you have an extremely compact magnetic circuit around the copper wire at every point. The magnet part is attached to the frame of the waggon or carriage, and the ring-armature is attached to the wheel or to its axis. On switching on the electric current the rim is powerfully pulled, and braked against the polar surface of the electro-magnet.

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* Extracted from the Cantor Lectures delivered by Prof. SILVANUS P. THOMPSON, D.Sc., before the Society of Arts.

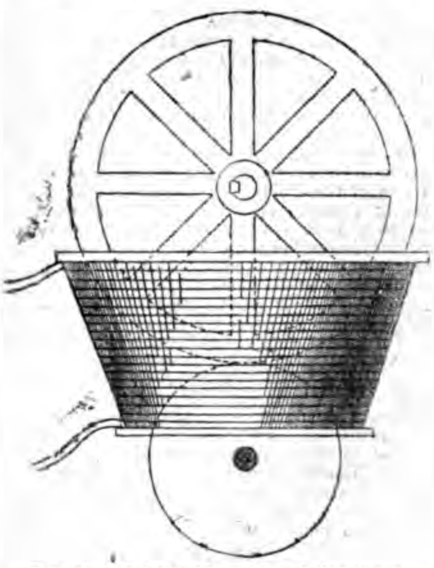


FIG. 39.—Nicklès' Magnetic Friction-Gear.

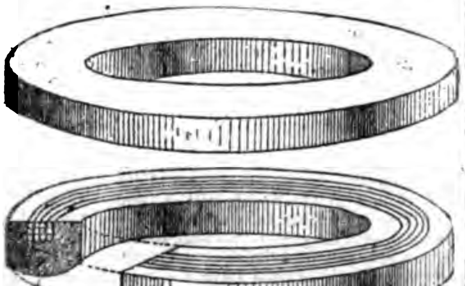


FIG. 40.—Forbes's Electro-magnet.

Forbes's arrangement appears to be certainly the best yet thought of for applying a magnetic brake to the wheels of a railway train.

Another, but quite distinct, piece of mechanism depending on electro-magnetic adherence is the magnetic *clutch* employed in Gü'cher's arc lamp.

### Repulsion Mechanism.

Then there are a few pieces of mechanism which depend on repulsion. In 1850 a little device was patented by Brown and Williams, consisting, as shown in Fig. 41, of an electro-magnet which repelled part of itself. The coil is simply wound on a hollow tube, and inside the coil is a piece, B, of iron, bent as the segment of a cylinder to fit in, going from one end to the other. Another little iron piece, A, also shaped as the segment of a tube, is pivoted in the axis of the coil. When these are magnetised one tends to move away from the other, they being both of the same polarity. Of late there have been many ampère-meters and volt-meters made on this plan of producing repulsion between the parallel cores.

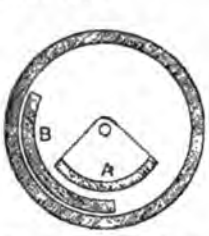


FIG. 41.—Electro-magnetic Mechanism working by Repulsion.

Here (Fig. 42) is another device of recent date, due to Maikoff and De Kabath. Two cores of iron (P Q), not quite parallel, pivoted at the bottom, pass up through a tubular coil. When both are magnetised, instead of attracting one another, they open out; they tend to set themselves along the magnetic lines through that tube. The cores being wide open at the bottom, tend to open also at the top.

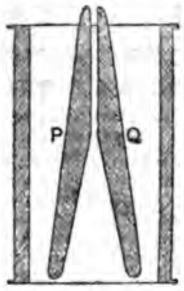


FIG. 42.—Repulsion between two Parallel Cores.

### Electro-magnetic Vibrators.

Then there is a large class of mechanisms about which a whole chapter might be written—viz., those in which vibration is maintained electro-magnetically. The armature of an electro-magnet is caused to approach and recede alternately with a vibrating motion, the current being automatically cut off and turned on again by a self-acting brake. The electro-magnetic vibrator is one of the cleverest things ever devised. The first vibrating electro-magnetic mechanism ever made was exhibited here in this room in 1824 by its inventor, an Englishman named James Marsh. It consisted of a pendulum vibrating automatically between the poles of a permanent magnet. Later, a number of other vibrating devices were produced by Wagner, Neef, Froment, and others. Most important of all, is the mechanism of the common electric trembling bell, invented by a man whose very name appears to be forgotten — John Mirand. How many of the millions of people who use electric bells know the name of the man who invented it? John Mirand, in the year 1850, put the electric bell practically into the same form in which it has been employed from that day to this. The vibrating hammer; the familiar push-button; the indicator or annunciator, are all of his devising, and may be seen depicted in the specification of his British patent just as they came from his hand.

### Indicator Movements.

Upon the table here are a number of patterns of electric bells, and a number also of the electro-mechanical movements or devices employed in electric-bell work, some of which form admirable illustrations of the various principles that I have been laying down. Here is an iron-clad electro-magnet; here a tripolar magnet; here a series of pendulum motions of various kinds; here is an example of oblique pull; here is Jensen's indicator, with lateral pull; here is Moseley's indicator, with a coil and plunger, ironclad; here is a clever device in which a disc is drawn up to better the magnetic circuit. Here, again, is Thorpe's semaphore indicator, one of the neatest little pieces of apparatus, with a single central core surrounded by a coil, while a little strip of iron coming round from behind serves to complete the circuit all save a little gap. Over the gap stands that which is to be attracted: a flat disc of iron, which, when it is attracted, unlatches another disc of brass which forthwith falls down. It is an extremely effective, very sensitive, and very inexpensive form of annunciator. The next two pieces of polarised mechanism having a motion directed to one side or the other, according to the direction of the current. From the backboard projects a small straight electro-magnet. Over it is pivoted a small arched steel magnet, permanently magnetised, to which is attached a small signal lever bearing a red disc. If there is a current flowing one way, then the magnet that straddles over the pole of the electro-magnet will be drawn over in one direction. If I now reverse the current, the electro-magnet attracts the other pole of the curved magnet. Hence this mechanism allows of an electrical replacement, without compelling the attendant to walk up to the indicator-board. The polarised apparatus for indicators has this advantage—that you can have electrical as distinguished from mechanical replacement.

### The Study of Electro-magnetic Mechanism.

The rapid survey of electro-magnetic mechanism in general has necessarily been very hurried and imperfect. The study of it is just as important to the ecectric engineer as is the study of mechanical mechanism to the mechanical engineer. Incomplete as is the present treatment of the subject, it may sufficiently indicate to other workers useful lines of progress, and so fitly be appended to these lectures on the electro-magnet. In a very few years we may expect the introduction into all large engineering shops of *electro-magnetic tools*. On a small scale, for driving dental appliances, electro-magnetic engines have long been used. Large machine tools, electro-magnetically worked, have already begun to make their appearance. Some such were shown at the Crystal Palace, in 1881, by Mr. Latimer Clark; and more recently, Mr. Rowan, of Glasgow, has devised a number of more developed forms of electromagnetic tools.

### Suppression of Sparking.

It now remains for me to speak briefly of the suppression of sparks. There are some half-dozen different ways of trying to get rid of the sparkling that occurs in the breaking of an electric circuit whenever there are electro-magnets in that circuit. Many attempts have been made to try and get rid of this evil. For instance, one inventor employs an air-blast to blow out the spark just at the moment it occurs. Another causes the spark to occur under a liquid. Another wipes it out with a brush of asbestos cloth that comes immediately behind the wire and rubs out the spark. Another puts on a condenser to try and store up the energy. Another tries to put on a long thin wire of a high resistance of liquid, or something of that kind, to provide an alternate path for the spark, instead of jumping across the air and burning the contacts. There exist some half-score, at any rate, of that kind of device. But there are devices that I have thought it worth while to examine and experiment upon, because they depend merely upon the mode of construction adopted in the building of the electro-magnet, and they have each their own qualities. I have here five straight electro-magnets, all wound on bobbins the same size, for which we shall use the same iron core and the same current for all. They are all made, not only with bobbins of the same size, but their coils consist as nearly as possible of the same weight of wire. The first one is wound in the ordinary way; the second one has a sheath of copper wound round the interior of the bobbin before any wire is put on. This was a device, I believe, of the late Mr. C. F. Varley, and is also used in the field-magnets of Brush dynamos. The function of the copper sheath is to allow induced currents to occur, which will retard the fall of magnetism, and damp down the tendency to spark. The third one is an attempt to carry out that principle still further. This is due to an American of the name of Paine, and has been revived of late years by Dr. Aron, of Berlin. After winding each layer of the coil, a sheath of metal foil is interposed so as to kill the induction from layer to layer. The fourth one is the best device hitherto used, namely, that of differential winding, having two coils connected so that the current goes opposite ways. When equal currents flow in both circuits there is no magnetism. If you break the circuit of either of the two wires, the core at once becomes magnetised. You get magnetism on breaking, you destroy magnetism on making, the circuit; it is just the inverse case to that of the ordinary electro-magnet. There the spark occurs when magnetism disappears; but here, since the magnetism disappears when you make the circuit, you do not get any spark at make, because the circuit is already made. You do not get any at break, because at break there is no magnetism. The fifth and last of these electro-magnets is wound according to a plan devised by Mr. Langdon-Davies, to which I alluded in the middle of this lecture, the bobbin being wound with a number of separate coils in parallel with one another, each layer being a separate wire, the separate ends of all the layers being finally joined up. In this case there are fifteen separate circuits; the time-constants of them are different, because, owing to the fact that these coils are of different diameters, the coefficient of self-induction of the outer layers is rather less, and their resistance, because of the larger size, rather greater than those of the inner layers. The result is that instead

.e extra currents running out all at the same , it runs out at different times for these fifteen . The total electro-motive force of self- ction never rises so high, and it is unable to ) a large air-gap, or give the same bright k as the ordinary electro-magnet would give. will now experiment with these coils. The rential winding gives absolutely no spark at and second in merit comes No. 5, with the iple-wire winding. Third in merit comes the with intervening layers of foil. The fourth is with copper sheath. Last of all, the electro- net with ordinary winding.

### Conclusion.

)w let me conclude by returning to my ing point—the invention of the electro-magnet William Sturgeon. Naturally you would be to see the counterfeit presentment of the ures of so remarkable a man, of one so worthy e remembered amongst distinguished electri- and great inventors. Your disappointment ot be greater than mine when I tell you that ay efforts to procure a portrait of the deceased ator have been unavailing. Only this I have able to learn as the result of numerous in- es; that an oil-painting of him existed a few s ago in the possession of his only daughter, resident in Manchester, whose address is now, rtunately, unknown. But if his face must in unknown to us, we shall none the less dly concur in honouring the memory of one e presence once honoured this hall wherein we net, and whose work has won for him an im- hable name.

## ERESTING OPTICAL ILLUSIONS.*

'E is five. Two are ten. Straight is crooked. Motion is quiet. These are strange and ap- atly contradictory statements; but if we are ly entirely upon the evidence of our visual is, they are true. Human visual apparatus ertain qualities which cannot be classed among ts, although under certain conditions they nt seeing things as they really are. To per- ice of vision, or the property of the retinal s by which an image is retained after the t by which it was formed has disappeared, are he phenomena here described and illustrated.

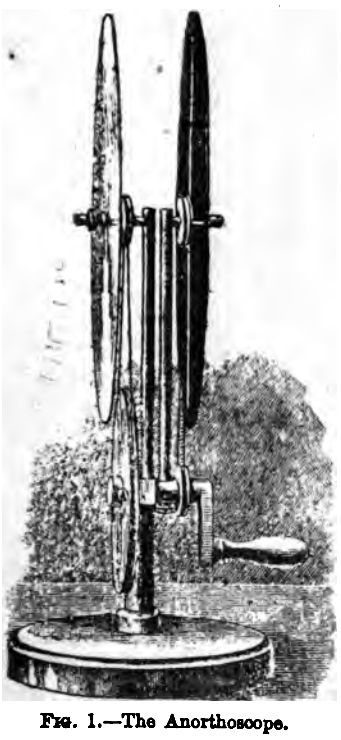


FIG. 1.—The Anorthoscope.

short time since the writer, in search of new al illusions wherewith to amuse, if not to act, a little company of scientific persons, found e store of the well-known optician, Mr. T. H. llister, of New York, an instrument known as northoscope, which was imported by him about y years ago. Although it was a novelty then, probably well known to many, it is now rare. act, perhaps not one in the two or three red who have seen it had ever even heard of it.

e anorthoscope shown in Fig. 1 is a modified of the instrument above referred to, and is ted to experiments other than those belonging to the original apparatus. This instrument has a standard provided with a sleeve upon which is pivoted a movable arm. In the upper end of the standard and free end of the movable arm are inserted studs upon which are placed sleeves, each furnished with a pair of collars for clamping the paper discs—presently to be described—also a grooved pulley.

Fig. 2.

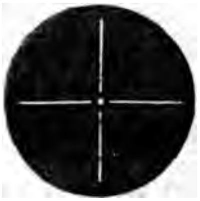
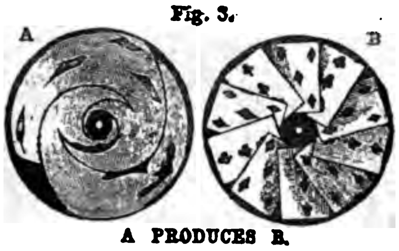

SLOTTED DISK.

Fig. 3.



A PRODUCES B.

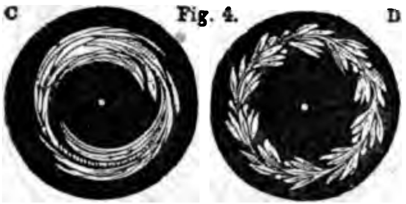


Fig. 4.

C PRODUCES D.

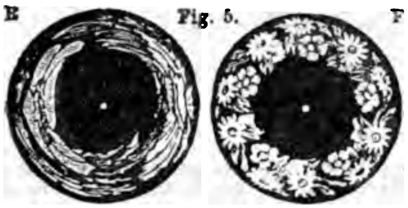


Fig. 5.

E PRODUCES F.

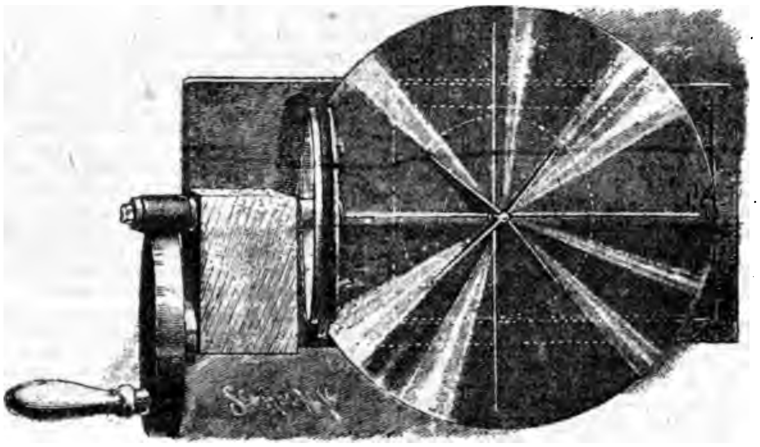


FIG. 8.—Rotary Disc for the Lantern.

In the sleeve in the standard is journalled a shaft having at one end a crank, and a pulley of the same size as that above it at the upper end of the standard, and upon the other end a grooved wheel four times the diameter of the grooved pulley at the upper end of the movable arm. The small pulley below is connected with the small pulley above by a crossed belt, and the large grooved pulley is connected with the small pulley above it by a "straight" belt. Between the collars upon the sleeve driven by the crossed belt is placed a black disc having four equidistant radial slots, and upon the other sleeve is secured a translucent disc bearing an anamorphosed design, which, viewed separately from the instrument, bears little resemblance to the object it is intended to represent, but when revolved in the anorthoscope and viewed through the slots of the black disc, the enormous distortion is corrected and five correct images arc seen. This number of images is accounted for by the four revolutions in one direction of the dise carrying the design and the single revolution of the disc with radial slots in opposite direction, giving five views of the same object for every revolution of the radially slotted disc. The designs are distorted only in the direction of their rotation, the proportions in the direction of the radii of the disc being normal. A face view of the radially-slotted disc is given in Fig. 2.

Fig. 9.

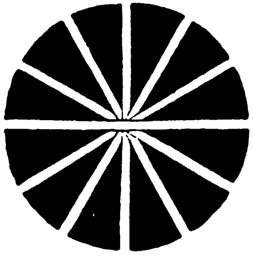


Fig 10.

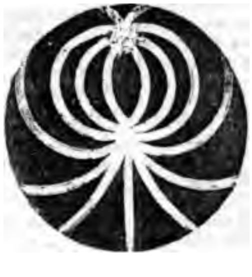
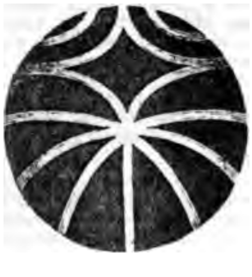


Fig. 11.



In Fig. 3 the distorted card design shown at A is seen in the anorthoscope as a hand of cards, as shown at B. In Fig. 4 the design C produces the

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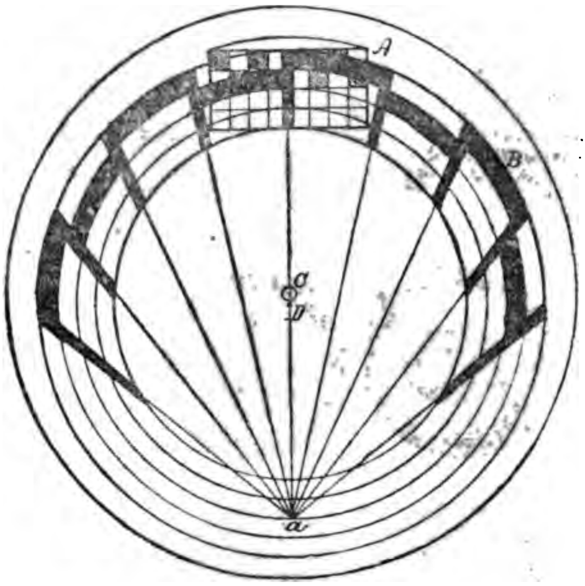
By Geo. M. Hopkins, in the *Scientific American.*



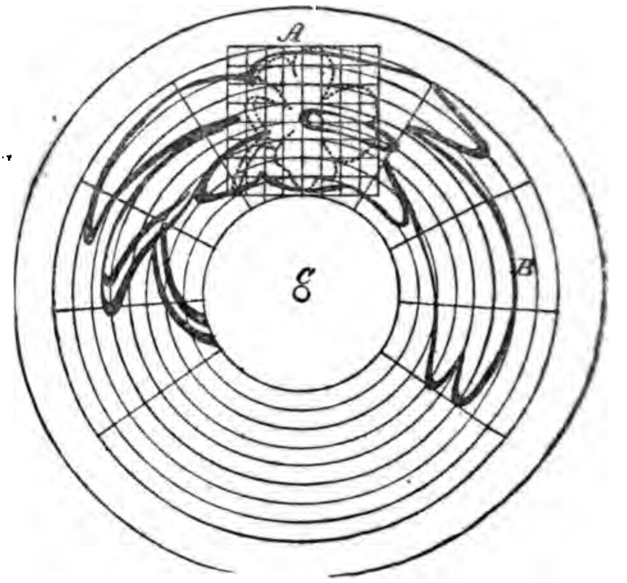


FIG. 6. — Methods of Laying out Anorthoscope Discs. — FIG. 7.

wreath D in the instrument, and in Fig. 5 the distorted flowers E produce the wreath F. The distorted image is seen only in narrow successive sections, which by the retaining power of the retinal nerves are blended into an image which is shortened in the direction of rotation to one-fifth its real dimensions, while it is multiplied five times.

There are two methods of laying out the designs for this instrument, both based upon the development of the original picture in a subdivided rectangle. It is obvious that if a subdivided square can be produced in the anorthoscope from a distorted representation of it, any figure that can be ascribed in such a square can also be produced in the same way. In Fig. 6 is illustrated a method of laying out a rectangular parallelogram, A, divided into 32 equal squares, alternate squares of the upper two rows being shaded.

To lay out the figure, from the centre C strike a circle bounding the periphery of the disc, draw a diametrical line, and at any convenient distance from the peripheral line lay out the rectangular parallelogram, as shown. From the centre C describe an arc, touching the outer angles of the parallelogram A; locate a new centre, D, below C, on the diametrical line, a distance equal to the versed sine of this arc. From this centre describe circles tangent to the horizontal lines of the subdivided rectangular parallelogram. Lay off on the central circle spaces five times greater than and equal in number to the longitudinal divisions of the parallelogram. From a point of the intersection of the diametrical line with the middle circle of the set thus drawn, draw lines intersecting the middle circle at the points set off. These lines radiating from the point *a*, and the eccentric series of concentric circles bound spaces which appear as squares in the anorthoscope. The lines radiating from the point *a* must be increased five times in thickness to secure a line of normal width in the instrument. The spaces in the distorted figure representing the shaded squares are filled up solid with black, the whole forming the figure B, which, viewed in the anorthoscope, appears as at A. Any figure drawn on the subdivided parallelogram and projected on the distorted figure B, would appear normal in the instrument.

When accuracy is immaterial, the figure may be developed on circular lines, as shown in Fig. 7, the horizontal spaces of the square A being developed on the circular lines by radial lines which intersect the middle circular line at equidistant points separated by spaces, each having five times the width of one of the smaller squares. The distorted figure B, viewed in the anorthoscope, appears very nearly like the outline drawing of the flower in the square A. In this diagram everything is drawn with reference to the centre C.

Recently the writer has adapted these experiments to the lantern. The distorted pictures, which are drawn on cardboard discs about 30in. in diameter, are placed on a large rotator about 25ft. from the lantern, and in the lantern slide-holder is placed the rotary disc shown in Fig. 8. This disc, which is provided with four narrow radial slots, is mounted on a small stud projecting from a plate of glass held by the frame of the apparatus. The slots are extended as nearly as possible to the centre of the disc, and the segments of the disc are strengthened by triangular braces.

To avoid using a belt, the disc is driven from its periphery by rubber frictional gearing, as shown. A lantern objective of low power is used, and the slots are sharply focussed on the large disc. The discs are arranged with their axes in line, and when the revolutions of the smaller and larger discs are as one to four, and in opposite directions, the effects above described are produced on a scale sufficiently extended to be seen by a large number of spectators. In this experiment the axes of the discs must be in line.

By substituting the disc shown in Fig. 9 for the anorthoscope disc some very curious effects may be produced. When the axes of the discs are in line, the radial bands will be apparently multiplied or reduced in number according to the relative speeds and the direction of rotation of the discs. When the radially slotted disc in the lantern is arranged eccentrically with reference to the large disc having radial bands, the effect shown in Fig. 10 is produced when both discs are rotated in the same direction, and when they are rotated in opposite directions the effect is as shown in Fig. 11. These forms may be greatly modified by moving the slotted disc in the lantern across the field.

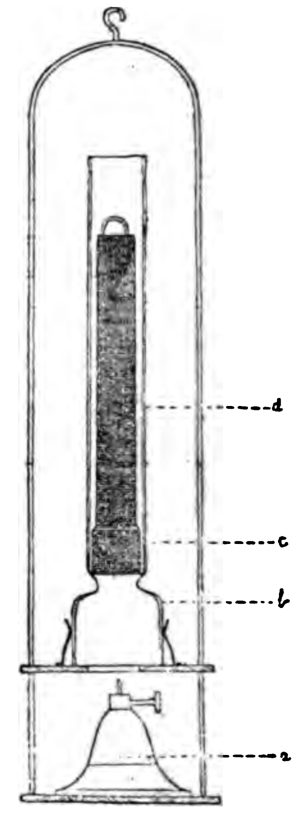
These curious effects are due to the crossing of the white radial bands by the bands of light from the lantern and the retention of the images of these spots of light throughout their entire course, thus giving the appearance of curved bands.

By substituting a disc with radial bands for the anorthoscope disc in the instrument shown in Fig. 1, and swinging the movable arm of the instrument over, so as to arrange the discs eccentrically with reference to each other, the effects last described may be viewed without the use of a lantern.

## LECTURE EXPERIMENT TO ILLUSTRATE THE INDESTRUCTIBILITY OF MATTER.

THE modification of a lecture experiment to show the indestructibility of matter has been devised by Mr. Saville Shaw, F.C.S., of the Durham College of Science, who describes it in the *Chemical News*.

The ordinary forms of apparatus for illustrating the indestructibility of matter by the increase in weight of a burning candle have the disadvantage either of requiring the use of an aspirator, which is apt to draw the student's attention from the more essential part of the experiment, or in the modification, where the chimney itself contains the absorbing material, the draught is often uncertain, and a deposit of soot liable to occur and choke up the spaces between the lumps of soda lime and caustic soda used. Both these inconveniences are obviated by employing the apparatus shown in the figure, which consists of a small petroleum lamp, *a*, suspended in a wire framework beneath an ordinary lamp chimney, *b*, sufficient space being left to allow of the lamp being lighted without removal. The chimney contains a coil of coarse copper gauze, *c*. In the lower part of the narrow portion above this is placed a rather open roll of iron gauze, *d*, provided with a handle of bent wire to facilitate its withdrawal, the roll being coated with caustic soda. The covering of the gauze is easily performed either by dipping it in molten caustic contained in a nickel basin, or by ladling the melted substance over it. The ch
may be removed from the apparatus and bot
closed by corks, enabling it to be used repe
without renewal. The gain in weight in th



four minutes amounts to about one grm., suf
to show very appreciably on even a coarse b
balance.

MR. BRUSH, the inventor of the Brush e
light, has illuminated his residence at Clev
U.S., by means of a windmill on a tower 60ft
erected in his garden. The wheel is 56ft. i
meter, the sail surface being 1,800sq.ft. Th
is automatic, and turns to the wind during
by means of an auxiliary vane. It drives a d
making 50 revolutions for one of the wheel.
matic switches send the current into an accum
of 408 cells, each having a capacity of 100 a
hours. These feed 350 incandescent lamps o
50 candle-power, about 100 of which are in
use. There are also two arc lights and three m
all worked by the power of the wind, which
nothing.

THE tramways, omnibuses, and undergrour
ways which serve the area in and round L
within a radius of five miles leave little for th
lines of railway in that district, and carry eac
about 453,000,000 passengers.

# SCIENTIFIC SOCIETIES.

## ROYAL METEOROLOGICAL SOCIETY.

THE annual meeting of this society was held on Wednesday, the 21st instant, at the Institution of Civil Engineers, 25, Great George-street, Westminster, Mr. W. H. Davies, B.A., vice-president, in the chair.

Dr. Tripe read the report of the council, after the adoption of which the officers and council for the ensuing year were elected.

At the ordinary meeting the following papers were read:—1. "Note on a Peculiar Development of Cirrus Cloud observed in Southern Switzerland," by Mr. R. H. Scott, M.A., F.R.S. 2. "Some Remarks on Dew," by Col. W. F. Badgley, F.R.Met.Soc. These are notes on observations which were made to discover whether all dew is deposited from the air, or if some also comes from the earth and plants, and also what quantity is formed during the year. The conclusions which the author deduces from his observations are: (1) that the earth always exhales water vapour by night, and probably a greater quantity by day; (2) that the quantity of water vapour given off by the earth is always considerable, and that any variation in the quantity is mainly due to the season of the year; (3) that the greater part of the dew comes from the earth vapour; and (4) that plants exhale water vapour, and do not exude moisture. The total quantity of dew collected on the author's grass plates in the year was 1·6147in.

## ROYAL MICROSCOPICAL SOCIETY.

THE annual meeting was held on the 21st inst., at 20, Hanover-square, W., the President, Dr. C. T. Hudson, F.R.S., in the chair.

The President said it was with great regret that he had to notify the death of one of their Honorary Fellows, Dr. H. B. Brady, F.R.S. He had suffered, as no doubt they were aware, from a long illness, and had died at a comparatively early age; but he had left behind him, as the fruit of 25 years' study of the Foraminifera, results that might well be considered the ample reward of long life and unvarying health. For, besides many memoirs on his favourite subject, written either alone or in conjunction with the late Prof. W. Kitchen Parker and Prof. Rupert Jones, he published single-handed the splendid report on the Foraminefera of the *Challenger* expedition, which had so extended their knowledge, and confirmed his high reputation. On his enthusiasm and unflagging industry it was needless for him to dwell; but he might be permitted to add that those who had the pleasure of knowing him well mourned for the loss not only of an accomplished scientist, but of a sterling friend. In addition to this loss, he had also to record the death of Prof. G. Govi, another of their Honorary Fellows, which occurred in 1889, but the notification of which was omitted from the Report of the Council in 1890. To fill the vacancies thus created, it was proposed to elect Prof. Hermann Foll, of Nice, and Prof. Sir Joseph Lister, F.R.S., nominations in favour of whom were then read to the meeting, and ordered to be suspended in the usual manner.

Mr. Swift exhibited and described a new form of Petrological microscope, which he had made under the instructions of Mr. Allen Dick. It differed from the ordinary patterns in having no revolving stage, but was so constructed that whilst the object remained fixed the eyepiece and the tube below the stage could be revolved.

The President expressed the thanks of the society to Mr. Swift for exhibiting and explaining the features of this microscope.

Mr. E. M. Nelson exhibited a new apochromatic condenser by Powell and Lealand, which gave a larger aplanatic solid cone than it had hitherto been found possible to obtain.

Prof. Bell then read the report of the Council for the past year.

The Treasurer, Mr. Frank Crisp, then read the annual statement of accounts from the duly audited balance sheet, and the reports having been received and adopted, Dr. Lionel S. Beale, F.R.S., moved—"That the thanks of the Society be given to the treasurer for his valuable service to the Society in that capacity during the past year."

The motion having been seconded by Dr. Hebb, was put to the meeting by the president, and voted unanimously.

Prof. Bell then submitted the following list of Fellows nominated by the council as officers and council of the Society for the ensuing year:—**President**: Robert Braithwaite, M.D., M.R.C.S., F.L.S. **Vice-presidents**: Prof. J. W. Groves, F.L.S.; Albert D. Michael, F.L.S.; Prof. Chas. Stewart, Pres.L.S.; Chas. Tyler, F.L.S. **Treasurer**: Frank Crisp, LL.B., B.A., V.P. and Treas.L.S. **Secretaries**: Prof. F. Jeffrey Bell, M.A., F.Z.S.; John Mayall, jun., F.Z.S. **Twelve other members of Council**: Lionel S. Beale, M.B., F.R.C.P., F.R.S.; Alfred W. Bennett, M.A., B.Sc., F.L.S.; Rev. W. H. Dallinger, LL.D., F.R.S.; James Glaisher, F.R.S., F.R.A.S.; Richard G. Hebb, M.A., M.D.; Charles T. Hudson, M.A., LL.D. (Cantab.), F.R.S.; Geo. C. Karop, M.R.C.S.; Thos. H. Powell; Prof. Urban Pritchard, M.D.; Walter W. Reeves; Wm. Thos. Suffolk; Frederick H. Ward, M.R.C.S.

The President, having appointed Mr. J. M. Allen and Mr. E. M. Nelson to act as scrutineers, the ballot was proceeded with.

The President then read his annual address, concluding with the exhibition of a number of coloured transparencies, some in illustration of portions of his subject, and others to demonstrate the adaptation of this plan for the display of diagrams on various points in natural history and astronomy.

The Rev. Canon Carr said he rose for the purpose of heartily thanking the President for the address which he had just delivered, and for the exhibition of his beautiful drawings. The Fellows were thankful to see him amongst them again, and hoped that his presence might be regarded as an indication that his health had been fully restored. They also further hoped that the fears which had been entertained with regard to his eyesight might not be realised. He felt sure that all who were present had been very much pleased with the address, and would heartily join in giving their best thanks to the President for it.

Prof. Bell had much pleasure in seconding the vote of thanks to the President for his address, and also for his services to the Society during the past year. The lateness of the hour, and the knowledge that Dr. Hudson was anxious to leave as soon as possible, were reasons why he should not make any lengthened remarks in support of a resolution which he felt sure commended itself to every Fellow of the Society who had listened to the address. He would, therefore, ask Canon Carr to put it at once to the meeting.

The motion was then put to the meeting and carried by acclamation.

The President, in reply, thanked the Fellows of the Society heartily for the cordial manner in which they had received his address, and also for the honour done to him by his election as President during the three previous years. In accepting the office he had fully anticipated that the state of his health would have admitted of his attendance at the meetings more often than had unfortunately been possible; but he could assure them that it had given him great pleasure to come as often as he had been able, and he hoped still to be able to come to future meetings whenever circumstances permitted.

The President announced that the scrutineers had handed in their report of the result of the ballot, from which it appeared that the whole of the Fellows nominated by the council had been duly elected.

Mr. G. C. Karop then moved—"That the thanks of the Society be given to the auditors and scrutineers for their services," and the motion having been seconded, was put to the meeting by the President, and unanimously carried.

The President said he had now the pleasure of welcoming to that chair his well known and learned successor, Dr. Braithwaite, and of congratulating the Society, not only on so happy a choice, but also on the fact that the zoological dynasty had made way for a botanical one. Variety was the salt of life, and it was a fortunate thing that their large and flourishing Society contained members of very various tastes, but who resembled each other in their zealous pursuit of natural science, and in the success with which they pursued it. With the wish that Dr. Braithwaite might have a long, happy, and prosperous reign, he became now one of the most loyal of his subjects.

Dr. Braithwaite, who was very cordially received on taking the chair, said he had in the first instance to thank the retiring president for the kind way in which he had referred to him, and next to thank the Fellows of the Society for the honour conferred upon him by his election to the position he was about to occupy. He could assure them that so far as he was able to sustain it, the high position which the Society then held should not suffer from the the change which they had made. He knew that the position was not a light one; but he was encouraged by the sight of many old friends before him, to believe that those who so ably assisted him in the discharge of similar duties at another society some years ago, would also give him the benefit of their assistance during the coming year. One observation, however, he should very much like to make before he sat down—he thought it very desirable that original papers should fill a much larger space in the *Journal* than was at present the case. The *Journal* had already a world-wide reputation, and the surest way to maintain this would be to increase, as far as possible, the number and value of their original communications to the Society.

The next meeting will be held on Wednesday, February 18.

A MOUNTAIN finch—a visitor from the North, comparatively rare in most parts of England, excepting in unusually severe winters—was found a few days ago in St. James's Park.

# SCIENTIFIC NEWS.

THE results of the observations made at Harvard during 1882-88 by Prof. Pickering and Mr. Oliver Wendell, with the meridian photometer, have been published, and will be eminently useful in future estimates of the magnitudes of stars, as the number reaches a total of 20,125. The object was to determine the magnitude of a sufficient number of stars contained in the Durchmusterung, as would serve for the comparison with future measures of magnitude, and for reducing previous measures to the photometric scale.

The Kew report for last year states that sketches of sunspots were made on 198 days, and the groups numbered after Schwabe's method. Photographs of clouds, with the object of determining their height and velocity, by the method suggested by General Strachey, have been taken, and the groups give heights extending from 1½ mile to 8 miles, the velocity ranging from 5 to 64 miles an hour.

The death is announced of M. Emile Reynier at the early age of forty. The deceased will be remembered for the work he did in connection with batteries and accumulators. He was born in Paris, and was apprenticed to engineering; but devoting his leisure to scientific pursuits, he made several more or less important inventions in connection with electricity, and worked with M. Faure in the development of the latter's accumulator. M. Reynier was the author of several works in connection with his favourite science.

The death is also announced of Mr. John Hampden, a gentleman whose name was well known to our readers as that of a believer in the flat-earth hypothesis. Mr. Hampden was 71.

Dr. William Orlando Markham, the medical inspector for the Metropolitan district, died on the 23rd inst. He was for some years physician to St. Mary's Hospital, and was well known to, and highly esteemed by, many members of the profession.

The Chemical Society will hold a meeting in the hall of the Society of Arts to celebrate its jubilee. The first meeting of the society was held in that place on Feb. 23, 1841, and on Feb. 24 next the President and Fellows of the oldest chemical society will meet at the old spot in the Adelphi from 3 to 5 p.m., and at 8.30 p.m. the officers will hold a reception at Goldsmiths' Hall. On Feb. 25 the Fellows and their friends will dine at the Hotel Metropole.

At the general meeting of the Association for the Improvement of Geometrical Teaching, a petition prepared by the Decimal Association, urging the prompt introduction into the United Kingdom of a decimal system of coinage, weights, and measures, was signed by nearly all the members present.

The Council of University College have arranged a series of free evening lectures on Wednesdays, commencing on Feb. 11, when Mr. Leonard Courtney will discourse on "The Difficulties of Socialism." The subjects are not exclusively or mainly political. On Feb. 18 Mr. Augustine Birrell will give a critical estimate of Samuel Richardson, and on March 18 Prof. Beesly will deal with the career of Sir Henry Vane. The lectures, which will be delivered every Wednesday from Feb. 11 to March 25, are open to the public. The place of delivery is the Lecture Hall in Gower-street, and the time half-past eight. On March 11 Prof. W. Ramsay will lecture on "Ice, Water, and Steam," and on March 25 Prof. S. Poole will discourse on the "Universities of Egypt."

The president and council of the Royal Asiatic Society have made arrangements for the delivery in future, during the course of each session, of evening lectures on Oriental subjects. The inaugural lecture will be delivered by Prof. Max Müller, on Wednesday, March 4, at 8.30 p.m., in the lecture-hall of the University of London, Burlington-gardens.

The Sunday Lecture Society have issued the list of seven lectures up to March 15, to be delivered at St. George's Hall, Langham-place, at four p.m. In consequence of Commander Cameron being unexpectedly detained on the Continent, the lecture for Feb. 1 will be by Mrs. S. D. Proctor (widow of Mr. R. A. Proctor), on

"The Life and Death of Worlds." On Feb. 8, Prof. H. Marshall Ward, F.R.S., will lecture "On a Piece of Wood: its Origin, Structure, and Uses."

The address delivered by Dr. W. Crookes, as President of the Institution of Electrical Engineers, should be studied by those interested in pursuing the subject of "Electricity in transitu: from Plenum to Vacuum." Dr. Crookes looks upon electricity as a "tool," and believes that we have in it a means for investigating many matters beyond our present knowledge. The address will, we presume, be published separately, for it is a most important paper, and should be studied in its entirety.

Koch's lymph is, it appears, not by any means the only thing to destroy bacteria or render them innocuous. Shiel's investigations of 1875 have been repeated by others, and it now appears that electricity will really destroy microbes; but whether it does so directly or by setting up changes in the experimental solution has not been determined.

The method of assisting the operations of tanning by the use of the current is likely to prove commercially successful; but we notice the matter because a recent law case in connection with it shows the advisability of taking out patents simultaneously in different countries, as prior publication here invalidates a patent.

The discussion on Prof. Minchin's paper, "Experiments in Photo-Electricity," read before the Physical Society, was postponed until Feb. 13. The subject has attracted much attention, as it points to the possibility of finding a really accurate and scientific photometer, and also suggests the probability of utilising the solar energy by some such means.

At a recent meeting of the Cleveland Institute of Mining Engineers an interesting discussion on the present attitude of the Admiralty, Lloyd's Register, and the Board of Trade towards steel made from native phosphoric ores by the Thomas-Gilchrist or basic process took place. Mr. Gilchrist explained that by the French, Belgian, Austrian, German, and Russian authorities basic open-hearth steel was freely accepted upon the same terms as that made from hematite ores. He pointed out that by the displacement of the 4,000,000 tons of foreign ores at present used we should be rendering ourselves independent of foreign supplies. Mr. W. H. White, Director of Naval Construction, said that the Admiralty were using basic-steel rivets largely in ship-work, and with excellent results; the engineering department were also using basic plates of low tensile strain. Mr. Milton, chief engineer of Lloyd's Register, said that Lloyd's by no means wished to throw cold water upon basic steel. At present certain works were manufacturing basic steel for shipbuilding purposes under Lloyd's tests, and had been doing so for the past three years, and they were fully prepared to allow other firms to do the same, provided Lloyd's were first satisfied that the steel made by each individual firm was both regular and good in quality.

The bill proposing to lay on oxygen for public and private lighting purposes in London is, it appears, not to be proceeded with this session. Cheap oxygen would be very useful if it could be laid on and used as wanted, not only for lighting, but for "invigorating" the air that has to be breathed in crowded and ill-ventilated places.

Lord Justice Fry, F.R.S., in the course of his lecture at the Royal Institution on "British Mosses," which attracted a numerous and distinguished audience, said that to the peculiar structure of the turf moss great results in the history of the world were to be attributed. And this was as true of Great Britain as of any other country. But for it the forests that once covered the land might still be standing; but for it large tracts of country would still be lake or sea; but for it every freshet in a highland river would be a flood.

The interesting and useful series of British plants exhibited in the Botanical Gallery, Natural History Museum, Cromwell-road, has now been extended to the mosses. Each species is represented by a specimen, and (in the case of mosses) each genus by a coloured drawing, showing an enlarged view of its structure, while a printed description is appended in every case. The whole series furnishes the casual visitor to the gallery with a good idea of the number and variety of this group of cryptogamic plants. It is intended to carry on the series through lichens, algæ, and fungi.

The Council of the Society of Arts announce a course of five popular lectures on "The Science of Colour," by Capt. W. de W. Abney, F.R.S., for the afternoons of Feb. 13, 20, 27, March 6 and 13. The lectures will be of an elementary character, and be fully illustrated by experiments. The regulations as to admission will be the same as for the courses of Cantor Lectures.

# LETTERS TO THE EDITOR.

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*[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]*

*All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

*All Cheques and Post-office Orders to be made payable to* J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

◆

## THE PERSEID RADIANT.

[32016.]—SOME time ago I expressed in your columns my doubts as to the shifting of the radiant point of the Perseid meteors in July and August which Mr. Denning strongly asserted. I have recently been looking over many earlier observations, in which I can find no trace of it; but I think it worth noting that in Heis's "Resultate" (published posthumously) there seems to be one curious instance of shifting in the opposite direction. On July 22—25, Heis finds a radiant at 24° + 50°, which is not far from the point where Mr. Denning places his shifting radiant on the same day. On July 26, 27, 28, and 29, it is still at the same point; but on July 30—31 this radiant disappears, and is replaced by one at 21° + 51°, which has not previously been noticed. On August 1 and 2 the radiant is at 19° + 52° (where Mr. Denning finds it on July 19); while on August 3, 4, it is found at 18° + 50°, after which it disappears. On the first three of these occasions Heis recognises its identity by using the same symbol ($A_{10}$) to denote it; but on the last occasion he employs a new symbol.

I suspect that these apparent shiftings are usually of a local and temporary character. Compare, for instance, Mr. Denning's observations on the great Andromeda shower of 1885 with those of Schiaparelli and Denza. At all events, I hope Mr. Denning will publish a fuller statement of the evidence in favour of the shifting of the Perseid radiant.

Dublin, Jan. 23. **W. H. S. Monck.**

## GLACIATION OF THE MOON.

[32017.]—Do I understand Mr. Dixon to doubt the power of the solar rays to melt the lunar snow or ice? The solar rays traverse space of an identical nature as they come to the earth, and meeting here with our transparent blanket of moist air are absorbed and reduced in intensity before we feel them. But if this blanket is at rest, as it is in the moon, the rays will be more effective there. Ice is a bad conductor of heat, and the intense cold of space would not penetrate far into the covering of ice. The solar rays falling directly on a globe of ice in space, solid if you like, and without mountains, would melt a large portion of that ice, and there would be an ocean with shores and bottom of ice, this liquid ocean would slowly follow the sun round the moon, and would be bounded by that line where the rays became oblique enough to be balanced by the radiation of the heat of the water and ice into space, and then regelation would occur. Such a state of things is impossible in the moon; the atmosphere and the changes of surface would be apparent. I take it that if there were no renewals of snow on our Equatorial peaks: they would soon be bared to their rocky bones.

The reasons why we have snowy peaks in Equatorial latitude are various. It is true that the radiation from the sun is equal per square yard, whether on a peak or in a valley; but the effects are very different, owing to local causes. On peaks the solar rays shine through a much thinner coating of vapour, and much less of their heat is absorbed than at the level of the sea or in a valley, and their direct power is much greater than in the valley; but in the valley, though the direct melting work of the solar rays is less, they are there assisted by reflection of heat, further radiation from earth surfaces and from hot air, and relatively little change of surrounding air, and thus is established the snow-line where the renewal of snow is equal to its destruction by melting. Does Mr. Dixon suppose that at great elevations there is no melting of snow, and that the gradual descent of ice-sheets by gravitation into the warmer valleys is the principal or sole cause of their melting? Even if this were so, where is the snow-line on the lunar ranges? But, further, there must have been a time when lunar and solar heat together melted the ice to the extent that polar ice-caps must have collected, and so remained. Where are these ice-caps now?

Stroud, Jan. 25. **W. J. S.**

[32018.]—REFERRING to the letters of "W. J. S." (31969) and Mr. H. G. Dixon (32001), the original statement respecting the amount of ice that would be melted over the whole of the earth's surface by the sun in a year was, I believe, made by Pouillet, who assumed the entire absence of an atmosphere. It is some time since I read Prof. Tyndall's book; and not having it by me, I am unable to say whether he mentions this fact, which, to my mind, constitutes a decisive answer to Mr. Dixon's second paragraph. **B.**

## THE MOON'S ATMOSPHERE.

[32019.]—"JA. HA.'s" suggestion that the decrease of gravity in rising through successive strata of 22 miles above the Lunar surface should have been taken into account, will not help him in his theory that evaporated molecules of water vapour would be thrown off with a velocity that would cause them to leave the sphere of the moon's attraction. I did not refer to the small decrease of gravity, because its effect happens to be exactly balanced by another element of the problem, which was not taken into account in my already too long letter—viz., the increase in volume of spherical shells of the same thickness as we proceed upwards. The area of a sphere increases as the square of its radius increases, consequently the volume of thin spherical shells, of the same thickness, varies as the squares of their radii, and a stratum of air carried upward (if the pressure, the temperature, and gravity remained the same) would become thinner by reason of its being spread over a larger surface. The decrease in gravity, owing to its new position, would cause it to become thicker; and the increase due to the change of gravity would, since it varies inversely as the square of the radius, exactly balance the decrease due to the larger area over which the stratum of air would be spread.

**A. Cowper Ranyard.**

## ALPHA LYRÆ.

[32020.]—WITH reference to Messrs. Fowler and Lockyer's "preliminary note on the duplicity of the above," which has now assumed such a curious appearance, I should like to say that a few years ago, when I began to feel a vital interest in astronomy, I purchased as a preliminary work Lockyer's "Elementary Lessons in Astronomy," dated 1886—stereotyped edition.

Last night, after separating α Geminorum with my 3in., I referred to a list of double stars contained in that book, and was surprised to find α Lyræ given there as double, divisible by powers 80—120 on the refractor. This, I say, is dated 1886; hence I am puzzled to know why that ill-fated "preliminary note" should be sounded abroad as the outcome of recent discovery.

I have before had occasion to call attention to the misguiding character of the book in question. In the lack of adequate explanation of such apparent blunders, it is ridiculous to say the remarks of "F.R.A.S." on the responsible party are a bit too severe. **William Godden.**

43, Hindon-street, Pimlico, Jan. 26.

## β LIBRÆ.

[32021.]—SMYTH calls this star pale emerald in colour, and Webb specially calls attention to its beautiful pale-green hue. In 1870 I noted it as pale green, using a 6½in. silvered glass reflector; but in 1889-90 I called it white, with a very fine 3¾in. Cooke refractor. Have any of your readers any recent observations on the colour of this star?

**H. Michell Whitley.**

Eastbourne, Jan. 24.

## HENRY'S COMET.

[32022.]—I WAS surprised to find that "F.R A.S." understood me to say that, according to Guillemin, Henry's comet divided. I certainly did not mean to say anything of the kind, as Biela's is the only case recorded of such a thing taking place. As I failed to make myself understood in my first query, will you kindly allow me to state my question again? Are the illustrations of Biela's comet after the division, given by Proctor in his "Mysteries of Time and Space," correct, or is Guillemin ("World ets") correct in describing the same illustra- P. Henry's comet, as it appeared on two it occasions—August 26th and 29th, 1873?

**J. Hendry.**

## FOCUS OF TELESCOPE.

23.]—WILL you allow me the privilege of ing a statement of the late Rev. T. W. which Mr. Caplatzi describes as an "un- itable conclusion" not "drawn from actual ation"—namely, that a telescope requires ng differently for different objects?

I am sure if Mr. Caplatzi had had only a portion of Mr. Webb's "actual observation" edge, he would have known better than to ritten what he has. The truth is, it is Mr. C. xpresses opinions about telescopes which do ree with "actual observation." This is clear everal statements contained in a letter of short time since, which I should have at the time had not Mr. C. treated the n (reflector *versus* refractor) almost entirely telescope *dealer's* point of view. He says, tance: "The refractor will *sell*, but the r is a drug in the *market*" (italics are mine). it may save an improper use of space in the ." by reminding Mr. Caplatzi that a discus- the scientific merits and use of two different of instruments is one thing, and their etable" commodity is another thing. The is a legitimate and useful subject for discussion entific journal like the "E. M."; the latter and that Mr. C. should not be surprised or pinted that the users of a particular scientific ment prefer to get their supplies from those st understand them.

Webb's book is one of the best—I would say *the* best—companions of the amateur mer, and, by consent of the best critics, larly free from errors." On the statement Mr. C. disputes, it is quite safe to say that ebb is perfectly right, and Mr. Caplatzi is ly wrong.

ourse Mr. Webb *did* know what he wrote and that the change of focus for different was due to a relation between focal length gular aperture, and is as real a fact of l observation" as it is to say the angle sub- by the focal *image* is due to focus. Those e large apertures of short focus can assure that such instruments are very sensitive to erence in distance of the heavenly bodies. son is obvious: some are practically at an distance and exhibit no sensible angle; being near, do so.

e see "Wega" might not realise this change with his telescope; but just let him try the ment with an aperture of, say, 18in., with a ke his, and he would at once see that the W. Webb was right, and himself one of those observers" Mr. Caplatzi imagines do not

**G. Calver.**

## CREATION, CREEDS, AND HYPOTHESES.

4.]—I CANNOT leave Mr. Jas. Johnstone's 31986, p. 443) unnoticed, though I should uss its subjects, because not suited to these I did not "attack the Westminster Stan- nd God's creation works" (p. 404). I only l to the Westminster Confession as an e of how easy it is for the best intentioned convert their own notions into truths, and d to metaphysical ideas about matter.

uld not think of attacking any "creed," n a discussion upon religious subjects. If stminster divines had merely stated "it God to create all things in six days," &c., uld have been in their rights, as concisely what their avowed authority told them. ds only objected to their adding, without hority, their own definite interpretation of d "create," as "or make out of nothing." ld not think of attacking "God's creation

' Few scientific men nowadays accept the ion's description of their process. For myself hat the earlier portion of Genesis, which was thority, is no genuine portion of the original Scripture. I think Chap. I. and three verses p. II. are probably the oldest existing in the world, somewhat modified; and, to Chap. X., is a collection of Persian and n literature, collected during the Babylonish y, and edited by, or under, Ezra and his s. Personally, the idea of a creation n time is to me inconceivable, as is, in fact, of a beginning. But I do seriously hold creation works" as the result and evidence ne will and energy—operative, not only ars ago, but through the past eternity (not ily in present forms), and as fully "to-day, y, and for ever." I hold that "evolution" orking of the Divine thought in the Divine e, which we call matter; while natural , survival of fittest, and so on, are the n which we trace the actions. I can even me of the ideas of "Evolution and Special Creationist," p. 466, and recognise in that garb the author of many an elegiac contribution. None the less, I know these are but hypotheses, and should not think of attacking the ideas others may form on these subjects.

**Sigma.**

[We have had enough of this.—ED.]

## IS IT POSSIBLE TO CURE BLINDNESS?

[32025.]—LIVING as we are, in such an age of scientific achievement and improvement, it surprises one when he considers the small advance that has been made in the treatment of blindness, and disease of the eyes in general. Perhaps it is, as the eye is an organ of such delicate adjustment and constitution, that the oculist shows such trepidation in meddling with the subject; or, perhaps, owing to the erroneous notion that a person who is blind is beyond all cure. We must first understand how the eye causes vision: this will be readily explained by referring to Fig. 1, where we have a section of the human eye. The light A, coming from the object B, enters the pupil C; the rays of light then converge to a focus upon the retina D, producing a minute inverted image of B; the optic nerve E conveys the impression to the brain. From what has been said, it will be seen that the sole seat of vision lies in the wonderful network of nerves, the retina, *and the only optical condition necessary for vision is the formation of a distinct image exactly upon the retina*. Now, a frequent cause of blindness is due to injury, or disease, of the cornea (see F, Fig. 1); but it does not follow that because the cornea is destroyed the retina should suffer in the like manner; the blindness in this case is not caused by the destruction of the cornea, *but is due to absence of light upon the retina*. Now my theory is, that if by artificial means light be admitted, and be correctly focussed upon the retina, a blind person would be able to see those around him. A possible contrivance is shown in Fig. 2. A B is the segment of a sphere of opaque glass, the interior of which is stained a dense black, and having an opening at C; D is a cover of transparent glass to prevent dust, &c., from entering the aperture E; F is an achromatic lens having a short focus, and securely fixed in the glass ring G; H is a ring of coloured glass representing the iris (see F, Fig 1). A front view of this contrivance is shown Fig. 3. I will conclude by saying I believe it possible for such an instrument to be inserted and securely fixed in the place of a diseased part, and if the retina is free from disease, vision might possibly be restored.

**W. E. Sutton.**

Fig I

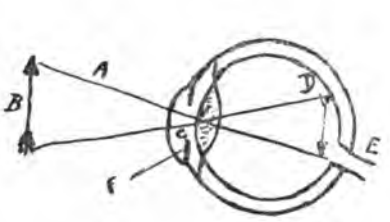


Fig II

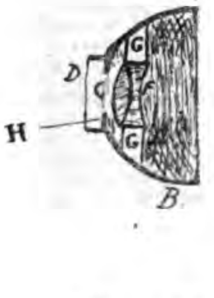
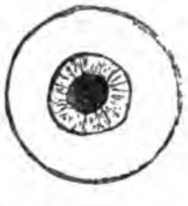


Fig III

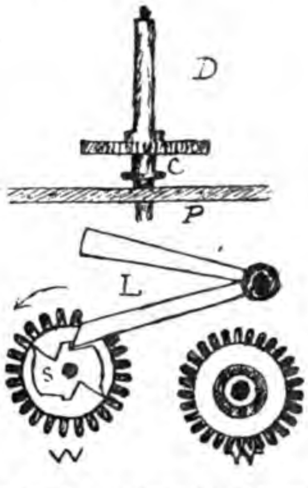


## AN IMPROVEMENT IN THE STRIKING PART OF CLOCKS.

[32026.]—THE object of this contrivance is the prevention of the striking of a clock when the minute hand is set back. Its use is restricted to clocks the striking work of which is constucted on the "locking-plate" principle.

As is well known, the hand of a clock of that kind cannot be turned back after the "warning" has taken place without the striking going off, when the order of the striking is entirely deranged. A reference to the figures will enable anyone to form a fairly correct idea of the proposed remedy. The lever and wheel connected with it are reversed in order to show the parts. L is the lever which acts on the warning-pin; W the minute-wheel; S the new safety-piece which is placed under the wheel, and is made of brass of about the same thickness; C is the collet on which the new part turns. The minute-wheel is also shown without the safety part, having a sink cut in it, and a pin fixed in the centre of the sink. D gives a side view of the wheel and collet, also part of the plate.

The new part turns on the pipe of the collet, and a shoulder on the latter prevents the other touching the plate. If the pipe stands a shade above the surface of the safety-piece, in order that the wheel shall not bind it when the latter is pressed down to its place, it being most important that it (the safety-piece) should have perfect freedom.



To lessen friction a shallow sink is turned at the back of the wheel, extending from near the centre hole to the teeth. Thus the two surfaces are separated, the new piece touching only on the shoulder of the collet on one side, and on the part left near the hole of the wheel on the other.

The two deep notches cut in the safety-piece serve for the lever's arm to fall into, when the striking follows as usual. The ordinary lifting-pins being dispensed with, the notches or "steps" in the new part answer the same purpose. It will be observed that the arm is resting against a spur. This part is sufficiently filed down to allow of the lever being raised over the spur *without the warning taking place*. When the arm has fallen over the spur it is clear that it cannot pass back again. This action affords the desired security. The higher part of the edge of the new piece raises the lever enough to release the locking-pin, when, of course, the "warning" is complete. If, now, the new piece is turned back till the arm falls against the spur, the warning-pin will still be held secure, so that the striking cannot follow. From this it will be understood that, no matter from what point of the dial the hand may be set back, the clock cannot strike. The result thus far has been to put a limit to the backward motion of the hand. To restore its freedom, the connection between the wheel and safety-piece must be effected. As has been stated, a sink is turned at the back of the wheel. The figure shows the part, and also a pin.

The sink is about $\frac{1}{3}$ of the wheel's thickness in depth. A pin is likewise placed in the new piece exactly corresponding with the one in the wheel. These pins are opposite each other, so that when the wheel goes forward it carries the safety-piece with it, the two going forward as one wheel. When the hand is reversed, the two pins are separated, and on the backwark motion being continued, they meet again at their opposite sides, when the new part is carried back till the locking of the arm in one of its notches stops further progress. The alteration permits of the hand being reversed from close on an hour to an hour and a quarter, according to where it happens to point to at the time.

This proposed change may not be new, but I have never yet met with anything of the kind in any clock of the many hundreds that have passed through my hands. The fault it is designed to remedy is a very annoying one, and few persons seem to know how to restore the order of striking once it has gone wrong. There is, of course, also a loss of time in having to strike the entire twelve hours round every time the error arises. That can be entirely avoided by prevention, and the plan suggested affords that completely.

It is chiefly in respect to clocks of the construction referred to, that are now in use, that the contrivance would be most useful. The number in existence is enormous, and as they invariably last a very long time, they are well worth improving. There is not much work entailed, and the time taken over it would be in proportion, so that the cost would be very trifling.

There are other two or three ways, differing somewhat from the foregoing, by which the same result may be attained; but they stand at a disadvantage in some respects, and upon the whole the one I have described is likely to answer best. There are a few details very desirable to bear in mind when the work is being done; but as they will readily occur to the practical horologist, it is scarcely necessary to allude to them.

It will be noticed that, by the employment of the new part, in the form figured, it sustains the constant pressure of the arm, except at those times when the latter drops into the "steps." The form is optional, a narrow straight bar answering just as well. With one of that shape the arm would be wholly free of it for a good part of the time. I prefer, however, the form here given, thinking it better that a pressure should be, as far as possible, distributed equally over a whole, than that perfect freedom should be given to one part at the cost of adding its burden to that of another.

**Jas. Haswell.**

38, Elizabeth-street, Eaton-square.

### ASBESTOS WATER-TAPS.

[32027.]—I AM the inventor and patentee of the asbestos-faced stop valve, which you described in an illustrated article in your issue of October 24th, 1890.

Assuming that Mr. Hosken refers to my valve in letter 31980, allow me to say that I have designed (on the same principle as my large valves) a small valve, which is specially applicable as valve taps of every description for hot or cold water, &c. Various packings may be used in these taps. I may also say that the four little screws referred to, and the frequent calls of the much-dreaded plumber are entirely dispensed with.

The Bells' Asbestos Company (Limited), of 118A, Southwark-street, London, are the sole manufacturers in Great Britain.

**James Robinson.**

Penryn, Cornwall, January 20.

### THE OPTICAL LANTERN.

[32028.]—REFERRING to your report on p. 459 of the lecture given by Mr. E. M. Nelson, F.R.M.S., before the Lantern Society, it is stated that a triple condenser showed a "remarkable superiority in the brilliancy of the picture over all the others." Mr. Lewis Wright, in his new book, "Optical Projection," says of triple condensers: "I have perfectly satisfied myself that for exhibition lanterns they afford no gain whatever. For large condensers, as 6in. and over, and where the light is to be condensed upon a *small* surface, as for the projection microscope, they are of advantage, and allow us to use a pencil of 90°." Your report goes on to speak of the lantern in its relation to the microscope, and gives, as Mr. Nelson's conclusions, that photographic lantern slides of microscopic objects are superior to the projection microscope for exhibiting results to an audience. Is there no qualification to this statement? **Arcanum.**

### ANEMOMETER.

[32029.]—I AM sorry I cannot exactly answer the query of our obliging correspondent "F.R.A.S.," but I give below the instructions issued with Casella's instrument. "The wind's velocity is measured by two wheels working in endless screws. The outer or port wheel, which revolves once for every five miles, is furnished with two graduated circles, the interior circle being subdivided to miles and 10ths of miles, whilst the outer circle is divided into 101 parts, each part being equivalent to five miles, so that it measures 505 miles of wind. The stationary index at the top of dial marks on the inner circle the number of miles (under five) and 10ths that the wind has traversed, in addition to the miles shown by the traversing index or hand, which revolves with the dial, and indicates on the outer circle the transit of every five miles. If the hands are at 0, the next observation will show the distance travelled by the wind during the interval; next read the hands as they are, by noting down the divisions and figures indicated by the traversing hand and stationary index at the top. Thus, say the former points to between 125 and 130, and the latter to 2·6, making together 127·6; this will now be the starting point. On next observation the traversing hand will point to say between 375 and 380, and the stationary index to 3·6. These two numbers added give the reading 378·6 miles. From this reading subtract the previous reading 127·6, and the difference 251 miles is the distance traversed by the wind during the interval.

**F.R.Met.Soc., &c.**

King's Heath, Jan. 23rd.

### HINTS FOR EXPERIMENTALISTS.

[32030.]—HAVING described a process by which effects in colour can be simply obtained from ordinary negatives, I will suggest a modification of it, which might furnish an interesting experiment to amateurs.

Prepare bichromatised gelatine solution, tinted of various colours, as for the autotype process, but thinner. Coat a plate with dark-brown gelatine solution, as if coating with collodion, and dry it. Next coat the same plate with dark broken-green gelatine, and then with medium green, light green, and light-blue grey in succession, drying the plate between each application. Now expose very fully beneath a negative showing sky, water, and foliage only. Transfer to flexible support as usual, and after development, flood with transparent gelatine solution, in which chrome alum has been dissolved, and apply a waxed glass-plate. After drying, strip off the flexible support from what is now the back of the print, and finally transfer to white paper. This would, I believe, give somewhat similar effects to those which were mentioned in the letter above referred to.

I will now touch on the first of the methods I propose for production of prints in natural colours. Suppose that of the image of any object we project two or more images, similar in all respects, upon the face of a sensitive film; or, in dealing with very transparent sensitive films, suppose that we throw one such image from the front upon the sensitive surface, and the other similar one from the back—that is to say, through the glass support. Let these two images (which for purposes of description we may call inferior images) be exactly superposed, and provide that the similar rays of light forming each visible pencil in the original picture are made first to diverge in two directions, one from another, in approximately equal proportions, and are then projected convergently upon the said plane in the said sensitive medium. Provide that every ray in such diverted images traverse, while within this system, an exactly equal path to that of every other ray in the same image.

Now, by a mechanical adjustment, or by introducing measured thicknesses of a transparent colourless retarding medium, we might so affect the path of one of these inferior images, as to cause it to interfere with the other, in respect of the rays of certain colours only. And so, by gradations, we could produce interference and suppression of the ultra-violet, violet, blue, green, yellow, and red rays, successively, and obtain by that means photographic negatives distinguished each by the absence of effect due to rays of specific primary colour. Not to prolong this description, I do not consider the reinforcement of certain other colours that would of course take place concurrently with such interferences. It is obvious that by the use of sensitive compounds responsive in the highest degree to the various groups of colours, we could then produce results absolute so far as those colours are concerned.

Another point is that, if the ultra-violet rays alone were made to interfere, we might obtain, to a great degree, with ordinary sensitive salts, the effects that are arrived at in using orthochromatic plates. It will be noticed that the position of the various sensitive plates that would be successively used as above, need not be more exactly regulated than is necessary to obtain good focus. What would have to be perfectly rigid, is the optical mechanism for projecting the similar images as described. The difficulties to be overcome appear to me purely mechanical. I think that a single image can be successfully split up and recomposed in the manner required; but supposing that cannot as yet be done with sufficient accuracy, it might, for some purposes, be worth while to experiment with a pair of very small lenses, so dealing with two primary images as nearly identical in origin as might be. Of course the question involved can be solved arithmetically by those who chose to give them attention, and particular forms of apparatus will occur to all who have a slight knowledge of optics. An experiment with pinholes touching one another will suggest itself.

It should be remembered that in reflection and refraction, there is a considerable loss of light, and it will be necessary to preserve the equality of our inferior images, otherwise the desired effect would be marred. There is, moreover, another reason why the paths traversed by all similar rays in the inferior images must be made nearly equal, it being well known that any considerable inequality in the rate of transmission of such rays would practically annul that identity of origin which is essential to interference.

It occurs to me as possible that satisfactory results would not be attained without using a shutter, with horizontal slit, which could be slowly dropped in the path of the primary image. A description in detail of such arrangements of glass plates, prisms, lenses, and mirrors, as appear to be suited to these experiments would require illustration which I should be glad to give at a future time.

**A. D.**

### THE SPEECH OF LOWER ANIMALS—CONTRACTION BY DAMP.

[32031.]—I THINK there are some rather important objections to Mr. Kincaid's plan. The number of vibrations in the highest note perceptible to the ear is about 48,000 per second. Now, if the voice of the animal is only one octave above this, the number of vibrations would be about 96,000. Again, as the pitch of a note increases, the amplitude of the vibrations of the sounding body decreases; therefore it is very probable that the record (if any) impressed on the cylinder would be too delicate to produce any perceptible effect. However, if Mr. Kincaid merely wishes to prove that they possess a voice, that could probably be discovered by the aid of a sensitive flame.

In reply to "A. S. L." (31981, p. 443), the number of impressions on the cylinder will be equal to that of the double (once backward and forward) vibrations of the diaphragm, except in the case cited in a former letter, where the recorder, being double-pointed, twice the number of impressions was made, and the note produced was the octave of the original.

On reading letter 31996, I repeated my experiment with strings of various sizes, and obtained precisely the same result, the note falling about one tone.

Can "Sm." explain the phenomenon? I should like to get to the bottom of the matter.

**Caldemona.**

### LOCOMOTIVES AND LOCOMOTIVE RUNNING.

[32032.]—UPON p. 402 your correspondent "Nun. Dor." asked several questions relating to locomotive working. To these I replied fully (page 423). In your last issue "Nun. Dor." (p. 465) disagrees with the whole of my replies. I have therefore but to adhere to the correctness of my former letter, and there is nothing which I desire to add to my previous complete statements.

"Nun. Dor." (p. 465) asks for opinions upon the merits of compound locomotives with four driving wheels and with a single pair of driving wheels. Compound engines with a single pair of wheels give better results than those with four wheels; but no compound locomotive engine has yet been built equal in efficiency to non-compound engines—say on the Midland, Great Northern, Caledonian, and other lines. The efficiency which is claimed for compound engines is simply due to the high steam pressure with which they work.

Compound engines with 175lb. or 180lb. pressure are always compared with non-compound engines with 140lb. The only way to fairly test the matter is to have two engines with similar boilers, fireboxes, and pressure, one "compound," the other "simple." The result would then be in favour of the "simple" engine.

"Nun. Dor.," I fear, knows but little about the "brick arch," or the "deflector," or "baffle-plate" in a locomotive firebox, or he would know that air must be admitted through the fire-door to prevent smoke. Some of your readers may remember that years ago the London and North-Western engines had two square openings at the front of the fire-box in order to let in air to consume the smoke; that plan has now been given up, as an enlarged fire-door supplies the air required.

"Nun. Dor." says you can't see the smoke when an engine is running. Can't you? Locomotive inspectors are constantly about on the line to see if drivers make a smoke near large towns, parks, houses, &c.

My statement relating to fog-signals is correct, and applies to *all* lines in this country. Two fog-signals *never* mean all right on any railway.

"Nun. Dor." states there are other points which might be "discussed," but he does not state to which he refers. It is, therefore, impossible to reply thereto. **Clement E. Stretton.**

10, Saxe Coburg-street, Leicester.
24th January.

### THE VIOLET FLAME FROM COMMON SALT.

[32033.]—THE letter of Mr. A. Percy Smith (32015) hardly seems to me to make this matter clearer. He asks how I know that there is no hydrogen present when coals cease to flame? Well, ıt this fact was pretty generally known, or, that most elementary treatises on chemistry ıat coke consists of tolerably pure carbon, ng only a small quantity of ashes. I have ı works before me as I write, which state fact, and to that extent I put faith in their y. If this teaching may be relied upon, as ure the ashes remain practically unchanged not furnish the hydrogen needed, it seems to if your correspondent's view is correct, that ırmation of HCl the H is dispensed with. scarcely understand what particular phrase tter can have suggested to Mr. A. P. Smith 'as possibly confounding the flame of ignited ı that produced by common salt. Let me, ', hasten to assure him that I am perfectly with the appearance of both these flames, ıt my remarks had sole reference to the

**W. T. N.**

## ALYTICAL METHODS FOR NON-CHEMISTS.

4.]—QUESTIONS on analysis are frequently ı this paper by persons who are evidently t of the first principles of chemistry, and it ıle that they suffer disappointment on reno replies. Under the circumstances replies ess, just as it would be waste of time to problem in higher mathematics for one who ant of algebra. However, let us not entirely

There are certain tests which may some- applied by the illiterate. Analysts occa- use "life tests" for the discrimination of ; but it has been reserved for an American ver that such tests may be applied to articles

He had twelve samples of butter sent him lysis, ten of which turned out pure, the re- being margarine. During the night, mice entirely devoured the samples of pure but left the margarine untouched. Struck ıis circumstance, the analyst repeated the ıent, but limited the quantity of butter. The 'as the same. When margarine alone was d the mice partook of it very sparingly. ıis fact it might be possible to make a quan- "mouse test," thus: Present to the mouse containing 10 per cent. margarine, side by h a sample of the suspected butter, then one r cent., and so on, until the mouse prefers ke of the suspected sample first. Its degree teration will then be ascertained to within ent., which will be near enough for practical s. Then as to milk. I have known cats to to drink milk when largely diluted with A point may be found where the animal is to detect its presence. It would be neces- employ a cat that had arrived at the age of ɔn. I am afraid a kitten would be too and therefore unreliable. Next as to It is impossible to make a good Welsh unless the cheese be rich in fat, a poor cheese t spread over the toast, but the caseine somewhat the condition of hard-boiled of egg. I fancy that a wide difference in ur will be exhibited between genuine and l cheese.

u drink a glass of bad whiskey overnight, certain to have a dry throat in the morn- What need to analyse the whiskey for fusel ave seen it stated that ants refuse saccharine, l regale themselves on sugar. Here is a means for the examination of syrups. I t multiply instances, but it is apparent that ample opening for original investigation by not necessarily possessing scientific know-

**Sm.**

## TAPER CHUCKS.

5.]—IN letter 32004, experience of users of ɔckets is asked. I use them constantly in and American machines. I find no need of if the taper-hole is well made—the shank ınd is properly driven in, *all clean*. A set- ept on a parallel shank, I consider a piece arism.

nerican and in English machines a screwed eyond taper of shank, also a bolt going ı the length of spindle and into, or on to, the are sometimes used. I use, in a confined , where driving is not possible, a piece of Γ shaped, screwed on tang, and fitting a hole in chuck. I put this in the mortise ive cutter into chuck, and then screw the ome. This answers well if the hole and re true. This device does not interfere with cleaning out the "sacred orifice" as does w beyond taper and would the set-pin. I he driven taper, because your screw devices ld your chuck or tool, dirt and all, whereas, lrive into a dirty hole, spoiled work will fitly your carelessness. In judging of holding much depends on the work. A Morse taper- ⅝in. at mouth by 1⅞in. long, has held a cutter, projecting 1¼in., of ⅝in. diam. at ı which were ten deeply-cut teeth. These rned off, no centre being used. These taper will carry cutters, large and small, doing full work on steel and iron, and if one of the screwing chucks is driven into a socket ¾in. at mouth, an 8in. wrench will not move it. High-speed fly cutting on hard brass can also be safely done. Tools would require less driving if made, say, 2° taper in shank. Small tools do not need flat tang, but the mortise as for a flat tang. The taper, being reamed to bottom of it, will give a little latitude in size of shanks, and render fitting easier. I prefer the Morse taper to a slower one for ease of fitting the cutters.

**British Bulldog.**

## LATHE MATTERS.

[32036.]—AMONG your numerous readers I expect there will be many like myself, "amateurs dabbling in lathe matters," as well as others, who would be very glad to see the letter 31977, by "Phederick," acted on, and "someone give a list of neat and useful nick-nacks to make."

Although I do not possess any ornamental chucks to my lathe, nor anything more than a drilling-spindle, drills, slide-rest, back-gear, and rough sort of overhead, which I made myself, I still read with very great interest all that appears in your valuable journal on lathe matters, and other articles on tools generally.

Like "Rushlight," I have had my lathe for some months, and want something to turn that will give me exercise as well as interest. Both letters from "Phederick" and "Rushlight" are interesting to all beginning amateurs.

What is the oval chuck like of which "Rushlight" speaks—I would like to try and make one?

Grays, Jan. 23. **R. N.**

## SLADE'S UNIVERSAL MICROMETER.

[32037.]—IN reply to Mr. Slade, my telescope is mounted on an altazimuth tripod stand, with steadying-rod, having slow motion in altitude.

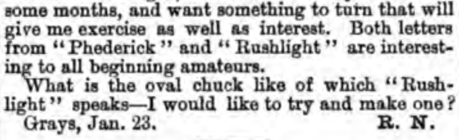
**Arcturus.**

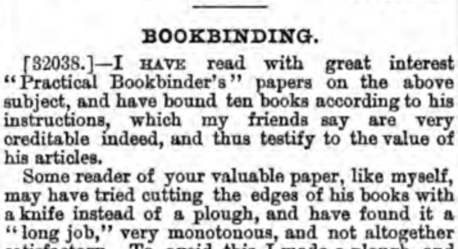
## BOOKBINDING.

[32038.]—I HAVE read with great interest "Practical Bookbinder's" papers on the above subject, and have bound ten books according to his instructions, which my friends say are very creditable indeed, and thus testify to the value of his articles.

Some reader of your valuable paper, like myself, may have tried cutting the edges of his books with a knife instead of a plough, and have found it a "long job," very monotonous, and not altogether satisfactory. To avoid this I made a plough, and should like—with the Editor's permission—to give my brother-readers a description of the machine, which is simply made and works splendidly, and need not cost more than a few coppers to a mechanical man, or 1s. 6d. to buy the various parts. It is made of hard wood—beech or mahogany—1in. in thickness, and 4in. by 10in. in height and length. In the middle of each side board a ½in. hole is bored, and the pair fitted with a screw (as inclosed sketch, Fig. A) made from ½in. bolt, with a T-head and shoulder, and a screw cut for 10in., from *a* to *b*. It also has two guide-pins of ⅜in. round wood to keep it steady and the sides parallel. The knife is an old-fashioned razor blade with flat sides (hollow ground won't answer at all), and is attached to the plough by means of a brass bar, inlaid, and kept in position by two screws (Fig. B).

A

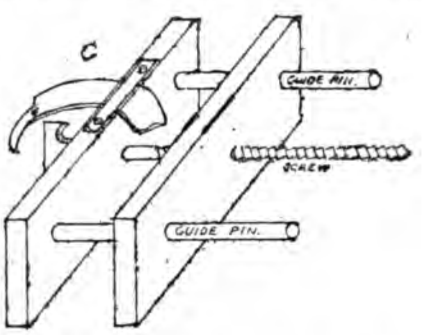




The razor blade can be put either with a short length out of a long one, for a book with few pages or many, and thus insure perfect level cutting in books of varying thickness. Of course no part of the brass plate or screw-head must project and scrape the cutting press, but must all be countersunk and quite level with the press, or it won't work properly.

It is as well to have a guide on the left side of the cutting press to keep the plough straight, say two pieces of wood the length of the press, and ½in. by ½in., nailed to the press 1in. apart, to allow the left side (non-cutting) of the plough to run in.

The sketch (Fig. C) shows the under side of plough reversed, with razor blade in position for cutting a moderately thick book, such as the half-yearly volume of the ENGLISH MECHANIC. Fig. B gives the detail of blade and parts. With the Editor's permission I should like "Practical Bookbinder" to give our amateur bookbinders the addresses of some firms where metal letters for lettering the backs of books can be procured, also where to procure "calf," "morocco," and such like, as I for one have to be content with binding my books in dark green window holland, and gold and buff holland (a charming back), and having printed labels surrounded with a red-ink line, instead of lettering in gold or black. In a country town we cannot get these things, so a few hints as to where to procure them would be highly esteemed by myself and others.



**Guillaume.**

## AUXILIARY POWER FOR TRICYCLES.

[32039.]—IN answer to letter (32009) in Vol. LII. No. 1348, p. 464, by "F.C.S.," what I have done in this way is only taking that which has been proposed for the job, ways and means, weight, &c., putting my wits to work as to ways and their results and requirements, showing what is absolutely necessary to set others thinking—in one sense, thrashing the thing out. I was not aware that you could get $CO_2$ so reasonable in liquid; if so, it is absolutely necessary that you should have a reducing valve and feed as well as a strong reservoir, i.e., the same as I have shown. Only dispensing with the indiarubber acid container, you must not expect that you are going to work these cylinders by percussive force—they are not guns or pile drivers. And, again, if it can be got so cheap, say, in London or Dublin, they will not keep it in stock at oil-shops, chemists, or bicycle stores. If it should come to pass that there should be a great demand for it, there are places near home that you would find as great a difficulty in getting it as you would if you were out in the deserts of Arabia or at the North Pole. If it can be got as you say, some other arrangement will have to be worked out for the application of it to the purpose aforesaid, which I will take up as soon as I am settled, as I have been forced to a sudden removal.

**Jack of All Trades.**

## USEFUL AND SCIENTIFIC NOTES.

THE number of barrels of beer sold in the United States for the year ended May 15 was 26,826,953. The consumption of beer in the States is on the increase, 1,722,188 barrels more having been used last year than the year before.

THE first vessel specially built for the Manchester Ship Canal trade was launched at Belfast by Messrs. M'Ilwaine and M'Coll. The new vessel, which has been named the *Manchester*, is the pioneer steamer of a direct service which is about to be established between Belfast and Manchester, with Liverpool as a port of call. She is built of steel, and is 180ft. long, but only 14ft. deep. Another vessel for the same company, of which Messrs. Lowther and Co., Belfast, are the managing directors, will be ready in a few months.

**Drill Clamp.**—To make a drill clamp, take 2ft. of bar iron, 1¼in. by ⅛in. or less, bend it at the centre to 1¼in., drill holes 1¼in. from each end for bolts, and pass it around the upright rod of the drill. Take a ½in. rod, 14in. long, make 1½in. bend in the middle, and turn up hooks at the ends. Over these put the ends of a trace chain, take a bit of slat 2½ft. long, put this through the chain at the floor. Put the end under a cleat nailed to the wall, put one foot on the other end, and bear down as you turn the drill.

# REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[72951.] —**Pidgeon English.** — The following extract from "Everybody's Scrap-book of Curious Facts," may interest the querist: —The word pidgin or pidgeon, as connected with English, is a Chinaman's poor attempt to pronounce the word business. Dr. Brewer gives it—business, bidginiss, bidgin, pidgin, pigion. Pigion English, therefore, means business English. It is a strange admixture of English, Chinese, and Portuguese, and is used in all parts of the far East as a means of communication between the natives and the foreigners. During nearly half a century, and especially since the opening of many of the Chinese ports to Europeans, business relations have developed to such vast proportions that some universally understood means of communication became absolutely necessary, and Pidgin or Pigeon English was the result. Its acquirement in the coast-ports is a matter of importance, both with traders and natives, and it has become a popular medium of communication. Experts in the East have amused themselves and their friends with translations of English poetry into Pigeon English. Two verses of Longfellow's "Excelsior" have been rendered as follows:—

"Two muchee darkee come chop chop,
  One young man walkee, no can stop,
Markee snow! markee ice!
  He cally flag with chop so nice.
      Topside-Galah.

"He muchee solly, one piece eye
  Lookee sharp, so, all same my,
He talkee large, he talkee strong,
  Too muchee curio, all same song.
      Topside-Galah."

As there is an Anglo-Chinese language called Pigeon English, so there is an Anglo-Indian of a somewhat similar character, called Baboo English, a mixture of English and Hindostani words.

C. E. B. K.

[73118.]—**Blackening Zinc Surface.**—I think "C. L." will find a solution sold by chemists under the name of "Ink for Zinc Tallies" suit his purpose. Gardeners use it for writing the names of flowers, &c., on zinc labels, and it does not wash off with six months exposure to weather. If he can't get it to buy I will hunt up the recipe and send it.

J. A. C.

[73122.] —**Composition of Gas.** —I did not explain myself properly in my query. I meant without taking any notice of the impurities in gas, but supposing the different gases were composed entirely of carbon and hydrogen. If this query is not easy to answer, could anyone tell me what quality of coal-gas is the gas of paraffin equal to—25c., 30c., or what? H. BOWDLER.

[73144.] —**Strength of Cylinder.** — Your cylinder should be made out of No. 8 B.W.G. copper, using $\frac{5}{16}$ rivets to rivet it together. The ends should be hemispherical, or, if you cannot hollow them this much, block them down as much as possible, making them out of a little thicker plate. Theoretically (if there were no joints), this should burst at 1,000lb. per square inch; the joints will reduce it down to about 60 per cent. of this, so that practically (if made properly) it should burst at about 600lb. per square inch pressure. I have only run this out roughly; if you want anything more, advertise your address, and I will help you further if possible. E. A. A.

[73202.]—**Occult Forces, etc.**—The following may interest those who are puzzled over the so-called feats of Indian jugglers:—The writer was entertained recently by a wonderful man, a resident of Lewiston, Maine, U.S.A. The gentleman is a well-known citizen of most trustworthy character. After an evening's performance he feels exhausted in the morning. He can do nothing with the palms of his hands on the object, but must use the tips of his fingers only. He first began with a common table with swinging sides. Placing his fingers nearly in the centre, he could cause either end to rise and remain suspended. It would rock, beat time to music, or turn a complete somersault. No part of his person touches the object but his finger-tips; and there are no secret wires, for we examined the table carefully. Next he let down the swinging sides, which are on hinges, and, by placing his finger-tips, could raise the leaf, and hold it in that position several minutes while we tried to pull it away from his fingers. Then we took a heavy braided rug, and folded it in four thicknesses, and placed it on the table. With this obstruction he easily lifted the table, and turned it completely over. A plate was put upon the table, and this proved no hindrance. Then a tin dish, inverted, was given to him, and still the table not only came up, but the tin dish stuck fast to the table. He lifted chairs and other objects while resting. Then the table was inverted; and, placing his finger-tips upon the table-legs, the heavy table came up, and remained clearly suspended from the floor, with one foot of clear space beneath. The writer then sat upon the end of the table, which came up so suddenly as to throw him off upon the floor. At last came a strong test. We seated ourselves in chairs at opposite sides of the table, the writer gripped the table-legs with all his strength, and the gentleman stood clear of the table, and, placing only his fingers upon the smooth surface, drew the table so violently as to bring us down upon the floor in confusion. Finally, we grasped hands and tested our natural strength in pulling, and the writer was the stronger man; but, as the current came down in his arms, it went up into ours, feeling just the same as when we hold the handles of a battery. Then the strength of the gentleman was wonderful, throwing us round the room as one would handle a toy. The whole evening was filled with these performances. There is no possible chance for deception, and those who have seen this say that the only motive power which these objects receives comes directly from the finger-tips of this man. He can perform the same feats in any room, or with any soft-pine table, which may be placed in any position.—E. W. HALL, in *Science*. How would your readers account for such performances—quite as wonderful as anything said to be done by Indian jugglers?

T. P.

[73238.]—**Vaporifer.**—The best thing anyone who gives such a heading as this to a query about hot-water can do, is to call in a competent engineer, who will be able to see what he really does mean. The question is, "In which should the water boil first, the boiler or the tank?" Well, it should not "boil" at all; but if it does or must "boil," it will have to do so in the boiler, unless the querist puts a fire under the tank. However, let him read up back numbers, or consult a competent man, for "high-pressure" boilers are not to be played with, even "in the kitchen."

NUN. DOR.

[73242.] — **Graining.**—Premising that it is cheaper to buy what is wanted than to mix, unless large quantities are required, the ground for wainscot oak (imitation, of course) is made up of the usual white-lead paint coloured with yellow ochre (for light) or with Venetian red and yellow ochre (for dark), and the grainer's art comes in there in mixing, for he can use umber, sienna, &c. The graining colour is made similarly, using darker pigments than for the ground, mixing with linseed oil, turps, and a large amount of driers, so that the covering coat will stand the comb. It is really a matter for experiment, and would occupy too much space to explain in detail. Put a definite question next time. NUN. DOR.

[73251.]—**Diameters of Cylinders.**—Is this query a joke? The diameters of cylinders can be measured by means of calipers, or a foot rule, using a lath when they begin to be very large. There are, I believe, some special internal gauges, which are made so that the two ends screw out, and a scale on the body shows the diameter. A table for converting fractions into decimals does the rest when the foot rule is used. The "clearance" in a cylinder is just the space between the piston at end of stroke and cylinder head. NUN. DOR.

[73257.]—**Gas or Steam-Engine.**—Whether a gas or steam-engine is cheaper depends, to some extent, on the price of gas; but at 3s. per 1,000c.ft. a gas-engine is necessarily more economical than a steam-engine. Running cost a penny an hour for a two-man engine, and that is outside allowance. About one to nine are the average parts of gas and air, but it depends on what the engine is constructed to take. VIDE.

[73258.]—**Fertilisation of Seeds.**—I do not think there are any methods of ascertaining whether seeds are fertilised or not, except by the actual test. Old seeds would likely show a withered germ; but so long as the seed is fresh I do not think it possible by any ocular examination to say whether or not it will germinate. Seedsmen with a reputation always test samples taken at random from bulk by sowing in pots placed in a moderate temperature. S. R.

[73261.] — **Problem.** — I am sorry I read "D. S. B.'s" solution so hastily, as it is, no doubt, correct, and he appears not to have understated the number of answers as I thought he had. But what a problem! Twenty-five answers! I think my plan of fixing the price paid by each, and only allowing whole numbers to be used, makes a neater problem, and gives a better idea of indeterminate equations. I wonder who concocted this wonderful problem.

Bath. M.I.C.E.

[73268.]—**Electrical.**—Perhaps this querist will refer to his back numbers for hints on the management of batteries; but he must send to an analyst some of those crystals he found on the porous pots of the Bunsens before he can expect to have an answer. The phrase, "bichromate cells and Bunsen batteries," seems to indicate a rather indefinite acquaintance with the elements of the subject. SILEX.

[73270.] — **Wheel - Cutting.** — The rules for screw-cutting have been given many times, and are to be found by consulting the very book "M." says he has. Let him try another—Price's "Turners' Handbook," published by Spon, if he cannot refer to his back volumes. I don't see why Martin's Tables should be accused of being "useless" just because "M.'s" lathe has a leading-screw two threads to the inch. S. R.

[73273.]—**Gas-Balloon.**—The lifting power of balloons is explained in the usual textbooks: but something depends on the quality of the gas, and whether it is dry; also on the material of which the balloon is constructed. Roughly, a balloon of sized paper or rubber 3ft. in diameter would lift from one to two pounds, according to whether coal-gas or pure hydrogen is used. G. P.

[73275.]—**Gas-Oven.**—I do not see how anyone can tell this querist how to convert his old-fashioned range oven into a "gas-oven," whatever that may mean. We are told that the "oven is not self-acting," and, speaking for myself, I doubt if there is a self-acting oven known to any reader; but I think "Apollo's" wisest course would be to endeavour to see some of the ovens specially built to be worked by gas. VIDE.

[73277.]— **L. and N.W.R. Compounds.**—This question about the average coal consumption of the compounds on the N.W. line can be settled only by an examination of the accounts, and those are not available to everybody; but there is no doubt that the compounds are doing good work so far as a small consumption of coal is concerned.

R. W. J.

[73280.] — **Camera Obscura.** — The camera obscura is described in the textbooks, and there is a useful letter in No. 1260, May 17, 1889, with illustrations which may help the querist. A piece of simple looking-glass fixed at an angle of 45deg. will do, and the table, or screen, need not be concave; but it is an advantage to take the rays through a double convex lens after they leave the reflector. S. R.

[73282.]—**Sensitometer.**—I suppose a Warnerke's sensitometer can be procured "ready made" from any of the dealers. It is usually a plate covered with luminous paint, which is excited by means of a magnesium light just before the plates are to be examined through the screen.

T. L.

[73287.]—**Boiler.**—About 3ft. high, 20in. diameter, with, say, 10in. tubes, would do; but you do not say what pressure it is required to work at, nor how much steam it will have to supply. These are necessary factors in making a calculation; but there are plenty of suggested designs in back volumes. VIDE.

[73288.]—**Sussex Roads.**—This question is best answered by another. Are there more roads in Sussex below the level of the fields than in adjoining counties? RESPICE.

[73290.]—**Tennis Balls.**—The tennis balls will keep soft if placed in a rather damp position, especially if when soft they are dressed with castor-oil, provided they are not rubber balls. T. L. P.

[73291.]—**Magic-Lantern Slides.**—The request of "Magico" is a rather "large order." If he cannot refer to the original articles by "Sable," in Vols. XII. and XIII., he should procure the reproduction, which I think is published by Mr. Hughes, of Mortimer-road, Kingsland, or refer to other back vols., for there are many articles in back numbers. A. B.

[73342.]—**Saccharimetry.**—I am obliged to "J. B. E." for instructing me how to convert cane into grape. Will he be good enough to give the chemical formula for grape, milk, and inverted sugars, and inform me whether grape and fruit sugars are identical in their composition?

H. K. L.

[73353.]—**Expansion of Series—Correction.**—In the last term of the expression given, p. 466, the figure 1 has been omitted, the quantity between brackets of that term should be $1 + 15 \cos. 4 l$.

Bath. M.I.C.E.

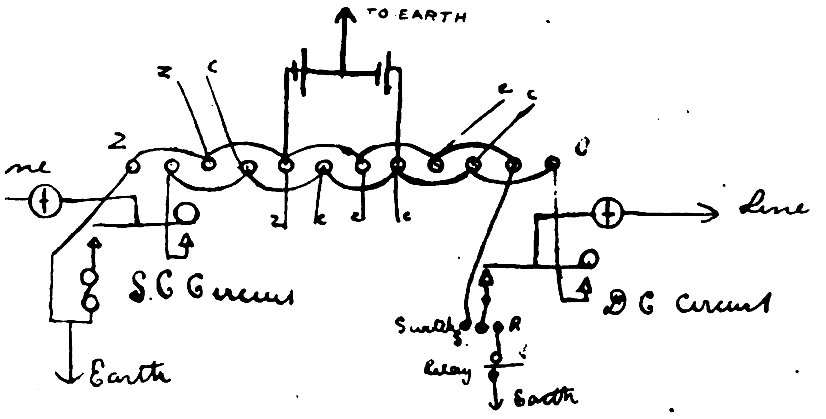
[73392.]—**Ellipse.**—In my answer of last week, for "making B D = O N," read "making N D = O N."

Charing. J. R. C.

[73410.]—**Running Resistance of Armature.**—This point is not generally known. It is, of course, admitted by all those who, like yourself and me, have actually tried it and tested it; but it is generally denied by those who have not.

S. BOTTONE.

[73428.] — **Coil Boiler.** — Judging from the way in which "Solent" finds fault with my answer to "H. B. S.," he has never heard of the Herreshoff boiler. Now, I merely answered



uestions, and I think that "Solent" hasty in attacking my reply without to what it refers. Had he turned up 's letters, mentioned by me, he would written as he has done. However, I will s objections in order: (1) The circulation the water being fed in at the top, and any not be converted into steam by the time it e bottom is carried over into the separator. e made one, and obtained plenty of steam om end of coil. (3) "Solent" will see it there is no occasion for a water-gauge. , one would be handy on the separator; on very well without. I will presently ing a short account of mine (which I shall to show "H. B. S." and "Solent" by ent), if they will advertise their addresses in the "Address" column, and shall be to see description of "Solent's" coil, isatisfactory. LONDON RIVER.

]—**Soldering Tin Tubes.**—This is easily l in the following manner, the only things being a common blowpipe (cost, say, 6d.), of blowpipe-solder, obtainable at most ers, &c., some powdered rosin, and a torch allow-dipped rushes about as thick as a The pieces of pipe to be joined must be the bottom piece cupped, and the top n the usual manner, so as to form a little r the melted solder. Scrape the surfaces press well together; sprinkle a little rosin joint; hold the rushes and blowpipe in hand (not an easy job at first), and hold against the tube just over the joint, and blowpipe-flame against it. Then before ay "knife" you will see the solder flow y round the joint, making it the strongest e pipe. It is sometimes convenient to cut p of solder and bend it in a ring round you will thus have one hand free. As g-point of the solder and tube are very e must be taken not to melt the tube. is usually called "compo," not tin.

F. SEARCH.

gh-street, Putney, S.W.

] — **Botanical Query — Important** —"Fermentation" should read "fecunda- Singena" should read "Smyrna."

EOS.

]—**Greek Accents.**—Accents are of no ever except for certain purposes—of the of Greek poetry. This is my answer, dare say an Oxford professor of Greek ly with several abstruse and ponderous mes on the subject. As to the pronuncia- ne knows how Greek ought to be pro- since it is a dead language. If you accept rity of Modern Greek—well, the modern ave swept away all accents by the board: ot even retain the ordinary aspirate. So, ctors differ, "Atkis" may sleep soundly, gh he has not mastered the niceties of the ent. CH. ROBINSON, B.A.

thby, Cumberland.

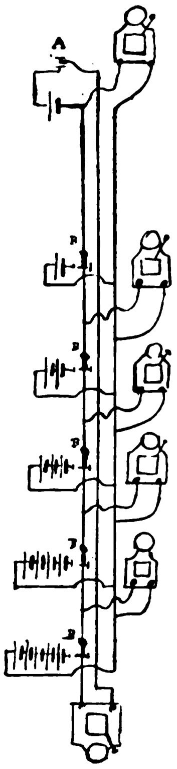
]—**Field-Magnet Winding of Dy-** The reply of Mr. Bottone, p. 468, to this so remarkable that in the interest of I should like to make a few remarks Prof. Silvanus Thompson's rule will not l any dynamo. If you wish to use it, you d the dynamo to the rule, and not apply o the dynamo. In all compound-wound with the shunt on the terminals of the all the current generated in the armature es go through the series winding, and if no is really compounded the current in the ot continually varying. Take a dynamo led to 100 volts with a shunt of 40 ohms , and if Mr. Bottone can demonstrate is ever anything else than 2·5 I shall be l. Again, if a dynamo requires 8,000 urns in all, how in the name of goodness quire 8,000 in the shunt and 8,000 in the

J. W. W. B.

[73442.]—**Electrical.**—(1) The "time constant" (T.C.) of a telegraph line is the time that a current takes to attain its maximum strength in overcoming the self-induction and resistance of the wire through which it is transmitted. If $l$ = the current due to self-induction, and R = the resistance of the line, then T.C. $= \frac{l}{R}$. In the case of the wire whose T.C. was ·5, it will be clear that it will take the current five-tenths or half a second before it has attained its maximum strength, owing to the causes described above. (2) Never heard of a "choking" coil. (3) I give a diagram of a universal battery system, in which you can join up any number of circuits, and give two circuits joined up as per sample.

Newcastle-on-Tyne. PERCY REID.

[73452.]—**Bell Signalling.**—To MR. BOTTONE. —The annexed illustration shows the mode by which the lower bell can be rung alone from above, while all the upper bells above the push touched



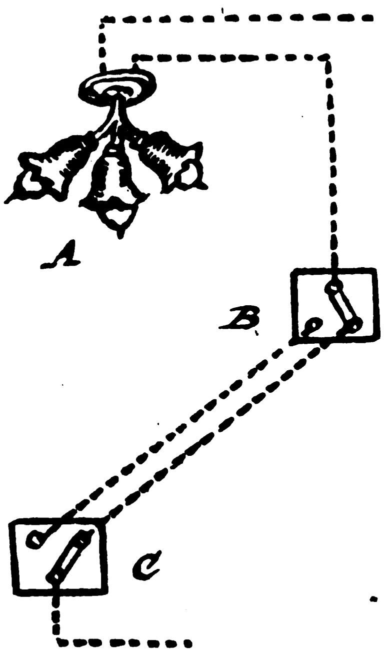
can be rung without ringing the lower ones. A is a single-way push or switch, B B B B B are two-way switches, which make contact with line when at rest, and with battery when touched.

S. BOTTONE.

[73456.]—**Two-way Switch for Electric Light.**—In reply to "E. G. L.," the result he mentions can only be obtained with three wires, two of these being of the same polarity. On ascending the staircase the switch will be turned, say on to the right-hand wire, which will complete the circuit to the lamp. On reaching the top of the stairs, the switch at this point would be turned on to the left-hand wire, and the lamp would be extinguished. The next person entering would turn the bottom switch on to the left-hand wire to obtain his light, and would extinguish it by putting the switch upstairs on the right-hand wire.

F. R. H.

[73456.]—**Two-way Switch for Electric Light.**—Only two wires are necessary between the two switches. See accompanying sketch. A



represents the lamps on ceiling, B switch at top of stairs, and C the one at the bottom.

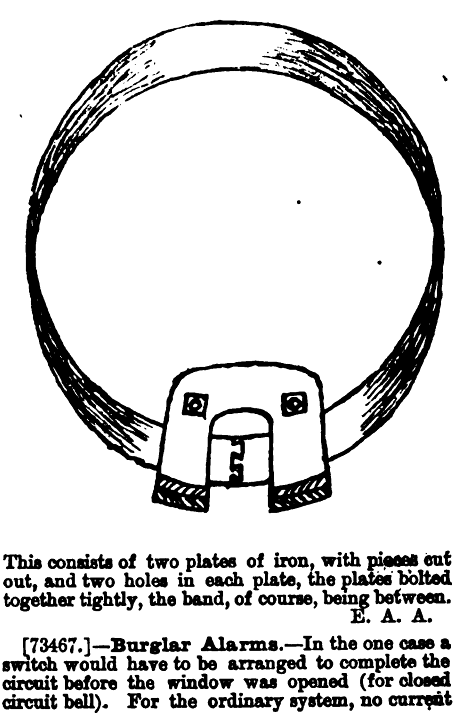
F. C. ALLSOP.

165, Queen Victoria-street, E.C.

[73463.]—**The Theodolite Superseded.**—In answer to "On Time," I may say that a little time ago I read a paper before the Plymouth Institution on "Surveying by Photography," in which I described a method of making maps and surveys by measurements from photographs taken for the purpose by a special camera, and reduced by mechanical means in the office, so that absolutely no calculations are required, and only one distance need be measured in the field. Since then I have been busy with other matters, but I shall be glad to communicate with "On Time" if he will advertise his address. I cannot be more communicative at present, as I am thinking of protecting the apparatus employed by letters patent.

W. GAGE TWEEDY.

[73477.]—**Brazing Iron Bands.**—If the bands are of light sheet iron, you may fasten them together by "cramping" one end of band, and hammering the two ends together. This is done by slitting (one end only), the same as for dovetailing, and instead of cutting the intermediate pieces out, lift them up a little, and place the other end of band between, hammer, and braze. If for stronger plate, you may use the device as given in sketch.



This consists of two plates of iron, with pieces cut out, and two holes in each plate, the plates bolted together tightly, the band, of course, being between.

E. A. A.

[73467.]—**Burglar Alarms.**—In the one case a switch would have to be arranged to complete the circuit before the window was opened (for closed circuit bell). For the ordinary system, no current passing till contact is made, the switch would have to be placed to break contact. These would have to be put inside the room, because if the ordinary window fastener was arranged to do this it would be useless as a protection. Please not to head your query to Mr. F. C. Allsop only. It makes it so difficult to find replies in the index in years to come. I think the above more suitable.

A. I. E. E.

[73488.] — **Armature Punchings.** — To MR. BOTTONE.—The following dimensions refer to the sizes which I possess:—

PACINOTTI RING PUNCHINGS IN CHARCOAL SHEET IRON, $\frac{1}{25}$ OF AN INCH THICK.

| Overall diam. | Inside diam. | Width of web. | No. of cogs. | Space between cogs. | Depth of cogs. |
|---|---|---|---|---|---|
| $2\frac{7}{16}$in. | $1\frac{3}{16}$in. | $\frac{3}{8}$in. | 6 | $\frac{9}{16}$in. | $\frac{1}{4}$in. |
| 3 | $1\frac{3}{4}$ | $\frac{1}{4}$ | 9 | $\frac{7}{16}$ | $\frac{5}{16}$ |
| 4 | $2\frac{1}{8}$ | $\frac{1}{4}$ | 12 | $\frac{1}{2}$ | $\frac{3}{8}$ |
| $4\frac{7}{8}$ | $2\frac{7}{8}$ | $\frac{1}{2}$ | 10 | 1 | $\frac{1}{2}$ |
| 5 | 3 | $\frac{9}{16}$ | 10 | $\frac{13}{16}$ | $\frac{1}{2}$ |
| 6 | $3\frac{3}{4}$ | $\frac{5}{8}$ | 12 | 1 | $\frac{1}{2}$ |
| 6 | 4 | $\frac{1}{2}$ | 14 | $\frac{7}{8}$ | $\frac{1}{2}$ |
| 7 | 4 | 1 | 16 | $\frac{3}{4}$ | $\frac{1}{2}$ |
| 7 | 5 | $\frac{1}{2}$ | 16 | $\frac{3}{4}$ | $\frac{1}{2}$ |

S. BOTTONE.

[73489.]—**Pocket Galvanometer.**—Use No. 24 wire for the quantity coils, and No. 10 for the tension coils of your galvanometer. Half an ounce of each will be as much as you will be able to get in a watch-case. For full instructions as to mode of construction, with sketches, see my book, "Electric Bells and All about Them." S. BOTTONE.

[73490.]—**Wire for Rhumkhorff Coil.**—To MR. BOTTONE.—Put two layers of No. 18 for the primary, and 28 layers No. 39 for the secondary.

S. BOTTONE.

[73491.]—**Wimshurst Machine.**—Do not try it. It can be done, but is wasted labour, because the plates twist about in action; surely glass is cheap enough, and certainly the best material.

SIGMA.

[73491.] —**Wimshurst Machine.**—Premising that there is absolutely no saving in expense in machines with pasteboard instead of glass (which, as described in my book "Electrical Instrument Making," can be used without having holes cut out), and that pasteboard plates are not nearly so effective as glass or ebonite, I may tell you that the board can be rendered insulating by soaking in melted paraffin wax. This must be done before the tinfoil sectors are stuck on. These latter may be affixed by the aid of a little thick shellac varnish. The plates should run as close to each other as possible without actually touching. I would recommend you to read the above-mentioned work before attempting to make a cardboard machine, which, I fear, would not give great satisfaction.

S. BOTTONE.

[73492.]—**Accumulator Voltage.**—To MR. BOTTONE.—A single cell of accumulator, no matter what may be the size or number of the plates which constitute the two elements, can only give two volts. The safe charging current need not exceed 2·5 volts in pressure per cell. You will want about a quart of dilute sulphuric acid, sp.gr. 1·150 to charge it with. The single cell can only light a 2-volt lamp; and with the size you name, it would light it for about 45 hours if the lamp does not take more than $1\frac{1}{4}$ ampère of current to light it. S. BOTTONE.

[73493.] — **Charging Accumulators.** — Certainly you can. Procure 16 cells if your voltage is correctly given at 30v., or 26 cells if the voltage of your lamp is 50v.; connect them in series, and place them across the leads of the dynamo precisely as if they were a lamp. You will need the type known as 23 S. of the E.P.S. accumulators to give you the desired eight hours' duration. For further information I must refer you to my advertisement in Sale Column on the "Management of Accumulators," price 6s. S. BOTTONE.

[73493.]—**Charging Accumulators.** — Certainly you can run a few lamps when charging accumulators, but you must have a resistance in series with your lamps. The value of the resistance must be such as to reduce the E.M.F. of the charging dynamo to the voltage of the lamps. To light 25 30-volt 16 c.p. lamps you would require 15 or 16 31 L. E.P.S. cells, as the current required would be 50 ampères. When charging with a compound-wound dynamo it is advisable to short-circuit the series winding if you do not want to risk spoiling your cells. If you wish to run 105 volt lamps while charging the above battery, do not short-circuit the series; but be very careful to ascertain that your dynamo has not reversed before switching on the cells, and you would also require a resistance in series with the accumulators of about one ohm. If you require any further information, or a sketch, I shall be glad to answer your inquiries either through "Ours" or direct. J. W. W. B.

[73494.] —**Rapidly-Rotating Spindle.**—The speed "C. G. T." speaks of is simply absurd, as he would know if he had anything to do with machinery. The speed is limited anyhow to 10,000 revolutions per minute or thereabouts, on account of centrifugal force, which would burst the disc at about this speed; and, again, it would be impossible to lubricate or keep cool a bearing at anything like the speed named, 48,000 revs. per minute. Supposing your driving pulley be 1in. in diameter, and it could not be very much less on account of the shaft, which would have to be a fair diameter, this would give a belt velocity of 12,000ft. per minute, about double what you would be able to obtain, and if your disc was not balanced to the greatest nicety, it would at the speed named double up the shaft like a bit of lead. But perhaps you have made a mistake about the speed. SPHINX.

[73495.]—**Ice.**—The chief point in the preservation of ice is the exclusion of moisture—i.e., all drainage should be carried off instanter; a deep bed of broken charcoal resting on a grating over a pit of small diameter (like a miniature well) is the best mode of effecting this important consideration. Another necessary precaution against waste is a double-walled construction of the ice-house, leaving a space of 2ft. or 3ft. between inside and outside; pounded charcoal, well rammed down, and thick felt being the inner materials used. During dry, frosty weather, the ice blocks should be packed tightly together, like blocks of stone, as cold begets cold; there should be a tightly-closing outer door, admitting ingress for the purpose of removing ice once in twenty-four hours (before sunrise). This being shut on entry, prevents the inrush of warm air when opening the door of the ice-store. For many years this was the plan adopted in India, and the only available article obtainable—viz., in thin sheets, made during the cold season by rapid evaporation on the open plains, lasted till the time for making it came round again—viz., eight months, in the hottest parts. Nowadays, there are ice ships from America, frequently calling at Calcutta, Madras, and Bombay, with tons of blocks for the great ice-houses at those parts, whence it is despatched daily by the far-extending railways, thick blankets and sawdust being the packing employed.

EOS.

[73497.]—**White Brass.**—Here are two or three white brass alloys:—Copper 80, tin 18, zinc 2 parts. Copper 56, tin 16, zinc 28 parts. Copper 74, tin 95, zinc 9·5, lead 7 parts. Melt the copper first, then add the others. Use a plumbago crucible.

Needham Market. GEO. WELLS.

[73497.]—**White Brass.**—Below I give proportions for various white brasses, as they are called. They can all be melted on a good hot fire; but a coke stove, in which you could get a slight blast, would be better still:—

| | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. |
|---|---|---|---|---|---|---|---|---|
| Lead ...... | 70 | — | 42·5 | 37·5 | — | — | — | 84 |
| Zinc ...... | — | 82 | 42·5 | — | — | — | — | — |
| Tin ........ | — | — | -- | 37·5 | 66·7 | 90 | 85 | — |
| Antimony .. | 20 | 11 | 15 | 25 | 11·1 | 7 | 10 | 16 |
| Copper .... | 10 | 7 | — | — | 22·2 | 3 | 5 | — |

Ordinary brass can, I have heard, be melted over an ordinary open fire; but I have never melted it so myself. SPHINX.

[73498.]—**Plaster of Paris.**—Alum dissolved in the water used for mixing plaster of Paris will cause it to set harder than it usually does.

J. M. GIBSON.

[73498.]—**Plaster of Paris.**—Put it into a clean iron pitch kettle, and place it upon a clear fire, and heat it well, continually stirring it to make it set harder; mix it up with alum water or glue water. To soften it, put the article into an oven, and gradually heat it. JACK OF ALL TRADES.

[73498.]—**Plaster of Paris.**—Plaster is rejuvenated by burning, and thus expelling the absorbed water. A crystalline salt, such as borax, mixed with plaster, renders it less friable; I do not know that it adds to its strength. To soften plaster, soak in water. SM.

[73498.]—**Plaster of Paris.**—(a) I fail to see how your first supposition can take place, as plaster of Paris is merely sulphate of calcium containing two molecules of water, $CaSO_4 2H_2O$. (b) The addition of a little alum in powder to the plaster of Paris will produce the desired effect. (c) Nothing that I know of. FREDERICK DAVIS.

86, Newington-causeway, S.E.

[73498.]—**Plaster of Paris.**—Place the plaster of Paris in a covered crucible, and expose it to a bright cherry-red heat for an hour. This will drive off any moisture it may have absorbed, and render it "strong" again. The addition of a little alum favours the hardening of plaster. By placing the cemented articles in a saucepan of cold water to which a little soda has been added, and gradually raising the temperature to the boiling point, the plaster will be softened. S. BOTTONE.

[73499.]—**Silver-Plating.**—Electro-plate them, using a solution of silver cyanide and one Daniell cell. See back numbers. SM.

[73499.] — **Silver-Plating.** — "Amateur" will find Watt's "Electro-Metallurgy" (Weale's series, price 3s.), an invaluable guide and instructor in this fascinating art, so intelligibly written and illustrated that any man can make his own batteries, salts, and solutions. EOS.

[73500.]—**Grinding Lawn-Mower Blades.**—If "Fitter" intends to make a grinding lathe for this job, he had much better make one apart from his turning lathe; the expense would be but little more. However, as anything of an affair would cost him a few pounds, he will have to do a great many of them to make it worth his while. A lawn-mower, if not gone very bad, may be ground up very well in the following way, and is done so in most small shops:—First take off the roller and other fittings not required for grinding purposes; then take off the plate (or bottom blade), and upon any ordinary grindstone take off the high edges at each end caused by the wear of the blade; at the same time grind off the width at the back of the blade, until the surface is about $\frac{1}{8}$ wide—be very particular not to interfere with the front cutting edge; replace the plate and cylinder blades, being a good fit in its bearings, set it just to touch the bottom plate all the way along, then by running it the reverse way at about 500 revolutions per minute, and applying oil and rough emery along the blades with a brush, you should in about 15 minutes be able to scour up to a good cutting edge. Afterwards clean and refit the machine. This scouring process would have to be done, even though you ground up the cylinder blades, but, of course, a better job is made if the cylinder blades are ground.

A. MORGAN.

[73502.]—**Hydrostatics.**—If your tank has an air-tight cover, and is hermetically sealed, the pressure in tank will be equal to that produced by difference of two levels of water—viz., 15lb. per 34ft. If the lid is not air-tight, the height of inflowing water has no effect. SM.

[73502.]—**Hydrostatics.** — Absurd as it may seem to "Hydro.," the statement is quite true, as I once told a gentleman who thought he had discovered an inexhaustible source of power, a small glass tube will balance the Atlantic ocean. The Hydrostatic Paradox given in the textbooks is the same thing, where a heavy weight is raised by pouring water into a small tube. SIGMA.

[73502.]—**Hydrostatics.**—I presume that the tank is a closed one, therefore the pressure on the bottom will be equal to a head of water 82ft. high. It makes no difference if it is a 1in. pipe or the full size of the tank, the pressure on the bottom will be the same. Rule to find pressure:—Head in feet multiplied by ·434 equals pounds per square inch on bottom of tank. Example: 82ft. head × ·434 =35·588lb. per square inch. J. T. P.

[73502.]—**Hydrostatics.**—Absurd as it may seem to "Hydro," that the pressure upon a joint at the bottom of the cistern should be the same, whether connected with an inch tube, or the sides of the tank themselves be produced 80ft. high, and filled with water, it is, nevertheless, a fact in hydrostatics, that such is the case. A cubic foot of water weighs $62\frac{1}{2}$lb., therefore the pressure upon a square foot at the base of the cistern would be $62\frac{1}{2} \times 82 = 5{,}125$lb., and the pressure upon the whole base would be $4 \times 3 \times 5{,}125 = 61{,}500$lb. It is this principle that is applied to so many useful purposes in hydraulics. B. W. L.

[73502.]—**Hydrostatics.**—The statement which you think absurd, is quite correct. It is one of the elementary laws of hydrostatics that the pressure in a vessel is entirely dependent on the depth of the contained liquid, and is independent of the quantity. The pressure is also equal for equal areas. This being premised, let us suppose that your pipe, instead of being 1in. in diameter, is of 1sq.in. sectional area. The depth of water in the tank must be added to that in the pipe to obtain the total amount of pressure on the bottom. The mass of water in a pipe of 1in. section, 82ft. long, is 984c.in., or $\frac{41}{72}$c.ft., the weight of which is $\frac{41}{72} \times \frac{125}{2}$lb., $= 35\frac{5}{8}$lb. pressure per sq. in. on bottom of tank. This property of liquids seems incredible at first sight, but it would really be very astonishing if it did not exist. Pascal (I think it was) burst a cask by means of a long tube inserted in the bung-hole, the apparatus being then filled with water. It was, in fact, a similar arrangement to your tank and pipe. CALDEMONE.

[73504.] — **Watch Key-Holes.** — Watch and clock key-holes are not drilled square, they are punched so. CHARLES A. JONES.

[73504.] — **Watch Key-Holes.** — For years I have been in the habit of making all square holes, large and small, by first marking the desired square on a piece of metal, then drawing a circle with its lines just inside the square, drilling a hole nearly as great in diameter as this circle, squaring its corners roughly with a file, and, lastly, using a taper-a tool which, being very hard, re- age. Eos.

**ectric Clocks.**—The failure is the lian." If he puts mercury instead he cup, current will pass and do ater the clock only works as long as the pendulum lasts, and does not clock. Sigma.

**ectric Clocks.**—It is very difficult the matter with your two clocks ;them; but I should not use Le- Even if they only send a current which on the most favourable calcu- this carried on for hours, days, and e extremely likely to cause the usual l falling-off in E.M.F. Use a couple unsens. I can only say: See that ntacts are perfect. See that the no unnecessary work to do, and try ortening the swing of the pendulum ss contact. It is likely yours is g too far before it makes contact.

ES A. Jones,
Clock and Instrument Maker.

**yal Engineers.**—There is a photo- in the Royal Engineers, and the re taking, developing, and printing, knowledge of photography. The y hard one. Negative.

**yal Engineers.**—The R.E. has no section"; but they have a school at hey employ a number of men on it at Survey Department, Southampton. made of the adjutant at Chatham, ive officer R.E. Ordnance Survey outhampton; or perhaps if he were to ar Office and see the chief clerk to they would give him all the necessary
John M. Gibson.

**stances of Stars.**—The parallax 7sec., which is equivalent to 3,078,000 s distance; 61 Cygni has a parallax d distance = 366,000 sun's distance; 9187sec., and 224,000 times. Sm.

**lectric Light.**—A shunt-wound t self-regulating, excepting within nits when the magnet iron is worked saturation curve; it is as you say, ng rapidly as the lamps are switched f resistance coils in the shunt saves d not a few lamps. J. W. W. B.

**lectric Light, Shunt Dynamo** . Bottone.—In a shunt-wound are two paths open to the current ated. 1st, round the field magnet sh to brush. 2nd, through the wires, onstituting the outer circuit. The ynamo will not work at all unless nt resistance in the outer circuit to he current round the exciting coils of ts. On the other hand, the E. M. F. e the current decreases, if increased laced in the outer circuit. Bearing ct that it is not the E. M. F. that ght, but the amount of current only, nderstand that if we build a shunt at when a single lamp is in circuit hall not rise greatly above the voltage e dynamo will regulate itself when lamps is put on, since in that case of the outer circuit will fall to a at it was when the single lamp was ge of the dynamo will fall; while tance is less, proportionately more w round the outer circuit. But the is not perfectly self-regulating. The that fulfils this condition is the nd. S. Bottone.

**l of Bergamot** is derived from a. Sm.

**l of Bergamot.**—Volatile oil or gamot is contained ready formed in the rind of the fruit of the Citrus of the orange tribe growing in the e. The oil is obtained either by ex- illation, the expressed oil having the It is of a greenish-yellow colour ·885, and in chemical composition is volatile oil or essence of lemon, being nly used in perfumery.
P. H. Polglase.

**l of Bergamot.**—This oil may be the fruit of Citrus Bergamia, N.O. y expression or distillation from the fruit itself resembles an orange in e little spots outside the fruit being aining the oil. As the oil exists in frequently largely adulterated with e, spirits of wine, oils of lemons and Its specific gravity is from 0·86 to is chiefly used in perfumery; but r various forms of skin diseases—
Frederick Davis.
n-causeway, S.E.

[73513.]—**Recovering Zinc.**—This may be precipitated with bicarbonate of soda, I expect.
Jack of All Trades.

[73513.]—**Recovering Zinc.**—Neutralise with chalk, and roast with coke or anthracite in crucibles provided with a descending-tube, to carry off and condense the vapour of the metal. Sm.

[73513.]—**Recovering Zinc.**—Premising that this will cost you more than buying the zinc first hand, the following is a method by which you can reduce your chloride of zinc to the metallic state. Make a solution of common washing soda in water. Add this, little by little, to your zinc solution, as long as a white precipitate is formed. Collect the precipitate on a filter, mix with its own weight of powdered coal or coke. Expose to a bright-red heat in a loosely-covered crucible. S. Bottone.

[73514.]—**Hardening Tools for Chilled Rolls.**—The tools you want are either Mushet's steel or chilled cast iron. Jack of All Trades.

[73515.]—**Tinned Steel Plate.**—Yes; this can be obtained in sheets 6ft. by 2ft. or 6ft. by 3ft., and can be worked with ordinary tinman's tools—at any rate, up to No. 18 gauge. Further information if you wish.
Needham Market. Geo. Wells.

[73516.]—**Dynamo to Light 58 20c.p. Lamps.**—In reply to query 73510 I have given dimensions for a dynamo which will just suit your purpose. This reply, owing to being accompanied by a cut, will probably not appear till next week. The two horns of a dynamo generally embrace two-thirds of the diameter of the armature. The voltage of 20c.p. lamps varies with the requirements of the purchasers. Some of Woodhouse and Rawson's are made as low as 48 volts. The general run is made of 55v., 60v., and 110v., to suit the voltage of the dynamos made by the large makers.
S. Bottone.

[73517.]—**Hayrakes.**—I can remember a cutter used by agricultural implement makers long ago: a roughly-planed shaft, while revolving in a lathe, is shaped smoothly by passing along through a metal cylinder, armed with transverse blades. The teeth of rakes should be easily turned out by a small tool on the same principle as the one I use in reducing soft steel and other metal rods for bolts and screws. The angles of the teeth set round the orifice of the hole would, I think, require to be considerably less, and the teeth fewer in number. I made my own, but it is a tedious job. Eos.

[73519.]—**Electric Railway.**—The motors are of the same type as the Edison-Hopkinson dynamo, and the armature spindle is used as an axle for the wheels. There are two motors to each locomotive, each motor being coupled direct to two driving wheels of small size. The motors are series wound, the current passing first through one and then through the other machine. They are supported from the framework of the car by a link from their yoke-pieces, and are at an angle to the axle, so as to be capable of vibrating without injuring the shaft or bearings. The lamps are, as you imagine, in the same circuit as the dynamo, being banked together in series until their E.M.F. is equal to that of the line to which each batch is attached in parallel. Sphinx.

[73519.]—**Electric Railway.**—The armature is fast upon the axle, and drives direct. It is a laminated armature, about 14in. or 15in. diameter, and, from what I saw of the engines when they were delivered, would be drum-wound, I should think. The current is picked up by a shoe from a central rail, and delivered at the inner rail, I believe—that is, speaking as you travel—and I should think the current is picked up by the leading motor, and passed through the pair before it is returned. The lamps were taken off the same; but if not altered now, will be, I believe, and supplied from accumulators. You are fortunate in being a frequent traveller. I have made several attempts to travel by it; but when I arrived there it was always broken down, and hundreds have been waiting outside on the same suit. There is not much chance to inspect the affair, I believe. I should like very much to do so, as well as the plant.
Jack of All Trades.

[73521.]—**Voltaic Pile.**—It is the dry pile, made of thousands of discs of foil and paper, that is needed for the purpose of "W. B." Sigma.

[73522.]—**Fusible Alloy.**—Bismuth 2, lead 1, tin 1. Fuses in boiling water. Price of commercial bismuth 10d. per ounce. Sm.

[73522.]—**Fusible Alloy.**—Bismuth two parts, lead five parts, tin three parts, melt. Melts in boiling water. I do not know the temperature exactly, somewhere about 180° F. The cost of bismuth is about 10s. per lb., and can be obtained from most large manufacturing chemists. Brownlow.

[73522.]—**Fusible Alloy.**—Melt five parts tin, three parts bismuth, and three parts lead, then add three parts mercury.
Needham Market. Geo. Wells.

[73522.]—**Fusible Alloy.**—Bismuth is not a cheap metal; but a little goes a long way. Bismuth 2 parts, lead 5 parts, tin 3 parts; melts in boiling water. Bismuth 5 parts, lead 3 parts, tin 2 parts; melts at 197° Fahr. Used for toy teaspoons, to surprise the user by melting away in hot liquors. Obtainable from manufacturing ironmongers and dealers in metals and solders.
Eos.

[73522.]—**Fusible Alloy.**—Bismuth can be procured from most metal merchants, and from the wholesale chemists. Its present value is about 10s. per pound. I give the composition of three well-known fusible alloys, with their melting-points in degrees Fahr.:—

| | Newton's, fusible at 212° | | D'Arcet's, fusible at 201° | | Wood's, fusible at 140° |
|---|---|---|---|---|---|
| Bismuth .. | 5 parts | .... | 8 parts | .... | 5 parts. |
| Tin ...... | 3 ,, | .... | 3 ,, | .... | 4 ,, |
| Lead .... | 2 ,, | .... | 5 ,, | .... | 8 ,, |
| Cadmium.. | .... | .... | .... | .... | 3 ,, |

S. Bottone.

[73522.]—**Fusible Alloy.**—The following is an alloy that will melt in boiling water:—Bismuth 4oz., lead 2½oz., and tin 1¼oz. The bismuth to be melted first, and, when quite fused, the lead to be added, and finally the tin. This metal is sometimes made into teaspoons, which melt when put into a cup of boiling tea. The following are also soft solders which melt below the boiling-point of water:—

| Bismuth. | Lead. | Tin. | Mercury. | Melt at |
|---|---|---|---|---|
| 3 .... | 3 .. | 5 .. | — .. | 200° F. |
| 3 .... | 3 .. | 5 .. | 3 .. | 120° F. |

Bismuth costs—commercial about 1s. 3d. an ounce, and pure about 3s., and can be obtained at most dealers in chemicals. J. J. H.

[73522.]—**Fusible Alloy.**—These alloys, as you suppose, all contain bismuth, and this is rather an expensive material to buy if required in any quantity; but if you require only a few ounces of it it will not cost you very much. Below I give proportions for a few alloys, together with their melting points.

| | Degrees F. | Lead. | Tin. | Bismuth. | Cadm. | Arcet's metal. | Mercury. |
|---|---|---|---|---|---|---|---|
| Fusible amalgam | 127 | — | — | — | — | 9 | 1 |
| Wood's alloy .. | 151 | 2 | 4 | 7·8 | 1·2 | — | — |
| Arcet's metal .. | 210 | 5 | 3 | 8 | — | — | — |

Sphinx.

[73524.]—**Casting Medals.**—You cannot succeed well with lead. Type-metal would be better; but why not get a small press and dies?
Sm.

[73524.]—**Casting Medals.**—I think you would find moulding and casting the medals in any hard white metal a very tedious operation, as I suppose you will require hundreds. It would be better to have a die and press, with a good supply of blanks for use, or you can get the medals made cheaply by the gross at Birmingham. Lead will not do. Pewter or button alloys are cheap enough.
Eos.

[73527.]—**Electro-magnet.**—A rod of ¼in. soft iron, 9in. long, bent into the shape of a horseshoe with parallel limbs, the poles being about 3in. apart, wound with about 1lb. No. 18 d.c.c. wire, will, when excited by a single freshly-charged chromic-acid cell 1 pint capacity, lift easily from 15lb. to 20lb. weight. The shape of the bobbins and their heads, &c., is immaterial. Better dress the iron with a roll of brown paper, neatly glued on, and wind direct on to the cores.
S. Bottone.

[73528.]—**Induction Coil.**—You had better use two layers of No. 20 instead of three layers of No. 17 for the primary; 1lb. of No. 38 silk-covered will do very well for the secondary. Two sections will be enough for so small a coil.
S. Bottone.

[73530.]—**Stopped-up Gun-Barrel.**—Can you not burn out the rag with a red-hot iron? Sm.

[73530.]—**Stopped-up Gun-Barrel.**—Get a piece of iron wire a shade smaller than the bore, and with the edge of a half-round file make a gimlet point to it. Put some paraffin oil into the barrel, and bore away until you clear it.
Jack of All Trades.

[73530.]—**Stopped-up Gun-Barrel.**—"Lal Tulwar" appears to be one of those persons who should not be allowed to have a firearm in their possession, in case they point it at someone, thinking "it is not loaded." What sane man, accustomed to guns, would try to clean one by "firing some bulleted caps"? Let the querist try forcing the rag out with a strong steel rod, and if that fails, burn it out by making the rod red-hot.

F.R.S.E.

[73530.]—**Stopped-up Gun-Barrel.**—To remove the lead (bullets) from the barrel, pour a little quicksilver down the barrel, and shake well; the lead will amalgamate with the quicksilver, and they will come away together. To remove the rag, pour boiling water down the barrel, which will soften it, and then take a piece of wire the size of bore, and force it down, using a hammer; if it will not go, then file a point to wire (or, better still, a wire with a taper screw on the end), and turn up the end with a hammer so as to make a fine hook, and pick the rag out. This may take some time, but is sure. If boiling water is used, and not left long in the barrel, it will not rust it.

J. J. H.

[73531.]—**Astro. Telescope.**—Though addressed specially to "F.R.A.S.," our most valued correspondent on optics, I make bold to reply to it, and to express the hope that he will not waste his valuable time and knowledge in making head and tail of such a confused query as this is. In saying that, I mean no disrespect to the querist, who has probably put it as clearly as he could, as most of us do, but to check a little the further occurrence of such questions to such correspondents, and to economise his precious time and invaluable knowledge for more important queries. A couple of weeks ago a query was addressed to him which, I think, no man could have answered, even approximately, without spending more than a year of hard labour, and this week we have one going to another extreme.

A. Caplatzi.

[73532.]—**To Mr. Bottone or "Askew."**—The best battery for your use would be a Leclanché of four cells, or the same number of dry cells; but as you want to use your carbon rods, try the following. Cast a lead ring around the tops of carbons, and arrange them as if for a Fuller cell; charge the outer jar with nitrate of soda and sulphuric acid; put ½lb. of nitrate of soda into each outer jar, and fill up with water 3 parts, acid 1 part; the zinc compartment to be charged with acidulated water 1 in 12. The battery of three cells will light two 4-volt 2½c.p. lamps well, either continuously or at intervals for twelve hours. Change the porous pot solution once a week.

F. Askew.

[73532.]—**Battery.**—You can make an effective battery on the plan you describe. To cast the lead ring round your carbons, tie the rods parallel to one another with their lower ends all level, round a circular wooden disc, by their upper ends, so that they form a cylinder of the diameter you desire. Now get a flat piece of sheet iron, and mark on it the inner and outer diameters of your intended leaden ring. Now make two rings in stout brown paper, corresponding to the two circles just marked, and as high as you wish the ring to extend. Place these on the iron plate, and fill in the centre of the smaller ring and the outside of the larger ring with a stiffish paste of freshly-made plaster of Paris. When set, place your carbons with their free ends in the channel thus produced, and pour in your melted lead.

S. Bottone.

[73533.]—**Telephone Winding.**—To Mr. Bottone.—About 10 yards.

S. Bottone.

[73534.]—**Harmonium.**—There is no necessity of using American-organ reeds for harmoniums. There would be no advantage gained in doing so. An octave coupler can be applied to any harmonium. Pay no attention to those who say it cannot be done. It has been actually and successfully accomplished, and can be done again. Coupler and instructions can be obtained at the low cost of 8s.

G. Fryer.

[73534.] — **Harmonium.**—You cannot put American-organ reeds in a harmonium, as the reeds in an American-organ are placed upside down, or inverted. The wind is first drawn through the reeds into the wind-chest or reservoir to be exhausted by the bellows; but in the harmonium the wind is first pumped into the wind-chest to be forced through the reeds, so is the difference that you would require the wind supply on the American-organ principle. It is very difficult to add octave couplers to harmoniums unless they are made for them, there not being sufficient space between keyboard and valve-levers for the couplers to drop when not in action by the stop. In regard to adding pedals, you would have to reconstruct the lower part of instrument on a different scale, besides employing a person to blow. I should recommend you to get the instrument tuned and put in repair as it is, then I think you will find that nine half-sets of reeds will make quite "enough noise" for anyone possessed of the average power of hearing.

W. J. S.

[73537.]—**Chemical Action of Light.**—Are you quite sure that it is the red rays which are the most active in effecting chemical changes in living plants?

S. Bottone.

[73540.]—**Bubble.**—The cause of the elongation of bubble is the crack in the glass, through which some of the spirit with which the tube was filled having evaporated, there is no remedy except a new level tube.

J. B. E.

[73540.]—**Bubble.**—This is undoubtedly due to the spirit leaking through the tube on account of the cracked glass and the different temperatures to which it must be exposed, and I do not see how you will get over the difficulty without a new glass. As the spirit would evaporate as it came through, you would not, of course, notice it.

Sphinx.

[73541.]—**Dynamo: Calculating Output in Amperes.**—The calculation will differ somewhat, according to whether the machine is series-wound or shunt-wound. In either case the available current is always obtainable by an application of Ohm's law—namely, that the current in ampères is equal to the E.M.F. in volts divided by the resistance in ohms. Let us suppose we have a series-wound dynamo, the armature of which can be driven at 1,250ft. per minute angular velocity. Suppose we wind this with 50 yards No. 14 wire, so as to get 50 volts E.M.F., and the field-magnets with 63 yards of No. 12 wire. Now, the current has to traverse all this wire in series, and since the resistance of 50 yards No. 14 is 0·28 of an ohm, and of 63 yards No. 12 about 0·22 of an ohm—together 0·50 of an ohm—it follows that the largest possible current this dynamo could give on the short circuit with no resistance between the terminals would be $\frac{50\text{v.}}{0{\cdot}5\text{w.}} = 100$ ampères. If the resistance were increased, say, to 2 ohms by the insertion of 1·5 ohm in the outer circuit, the current would be $\frac{50\text{v.}}{2\text{w.}} = 25$ ampères, &c.

S. Bottone.

[73543.]—**Giving Motion to Water.**—Sink a Barker's mill below the surface, and pass your power through that.

Jack of All Trades.

[73543.]—**Giving Motion to Water.**—Mr. J. H. Greathead, the engineer of the City and South London Subway, some years ago invented an appliance which he termed an "injector-hydrant" in which the principle mentioned by "Water" was employed. Experiments were made before Captain Shaw, the superintendent of the M.F.B., on the use of the injector as a fire-engine. Later, when the mains of the Hydraulic Power Company were laid, these experiments were repeated with very satisfactory results. A ⅜in. jet of pressure-water (at 730lb. per square inch) injected into an ordinary jet of water at the pressure in the water-companies' mains caused the jet which previously only reached a height of 40ft., to ascend to from 90ft. to 100ft. An account of these experiments will be found in a paper (published by the Institution of Civil Engineers, 25, Great George-street, S.W.) on the distribution of hydraulic power in London. A copy could probably be obtained on application in writing to the secretary.

F. G. D.

[73545.]—**Minimum Deviation.**—What would be the use of a prism if the emergent rays were parallels? The object of it is to spread the rays out into a divergent cone, arranged in order of the wave-lengths of the original rays.

Sigma.

[73545.]—**Minimum Deviation.**—Are you not aware that the emergent rays undergo dispersion, some rays being refracted more than others: and have you not observed that the length of spectrum thrown on a screen is longer than the face of the prism? How, then, can the rays be parallel?

Sm.

[73545.]—**Minimum Deviation.**—The rays proceeding from each point of monochromatic light, or light of one definite degree of refrangibility, rendered parallel by means of the collimating lens, continue parallel after emergence from the prism or train of prisms of the spectroscope, whether placed at the angle of minimum deviation or otherwise; but, of course, the rays pertaining to each degree of refrangibility in ordinary light, after dispersion by the prism, differ in their parallelism from those of other degrees of the same. By using the prism at some other angle than that of minimum deviation, the spectrum becomes more or less elongated or shortened, but in the former case without any corresponding advantage in dispersion. The principal reason, however, for the general adoption of this angle is, that thereby the largest amount of surface is presented to each objective, and therefore the maximum of light and greatest efficiency secured.

W. T. N.

[73546.]—**Malleable Iron Castings.**—This is not possible on an ordinary fire, as the heat generated is not sufficient to melt the iron. Neither sea sand nor river sand is of the slightest use in moulding, as they will not stick together when rammed. What you would require would be red moulder's sand. If you take a handful of this stuff, and make a ball of it, and then place it gently on a table, it will retain the exact form you have given it on account of the grit, as it is called. No other sand that I know of does this, and this, after once being used, becomes useless for moulding purposes, and is used for filling mould, black mortar, &c.

Sphinx.

[73548.] —**Mail-Cart Wheel-Spokes.**—If "J. H. E." has another set of wheels made, let hi make sure that the hubs are tapped with a go thread, the spokes screwed the same pitch, a made a proper fit; he will find that oil does n work through where there is no room for it.

A. Morgan.

[73548.]—**Mail-Cart Wheel-Spokes.**—Do a have done: Discard the drilled and tapped hub and use Dunkley's wheels. I do not know th they have been described in "our" paper, so gi the following particulars. The hub is a piece weldless steel tube, with right and left-hand thre cut on outside from the centre to end; the flang are stamped out of steel, and made in pairs to scr on to hub; the spokes *hook* into holes in flang The hub is taken, and a pair of lock-nuts run on the middle; then the flanges are run on up to t nuts, the spokes are dropped through the rim in t usual way, and then hooked into the holes in flang The hub is then held while the rim, spokes, a flanges are revolved. This action screws the t flanges apart, thereby tightening the spokes a pulling the rim dead true. The lock nuts then f it permanently.

Bill.

[73551.] —**Stamped Metal-Work.** —Liqu ammonia and ground chalk applied with a brus and afterwards polished with washleather, will b found effective.

F. J. B.

[73552.]—**Harmonium Pan.**—You can pur chase a soundboard suitable for one row of reed for 7s.; therefore it is not worth while to go to th trouble of making one. Besides, if you have no had sufficient experience in making harmonium pans, you are likely to fail in the first attempt. The best advice I can give you (or anyone else) is to buy one. Harmonium pans are cheap enough nowadays.

G. Fryer.

[73553.]—**Microscope.**—A very good microscope indeed, and one with which I have worked for a long time, is Chas. Collins's histological microscope, the stand, and various eyepieces, objectives, &c., £13 10s. A sound instrument, with very smooth, coarse, and fine adjustments; but with all its good qualities it has its defective points—the stage is perfectly plain, and its substage mirror is not a good one. These two parts can, however, be easily replaced with something better and more serviceable at a cost of about £3. There are, of course, many more expensive instruments; but this is a sound one at a reasonable cost.

Frederick Davis.

86, Newington-causeway, S.E.

[73555.] —**Lenses for Telescopes.**—From "P. J.'s" query, I infer that he wishes to make the so-called astronomical telescope of the textbooks; which, though long superseded by better instruments, has proved itself very useful in earlier times. In that case, his two eye-lenses are intended for *two*, not for *one* eyepiece. The 2in. focus lens forms a low power magnifying 20 times; the 1in. focus one a power magnifying 40 times; and if his o.g. will bear being viewed by a lens of ½in. focus, he will get with it a power of 80; and, viewed with a ¼in. focus, a power of 160. Divide the focal length of the eye-lens, whatever that be, into that of the o.g., and you will get the magnifying power of the telescope. But, before indulging too much in the craving for high powers, as most amateurs do, you should consider this: the shorter the focus of a lens, the greater its chromatic and spherical aberrations, or, in other words, the less perfect it is, and *vice versâ*, generally speaking. If a short-focus eye-lens is comparatively large, say 1in. or 1½in., it must be very thick, and to the two kinds of observations, which are thereby increased, is added the imperfection of the glass it is made of. If it be small, these imperfections are much less, but it will not give so much light. In most cases, this is a smaller evil. To know more of the "principles" of optics, "P. J." should invest a shilling in a book, preferably a second-hand one, and he will get more detail.

A. Caplatzi.

[73555.]—**Lenses for Telescope.**—Three tubes should be made, one about 36in. long, and internal diameter equal to the diameter of the o.g.; another about 2in. long, and of the same diameter as the eyepiece lenses; and a third about 8in. or 10in. long, arranged so as to form a connection between the other two. Thus it (the latter) may be of an external diameter equal to th internal diameter of the large tube, and have a one end a couple of internal circular discs accurately made, with concentric holes equal to th external diameter of the eyepiece tube. The mos important point is to make sure that the optic axe of the three lenses, when adjusted, are all in straight line. The two eye-lenses should be fixe in the eye-tube exactly 1½in. apart = half sum o focal distances. Between them should be fixed circular diaphragm with a hole of suitable size (sa half-diameter), 1in. from the eye-lens (the 1in focus lens). The eye-tube should be placed in th adapter, so that when the latter is fitted into th body-tube, the field-lens (of 2in. focus) shall be th nearest to the object-glass. I replied once befor

[73586.]—**Small Furnace.**—I should like very much to make a small furnace burning coke or other more suitable fuel. One, perhaps, 9in. by 6in. by 6in., or thereabouts, would suit, as I only want to melt a pound or two of metal. I would like to have it constructed so that I could be able to fuse copper or brass in a plumbago crucible. Would a common plumber's ladle do for melting copper?—W. J. D.

[73587.]—**Incandescent Lamp.**—I wish to make some incandescent lamps. What is put on the platinum wire to prevent it, when in a state of incandescence, from melting the glass through which it passes to the bottom of the globe? The lamps seem to have a piece of metal fixed on the wire.—WILCO.

[73588.]—**Wagner's Electric Bell.**—Will any reader kindly send a sketch of this bell, which was referred to approvingly by Prof. S. P. Thompson in the "E. M." of Jan. 2, 1891, p. 398? If, as described, the armature is supported on two hooks, with one edge in contact with the electro-magnet, the construction would seem suitable only for a single-stroke bell.—E.

[73589.]—**Wire for Induction and Medical Coils.**—Mr. Bottone has given some of the rules for calculating the wiring of dynamo. Will he do the same for the above, or is the wiring simply guessed at? If not a rational, is there an empirical rule?—GLATTON.

[73590.]—**Cutting Mirror.**—I have a mirror, 4ft. 6in. by 3ft. 6in., and I should think it is 3-16in. thick. I want to cut it across. Will some one kindly tell me if it can be done with an iron wire stretched across and touching the glass made incandescent by a current from a battery? How many quart Bunsens will be required, and what size wire? If this plan is not practicable, how are sheets of this size cut?—R. H. H.

[73591.]—**Armature.** — To MR. BOTTONE. — What would happen if the insulation of one or two of the armature coils was worn, and the bare wires rubbing on the field-magnets? I have one of the little dynamos described in your book in process of construction, and wish to know what current it will give, and at what pressure. I have made the armature of malleable iron (not cast), but is the same in all other respects as the one described by you.—JACOBI.

[73592.] — **Antifluctuator for Gas-Engine.** — Will some reader be good enough to oblige me with sketch and directions how to make a gas valve to prevent the jumping of gas-lights caused by suction of gas-engine? I am prepared to take some trouble. It is not possible to have separate gas main.—ANTI-FLUCTUATOR.

[73593.]—**Model Locomotive.**—To "J. H."—I am thinking of making a model loco. on somewhat the same lines as the one you have just started in the "E. M.," and would be glad if you would kindly answer the following question. 1. Would it make much difference in proportion if the driving wheels were 3in. diam., and leaders and trailers both 1½in. diam., and if so, what should be size and stroke of cylinder? 2. Could the frame-plates be cast separately from the foot-plate and afterwards screwed together? 3. Would it be possible to cut the whole wheel out in one piece by fretwork, and cast the wheel in one whole piece from the wood? 4. Would oscillating cylinders do for loco., and would they work it equal to slide-valve cylinders?—LOCO. No. 2.

[73594.]—**Paint in Collapsible Tubes.**—I should be very much obliged if some reader would kindly tell me the best way to put paint into collapsible tubes. How is it usually done?—H. H., Montreal, Canada.

[73595.]—**Hard-Drying Paint.**—Will some reader kindly tell me how to mix a paint which will, when applied to bright steel tubing, dry hard with a smooth and preferably dull surface, and which will not be liable to chip when roughly used? Colour immaterial. The metal is not polished, but merely cleaned up bright with emery-cloth. I may add that the quick-drying enamels sold by ironmongers, &c., are of no use for this purpose.—PERSEVERANCE.

[73596.]—**Organ-Pipe Decoration.**—I want ideas for the above. I want something out of the common for a chamber-organ in a drawing-room. Are there any designs published in any form?—F. C. H.

[73597.]—**Attraction of a Sphere.**—Perhaps some kind mathematical reader would assist me. I would like to see how to find the attraction of a spherical shell on an external particle. It is done in Todhunter's "Statics" (page 282), but it is there assumed that the attraction of the whole shell acts towards the centre and before integrating, the attraction of an element of the shell is resolved along the line joining the external particle to the centre. Is it not possible to find the total attraction by integrating the absolute attraction of each element of the shell, without resolving along the line joining the centre to the particle? This is what I would like to see done.—No Sio.

[73598.]—**To Mr. Bottone.**—Would you kindly inform me as to the size of an engine and boiler, suitable for driving one of your 15s. 6d. dynamos? Boiler vertical, preferred to burn coal, and if steel or copper; engine of launch type, and double cylinders (give bore and stroke and revolutions). Engine to drive dynamo by belt, and to run at a steady speed.—MALTA.

[73599.]—**Photographic Films.**—Will some one who has had experience with films kindly tell me what are their advantages and disadvantages? I am thinking of spending some time abroad this year, and intend to take a small camera with me, but am hesitating whether to use glass plates or films. I am inclined to the latter on account of their portability; but as all the photographers I know use glass, I hesitate to adopt them. Are they more difficult to develop, and can as good pictures be got from them as from glass negatives?—FAH.

[73600.]—**Vegetation in Coal-mines.**—I have been told that in unused coal-mines rhubarb plants are sometimes grown. If this is true, I shall be glad to know what soil is used, the colour of the leaves, whether earthing up is adopted, and whether the plants grow to maturity; also whether other plants than rhubarb can be grown in mines.—B. R.

[73601.]—**Cleaning Skin.**—I work in alabaster and find great difficulty in removing the dust from my skin. Soap quite fails to thoroughly cleanse the skin, being decomposed by the chemical elements of the stone dust. Is there anything that I can add to the water to counteract this action?—BETA.

[73602.]—**Marking Tools.**—I wish to mark some tools. Is there any acid that will indelibly mark them? I have tried nitric acid, but it only stains the steel.—BETA.

[73603.]—**Musical Box.**—Will some fellow-reader of the "E. M." help me out of my difficulty in repairing an 8-air musical box? I can make it play the six tunes, but two tunes are scarcely heard. I have tried many ways, but cannot make it play the eight, although I understand a little about them. Could I have new pins put in barrel, and where could I send? What makes some of the large teeth make a squeaking noise?—BUCKEY.

[73604.]—**Planetarium.**—I am making a planetarium, and can ascertain in what position in their respective orbits to place the planets from the *Nautical Almanac*, which gives their heliocentric longitudes, but cannot find out where to place the earth. Should it be 180° off the sun's right ascension?—VULCAN.

[73605.] — **Vertical Column of Light over Setting Sun.**—About five or six years ago a friend and myself saw a vertical column of light over the setting sun. I should say it would be about 10° high, the same width as the sun; and it continued visible for a considerable time. It would be about May or July, as the sun was setting north of west; but I did not make a written note about it at the time. We both regretted afterwards that we had not photographed the appearance as a camera was available. I saw something similar this last week, but not extending above a degree over the sun. Can any of your readers explain the phenomenon? Radial beams could be understood, but a long columnar extension of light does not seem easily accounted for.—S. BROUGHTON.

[73606.]—**Sun.**—I have several times tried to get a good picture of the sun thrown through a refracting telescope on to a white card held beyond eyepiece, but though focus is altered either way, the result is not good. Which is best plan to adopt? Telescope 2in., power about 35.—H. A. K.

[73607.]—**Pianoforte.**—To MR. SCHUCHT.—I should esteem it a great favour if this gentleman could advise me as to the following:—viz., What is the cause of what is technically termed "false" notes in a pianoforte? Is there any remedy for this, or is it possible to tune them correctly? If so, will he kindly state how to proceed?—B. S. D.

[73608.]—**Grinding Coprolites.**—Can any kind reader furnish me with a diagram of the best dress of millstones for grinding the above, the amount of work a pair of 4ft. French stones should turn out per hour, and also what degree of fineness they will grind the coprolites?—MILLWRIGHT.

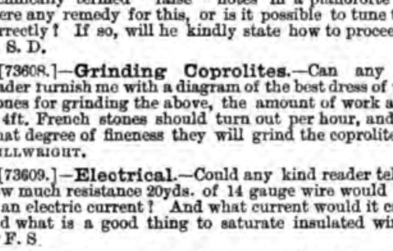
[73609.]—**Electrical.**—Could any kind reader tell me how much resistance 20yds. of 14 gauge wire would offer to an electric current? And what current would it carry, and what is a good thing to saturate insulated wire?—E. F. S.

[73610.] — **Electric-Bell Wire Calculation.**—Would Mr. F. C. Allsop kindly instruct me in calculating the resistance in bell circuits? A house having several rooms wired and fixed in indicator, each room varies in length of wire, one after another. Is it required to calculate all wire used, or would it be sufficient in measuring the room wired longest distance from press to battery, considering other rooms being less in distance will work in same for the calculation of resistance in circuit against battery-power, or, in other words, as work actively done by battery-power?—SOMERSET LAD.

[73611.]—**Coil.**—Will Mr. Bottone or any other correspondent kindly help me out of my difficulty? I have made a coil with a solid iron core 4in. long, ⅝in. thick. The coil is composed of three layers No. 22 B.W.G., and six layers of No. 30 B.W.G. cotton-covered wire; and I have got very poor results. The secondary wire is soldered to the finishing end of primary wire. What battery would be the best?—COIL.

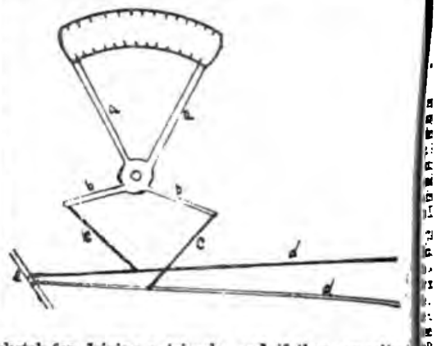
[73612.]—**Lampadorama.**—I should be glad if "A. S. L." (31956, page 423, "French Scientific Toys") would explain how the images of opaque slides are reflected on to the screen by the "Lampadorama," and if it is possible to adapt the ordinary magic-lantern to achieve the same result?—H. M.

[73613.]—**Problem.**—Suppose I take a bar of iron or steel 6in. long, 2in. wide, and ⅜in. thick, and bolt it with an inch bolt (1 1-16in. hole in bar) to a firm level support B, 3½in. from one end A to centre of bolt, thus giving a clear leverage of 3in. from A to edge of bolt. What force will be required to spring the end A away from the support B, first a distance of ⅛in., and secondly a distance of ¼in.? Would A spring back to bear with some pressure against B, on the force being removed, and would this pressure be equal to what it was originally? The nut being screwed down over a 2in. dia. washer, with a total pressure of, say, 10 tons. I shall be glad if you could give me the rules involved in these questions.—J. W. WHITE.



[73614.]—**Punkha.**—Could a small punkha for the night over a bed be oscillated by electro-magnets at any thing reasonable in price? I mean as to maintenance. If so, I should be much obliged if any of your readers could inform me through the medium of your paper—1. What size (section and length) the electro-magnets should be? 2. How much wire (and of what size) should be wound on them? 3. How many, what sized, and what make of batteries should be used? The batteries should be of such a size as to work continuously for ten hours, or any multiple of ten hours.—ACK.

[73615.]—**Driving Mechanism for Tricycles.**—I should feel thankful if any mechanical reader would give his opinion on the merits of mechanism shown in sketch for driving a tricycle, and if there are machines similarly driven. The double rack to have bevelled teeth. The racks to be in different planes—that is to right and left of one another. A pinion for each rack, with ratchet wheel and detent to alternately grip and slip past pinion. AA 8in. long, BB 3in. and 4in., CC 4in. and 5in., DD 20. Pinions 4in. dia., or approximating to these dimentions for a 48in. wheeled machine. DD to A fixed at C. The rack will oscillate by alternate pressure on the pedals D. The arrangement looks well on paper, as the pedals use all the weight on them throughout their course. An advantage obviously over the ordinary crank, when the driver can apply his full weight in only about one-third of the revolution.—KYMFER.



[73616.]—**Newspaper Rack.**—Will "Jack of All Trades," who recently gave a written description in praise of the above in the *Weekly Times and Echo*, kindly give an illustration, as I cannot understand from the description properly? I want two—one that will hold a great number of papers to keep them tidy and clean and out of the way, very large; the other, small, to be used in reading for the current papers. Also to keep papers for binding, best way.—NEWSPAPERS.

[73617.]—**Painting, Varnishing, and Brushes.**—Will any reader kindly tell me the most suitable brushes for painting, enamelling, and varnishing, to do good work so as to get a perfect surface without showing marks, lines, &c., of the brushes? Also how to use the paint, enamel, and varnish brushes, so that the paint, enamel, and varnish is a perfect surface when dry, without showing brush marks and imperfections that they often do with me?—PORCELAIN SURFACE.

[73618.]—**Restoring Leclanche Cell.**—Can the sealed porous cell of an ordinary Leclanché be regenerated by the current from a bichromate or Bunsen? If so, (1) What is the least current required, and for how long? 2. In what liquid should the porous cell be placed? 3. Which wire from the battery should go to the porous cell terminal, and how should the other wire be connected?—MU NU.

[73619.]—**Electrotyping.**—I shall be glad if any of your readers can inform me how to fix up a battery for electrotype? I want one that will deposit on about 24 6in. moulds at one time. I should also be glad to know of any practicable book on electrotyping.—ELECTROTYPER.

[73620.]—**Gas for Gas-Engine.**—I have a ½H.P. Otto engine, and require to run same about three hours every evening, but am unable to do so because there is not sufficient gas for both the house and it, and it causes the gas in house to jump up and down at every explosion. Will some reader state if there is a way of making gas from paraffin to work same? If so, state price of apparatus required? Also any hints to improve the working with ordinary gas will be thankfully received.—COLZA.

[73621.]—**Electrical Formulæ.**—How are tangent galvanometer degree readings converted into tangents?—SPIF.

[73622.]—**Telescope.**—Have means and facilities for making, but want particulars how to make a 5ft. or 6ft. telescope. Can make stand. Suggestions will be prized.—SPIF.

[73623.]—**Rate of Motion of a Pendulum.**—Will some kind correspondent help me to a solution of the following? I ought to say that algebra is the extent of my mathematical knowledge, and that, therefore, the explanation should be as simple as possible. Perhaps a graphic method, if that is feasible, would be best. Let AB be a pendulum suspended from A, the bob at the bottom occupying the point B when at rest. If the bob be drawn aside to C (through an arc of 30° or thereabouts) and then liberated, it will proceed to swing along the arc CB. Required, to divide the arc CB into a given number of portions (say, from 10 to 20), such that the bob will travel through each of them in equal times.—C. D. P. D.

[73624.]—**Chemical.**—Is the percentage of soda in caustic soda bottoms, and caustic ash calculated by the 31 or 32 equivalent in contracts made under the Alkali Association's rules? What is the best indicator to employ?—BLEACHER.

[73625.]—**Boiler.**—Will any reader kindly give me dimensions, &c., of a boiler (vertical) suitable for a vertical engine, with an inverted cylinder, 2¼ by 3½ stroke, driving at 40lb. pressure? Diameter of flywheel 10in.—FRED.

[73626.]—**Church Bells.**—Would any kind reader who understands bell-hanging kindly tell me what is the cause of church bells going up the wrong stroke when we are rising them, as we have to go up and turn the clapper on the other side of the bell before we can ring in peal?—A CONSTANT READER.

[73627.]—**Making Phonograph.**—Will some of your readers who know answer the following queries

e-diaphragmed phonograph? 1. What is
forming the phonograms? Should they be
, or on a foundation of cardboard, or how?
e them of equal parts of oleate and stearate
ed by gum damar, as recommended by
e issue of Dec. 12 last. 2. Is a piece of
serted between the diaphragm and the
dvantage to deaden the vibration of the
iolds stylus pressed against diaphragm?
lle foot-motion of an old sewing-machine
utilised as a motor for phonograph?—

**uatorial.**—Many thanks to those who
query (No. 73166, p. 347); but neither or
derstand my wants. What I want is re-
bb's "Celestial Objects" in foot-note at
n). I have a common equatorial stand
and I want to attach paper circles. Will
r that will kindly give me the instructions
stand. I have volumes of "E. M." back
not find what I want.—J. L. PARK.

**iring Shunt Dynamos.**—Would Mr.
tell me if the quantities of wire given in
Dynamo," for wiring shunt dynamos are
the best wrought iron only, as I see that
e gives in his reply in this week's "E. M."
lower in the difference of resistance be-
nets and armature. For instance, he gives
t 1 to 12, while in his book he says about
e seen a cast-iron machine of 100c.p. which
1 to 17, and seems to answer very well.—

**niell Cells.**—To MR. BOTTONE.—I have
lls. The solution consists of water poured
cell and porous pot. Sulphate of copper
ed into outer cell till water would dissolve
d that when zincs are placed in porous pot
get covered with a wet slate-coloured mud,
it is open. Also the surface of liquid in
vered with what looks like gold. Finally,
hissing sound. Two of the zincs were
lgamated, but the third I amalgamated
s one coats much more slowly. The cells
ling idle for some time with zincs removed,
top portion of porous pots covered with
and that the liquid in porous pot is also
ave had no experience with Daniell cells
l like to know if this is the sort of result
pect. I must add that no sulphuric acid
zinc has been used in porous pots.—C. J.

**ing Marbles or Carpet Balls.**—
our numerous readers inform me how the
the above? I imagine they are put on
of mechanism, as they are so regular.—

**tchener.**—I have an American kitchener,
atents. It was put in as cure for smoky
answered latter purpose, but does not
uires a much stronger up-draught. Stove
running through iron plate fitted across
Will a longer pipe, or one with a smaller
be an advantage? Will some kind reader

**ectric Bell.**—Stations A, B, C are con-
gle telegraph wire, used also as a telephone.
rn wire, but earth connection, and both
telephone have separate batteries. How
is one wire only, place calling bells at each
any reader kindly answer with sketch?—

**cro-farad.**—Will any reader kindly give
e quantity of tinfoil required for a con-
of a micro-farad capacity, using two thick-
lined tissue paper between each leaf, the
y preference, rectangular for the sake of
? Also say what pressure is necessary to
d capacity, and if the subject has been
er numbers of the "E. M." please refer
ers?—M. H. W. L.

**ck.**—Will any reader tell me how I can
t will open a drawer with a six-lever lock
original key after locking the said drawer,
et it open without damaging the lock at

**egilding Old Frames.** — Would
" kindly say if I am to use a mixture of
ze and water, and apply it to the parts to
ly, or can the whole frame be gilded with
using oil gold size and japanner's gold
ly get a matt surface. Thanks for past
BALLEY.

**itch.**—Three telephone stations: the one
put through, and forgotten to alter the
ot ring the bell from either end. Is there
ignalling to the centre station. They are
BELL.

**mposition.**—Thanks to J. Keene for
t would like further help if possible;
more details as to the purpose required,
ld into specific forms—such as rings for a
ss through and clamp against the side of
s and oven handles, &c. As usual com-
and break up after being heated several
IDER.

**s - Engine.**—Would some of "ours"
he following? I am about to make a small
rive a light 4in. lathe. Will an engine
. stroke be large enough, or would a 3in.
ke be better? I want to use simple lift
gas to be drawn in through one valve;
arg" made one (see Dec. 7th, 1888, p. 301).
will this valve opening be, also what
xhaust valve opening be? Would a plain
ithout a water-jacket, but having a tin
slip over do as well, or how could I make
ut casting on? What diameter should
Also what diameter crank-shaft necks?
as from oil to drive engine? Would 2½
without w.j. for short runs, say, one hour?
have the 2½ bore engine if it would be
—NAN.

[73640.]—**Electric Light.**—Will Mr. Bottone tell me how many bichromate batteries, consisting of two carbons and one zinc—carbons 6in. long—in each cell, it will want to light a 5c.p. incandescent lamp for six hours three or four times a week, and the best solution to charge the same with to remain charged for about three or four weeks? The best wire to connect up with?—CLOCKSMITH.

[73641.]—**Die Sinking.**—Can anyone give some hints on the art of die sinking, or perhaps some reader would write a few articles on the subject?—W. H. F.

[73642.]—**Portrait Lens and Lantern.**—I have a ½-plate portrait lens, and am desirous of utilising it as a lantern objective. Is it suitable for such, and what focus should the condensers be? I see in the report of the Lantern Society in the "E. M." last week, condensers of long focus were recommended. What would be considered long focus? What would be the best lamp, and what distance should condensers be from slide, and slide from objective?—J. H. C., Halifax.

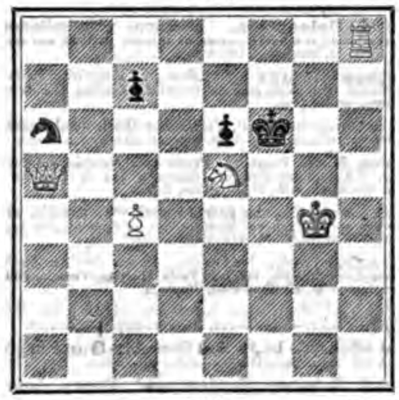
[73643.]—**Dichroism.**—Will some kind reader who knows give full particulars of dichroiscope as to size, shape, and fitting up of the various parts to test dichroism in gems?—COUNTRY WATCHMAKER.

## CHESS.

ALL communications for this department must be addressed to "J. PIERCE, Knollside, Yawl, Lyme Regis, Dorset."

### PROBLEM MCCXXXIX.

*Black.*



*White.* [5 + 4

White to play and mate in two moves.

SOLUTION TO 1237.

| *White.* | *Black.* |
|---|---|
| 1. K to K sq. | 1. Any. |
| 2. Mates. | |

### NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1237 by W. L. Martin, J. Kistruck, Biene, W. Gleave, C. P. P., W. A. Clark, A. Fellows, H. Fellows; to 1236 by D. Mackay and Lieut.-Col. Ryan; to 1235 by W. Jay and J. H. Eastwood.

G. W. WARRY.—If in 1237, 1. $\frac{\text{Kt-K4 (dis. ch.)}}{\text{P-QB6}}$, and there is no mate next move.

THE *Wesley College Magazine* received with thanks.

THE *Pictorial World* in the last number gives a portrait of the distinguished American composer—Mr. S. Loyd, whose well-known work "Chess Strategy" is out of print, and very valuable. There is also a picture and a full account of Chess with living pieces played at St. Leonard's on the 14th and 15th instant.

STEINITZ has won the match with Gunsberg, the score being ultimately Steinitz 7, Gunsberg 4, drawn 8. Most of the games, with appropriate notes, are given in the *British Chess Magazine.*

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The address is included as part of the Advertisement, and charged for.

Advertisements must reach the Office by 1 p.m. on Wednesday to insure insertion in the following Friday's number

**Holloway's Ointment and Pills.**—A few doses of the Pills taken in time are an effectual preventive against gout and rheumatism. Anyone who has an attack of either should use Holloway's Ointment also, the powerful action of which, combined with the operation of the Pills, must infallibly effect a cure.

## ANSWERS TO CORRESPONDENTS.

*\.* *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

### HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries, put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*\.* Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Jan. 28, and unacknowledged elsewhere:—

THOS. BEST.—M. Glover and Co.—E. Mahen—H. Milnes.—S. R. Bonney.—Amateur.—Engine Driver.—A. F. C.—R. Esson.—C. W. W. — Anglo-Saxon. — Niobe.—Agricola.—Pessimus Res.—A. Brothers.—One Who is Interested.—G. Hare.—J. E. Gibbons.—Rushlight.—H. Sadler.—D. S. B.—A Fellow of the Royal Astronomical Society.—N. Naws.—S. Bottone.—Mechanic.—Solent.—Percy Reid.—H. Broun.—A. S. L.

THOS. J. O'CONNOR. (The answer has been frequently given that anyone is at liberty to make a patented article for the purpose of experiment—in fact, that right lies at the base of the whole Patent Law, which is for the purpose of encouraging invention. But there must not be a beneficial user of the patented article without license, and at this period of its history it would be difficult to show that a Blake transmitter is used merely for experimental purposes, for its construction and capabilities are well known, and, if used, it is obviously used either to find out something else, or for its own purposes. When first patented it was within the right of anyone to make such an instrument merely to see if the statements about it were true.)—GASFITTER. (We never saw a gas-meter with the index dials arranged in the way you have sketched them. You have made a mistake in the value too. Look at the centre dial again, and compare the order of the figures with those on the other dials. According to your sketch the index reads more than the inspector makes it.)—G. V., Lille. (You will have seen the replies about hérule. "Irish linen" is generally understood to mean a textile fabric made of Irish flax. The chief seat of the industry is Belfast. 2. A "donkey" engine is any small or auxiliary engine not connected with the main engines. For instance, most steamers have a donkey engine to work the lifts for loading and unloading.)—LEVER. (If you want to make many of the stampings it would be advisable to have the machine made in iron, for to bend easily and well, the zinc should be hot—hotter than it is altogether pleasant to handle—otherwise there will be the risk of cracking it in the stamping. A fly press would be about the best thing; a lemon squeezer is scarcely adapted to such work.)—COSMOPOLITAN. (We have given full details of the uses to which the phonograph has been put; but the instrument is not at present for sale. The Edison United Phonograph Company, Edison House, Northumberland-avenue, W.C., will give all particulars.)—C. T. (See any catalogue of "Electric Bell Fittings," if you cannot refer to back volumes. Any sort of bell-handle can be adapted. It is only necessary to so arrange it that it makes contact and completes the circuit when pulled out. Send for a price-list from one of our advertisers.)—PUZZLED. (Not easy to say without seeing the coil and tracing the course of the wires. You will find some diagrams even in recent numbers which will help, and you can easily put the coil to the actual test.)—HERBERT C. BODEN. (If received no doubt it was noticed; but if it was about a dynamo, you were probably answered in this column, and referred to some of the numerous sketches and replies which have appeared—a few hundreds by this time.)—A TWELVE YEARS' READER. (Zinc and copper—lead will not do. Vinegar and water, or even salt, will answer.)—READER. (The bellows expands, and occupying the place of the water, drives the latter out at the jet.)—E. C. O. (Any of the large advertising agents will tell you, when they are informed as to what it is you wish to advertise for. If it is merely some special form of "French scientific instrument or toy," *La Nature* would be as good a medium as any; but no doubt an advertisement in our Wanted Column would put you in the way of getting what is required.)—A. W. B. (Only in the *Transactions* of the Royal Society, we should think; but try Schellen's "Spectrum Analysis." 2. The best work on "Sound" is undoubtedly Lord Rayleigh's "Theory of Sound," two volumes, Macmillan; but the popular work is Tyndall's "Sound," published by Longmans. 3. Certainly not by competent authorities, who have had some years to study it.)—PRACTICAL STUDENT. (We must refer you to publishers' catalogues for such works.)—C. T. Q. (See previous answer. There are numerous elementary textbooks on such subjects)—JOSEPH MORCOMBE. (Gegenbauer's "Elements of Comparative Anatomy," published by Macmillan and Co., may suit; but so much depends on what is wanted that it is difficult to advise.)—X. Z. Y. (There are some pamphlets on the subject; but it is quite a special line, and requires looking up in the *Transactions* of the societies.)—DUTCH PAUL, Jeypore. (Dr. E. J. Mills's "Destructive Distillation" may suit you; but the subject covers a wide field, and is very technical. There are several works which contain information that may be useful; but they are mostly cyclopædias. Perhaps Newbigging's "Gas-Manager's Handbook" would be useful.)—A New Subscriber. (Directions for electro-gilding have been given in back volumes; but if you want a book, Watt's "Electro-Metallury," Crosby Lockwood and Son, will, no doubt, suit.)—Mac. (If you have access to the Glasgow University Library, cannot you search yourself? Delany's system of multiplex telegraphy was described in the number for March 28, 1884, and you would probably find illustrations in the *Journal* of the Franklin Institute about that date.)—C. J. C. (So far as we know, the subject ended in Vol. XLIX. There were not any Replies to "Wounds" about the date given, and Query 72211 remains unanswered.)—Young Fitter. (What do you mean? A mercurial thermometer with a scale long enough will indicate the temperature until the mercury freezes. It does not freeze at "zero" of Fahrenheit, who ranged his degrees from 32, the freezing-point, to 212 the boiling point of water, starting with "zero," which he thought to be the greatest degree of "cold," and which he obtained by mixing equal parts of salammoniac and snow. See any textbook of physics.)—E. A. B. Stevenson. (We do not remember such a thing. There may have been something about brushes for electrical machines.)—Rachda. (Did you try the index to the last volume? See the number for June 20, 1890, and find several recipes for invisible inks.)—Fred. W. Pilditch. (Yes; a slip in printing—silver instead of sulphur. The meaning is clear, though.)—Hubert Dobell. (How can we say whether a permanent magnet will "retain its magnetic power for ever"? We do not know anyone who has lived so long. If properly made, it will retain its magnetism for a very long time, especially if the "keeper" is kept on.)—Leo. (There is much information in back numbers, but your questions take the form of an "estimate," and it would therefore be advisable to give all particulars to some firm, and ask what price they could do the work for. Why not send the questions direct, giving the necessary details as to the place to be fitted with the electric light.)—A Reader in South America. (Any of the emollient and cooling lotions may be applied after the bites, and some of the fragrant oils may be useful in warding off the attacks of mosquitoes; but we are very doubtful whether anyone can give the information you require.)—Aurora. (Please see indices for the last few years. We do not know the works referred to; but possibly the booksellers can answer the questions.)—Anxious, G. S. (Certainly, like other trades; but it is done by workers in general shops. It requires practice, but there is no great art in lacquering ordinary work. We do not know of any classes nor of a work devoted to the subject. See indices for references to the matter.)—Martin Tricycle. (Only from the patentee at the address given, we presume. As to the motor cycle, we know nothing more about it; but there is no doubt that electricity can be utilised to drive a cycle. At present, however, the law limits the speed to that of a traction engine.)—Volt. (We do not think there is such a work; but there are many articles, &c., on such subjects in back volumes.)—John Wilson. (Thanks for pointing out that the name of Prof. Casey was incorrectly given as Carey on p. 418, Jan. 9.)—Engine Fitter. (Reed's "Engineer's Hand-book," T. Reed and Co., Sunderland, will give all information. Must apply at the owner's offices or to the engineer on board.)—D. Darling. (We believe so. No doubt the announcement will be made in the usual way.)—A. B. (Do you mean the galvanic belts? We do not recollect dry pile belts being described. However, see recent numbers.)—M. A. (We are not sure, but think the address is 20, Hanover-square.)—H. G. (In official papers, we think, which are published by the Queen's Printers, Eyre and Spottiswoode, East Harding-street, E.C., and in the *Transactions* of the Institute of Naval Architects. 2. Not yet; but probably will be, either by the Society of Arts, or by Bell and Sons, York-street, Covent-garden.)—G. A. 'Sekon. (We have no space to discuss questions of railway finance.)—Canis. (No book that we know of. A bonâ-fide building society's sources of income are its subscriptions and its repayments on loans, and the profit goes, of course, to the investing members.)—Ed. M. (It is evidently an old "magic mirror," such as those which were used by Dr. Dee and other astrologers, who pretended to see therein the fortunes of those who consulted them. Some of these mirrors were made of opaque black glass, and others of polished coal and slate and other substances.)—Ja. Ha. (Presently, perhaps; just now we are too full.)—G. W. Middleton. (We believe a license *is* necessary. We do not think the law meant the "agents" of a lot of twopenny-halfpenny "Watch Clubs" to escape the liabilities and restrictions to which every respectable watchmaker is subjected. You had better consult your local Excise officer, and, better still have nothing to do with "watch clubs.")—C. K. and Others. (We have had enough about the "missing link" for the present. We are just now "full to brim" with matter, and beg readers with speculative theories, mathematical problems, and discussions about locomotives to hold their hands.)—W. Gillett. (They will do. Keep them in outline and black ink.)—Beauly. (No room.)—M.I.C.E. (Have given all the space we can spare to the Ellipse query. In fact there are one or two replies yet in type to appear.)

**Weak and Languid Feelings** may be speedily overcome by wearing Harness' Electropathic Belt. Doctors recommend it as positively the only bonâ-fide reliable means for the self-application of mild, continuous currents of Electricity. It has been the means of curing thousands of sufferers from nervous exhaustion, brain fag, liver and kidney diseases, rheumatic affections, ladies' ailments, &c. Copies of testimonials, pamphlet, and consultation free on application to the Medical Battery Company, Limited, 52, Oxford-street, London, W.

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## OUR EXCHANGE COLUMN.

*The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.*

Wanted, **Coleoptera.** Exchange with collectors, especially abroad; also books, papers, on subject, cartoon, and store-boxes.—D. D., 89, Elms-road, Clapham, S.E.

**Postage Stamps** for exchange. Anything bric-à-brac preferred. Selections sent on approval.—Address, Collector, 125, Coltman-street, Hull.

Will exchange for ½H.P. **Vertical or Horizontal Engine,** Lathe, 8ft. bed, work by foot.—B. B. Buck, Frettenham, Norwich.

Wanted, Model Printing Press and complete Outfit. Exchange B flat, plated Cornet (Besson's), and 68 numbers of English Mechanic.—M., 17, Ely-place, E.C.

Wanted, small Circular Saw, to work with treadle, with saws for fine work. Exchange Musical Box or Photographic Apparatus.—C. C. Vevers, 12, Market-street, Leeds.

**Instantograph,** half-plate, three double backs, tripod complete, value £4. Offers in Tools, Shafting, Vices, anything useful engineer.—D., 89, Elms-road, Clapham.

A **Pair of Rubbers** for safety bicycle, for 30in. wheel by ¾in. Offer.—R. G. Loote, 117, Fore-street, Edmonton.

What offers for a heavy No 1 Gem **Air-Gun**? in good condition.—F. Highfield, 197, Nantwich-road, Crewe.

Wanted, Hot-water **Boiler and Pipes,** Loughborough preferred, small size. Good exchange.—73, Forton-road, Gosport.

Achromatic Astronomical **Object-Glass,** in brass cell, 3¼, by good maker, wanted. Exchange offered. Transit Instrument, brass mounted striding level, two eyepieces o.g. 1⅝, Schwalcalder, Strand, value £7.—7, Sydenham Park, Sydenham.

**Lathe Head,** complete, 3¼ centres, with Poppet head, tee rest, two tees, crank, centres, no bed. Exchange.—Below.

**Facile Safety,** in good order, a strong machine, want painting.—Below.

**Organ Harmonium,** in splendid Mahogany, closed up case, no pedals, wants seeing to. Exchange.—Apply by letter only, Minters, 117, City-road.

2½H.P. Vertical Tubular **Boiler and Engine** combined, with water tank foundation, in splendid working order.—Below.

Horizontal **Boiler,** 2ft. 7in. by 14in., with water gauges and safety valve, for brickwork.—Below.

Vertical **Engine,** 2¼ by 4in., 12in. Flywheel, in good order. What offers?—Samuel Pinkney, William-street, Sunderland.

Double Cylinder **Launch Engine-Castings,** 4in. by 4in., cylinders bored and pistons fitted. Exchange for good, bad, or indifferent set of Bagpipes. Nothing else.—John Mc, 11, Albion-street, Belfast.

**Revolver.** in lock-up oak case; several Electric-Bells, Induction Coil, P.O. Sounder and Key. Good Model Engine wanted.—22, Dorset-road, South Lambeth.

Wanted, **Lathe Heads,** Drawing Compasses, Dynamo, Medical Coil, &c. Can give 7in. Slide-rest, Bellows, Down Quilt, and cash.—S. Hewitt, South Norwood, Surrey.

**Chemical Apparatus and Chemicals,** in good condition; valued at 25s. Will exchange for Electrical Machine, Leyden Jars, &c.—Dethier, 9, Teneriffe-street, Broughton, Manchester.

Strong 6in. Treadle Gap Lathe Planed **Bed,** double crank, partly finished, heads, gearings, &c.; Britannia strong drill, patterns, &c. List 2d. Offers.—Blakeley, Elland.

Portable **Harmonium,** two rows reeds, powerful. Exchange to value of £5.—114, Wandsworth-road.

American **Organ.** 9 Stops, and Couplers and Swells, five sets. Exchange to value of £9.—37, Camelia-street, Wandsworth-road.

**Football,** large size, Feltham's match, new, never been used. Exchange small Electric Motor or anything useful.—V. G. Bracey, Watson's Walk, St. Alban's, Herts.

5in. Centre Back-geared **Lathe,** 6ft Gap-bed, Face-plate, slide-rest, poppet head, &c., suitable for foot or power. Exchange for 1½H.P. Vertical Boiler.—S., 2, John-street, Hackney-road.

Will Exchange very old **Violoncello** for small American Organ.—J. Newton, 45, Ridley-road, Dalston, N.E.

Plain **Slides,** Ireland, Italy, &c., for sale or exchange. Exchange Magic Lantern, 2½ condenser.—Hawkins, Cedar Villa, Latchford.

Vertical **Engine and Copper Boiler,** 2½in. stroke, boiler 18in. by 9in. Exchange to value £5. Violin preferred.—H. C., 16, Myrtle-street, Hoxton, London.

Will Exchange pair 3in. centre **Lathe Heads and** Rest for 8in or 9in. four-jaw Chuck, or offers.—Menzies, Dunipace, Larbert, N.B.

Speaking **Canary,** answers Polly distinctly, delightful singer, 20s.; also pair Birds, with breeding cage, Mackley's best. What exchange offers?—Ruth, 119, Dereham-road, Norwich.

Will Exchange 16c.p. **Swan Lamp,** nearly new, for "Allsop's Practical Electric-Bell Fitting," in good condition.—F. Askew, 14, St. Paul's-road, Southsea.

Handsome **Wimshurst Machine,** 15in. Disc, ebonite pillars, condensers, in varnished case, value £3 10s. Exchange, Watch, Albert, Chuck, or offers.—W., Great Western-road, Gloucester.

Botanical and Dissecting **Microscope,** with rackwork, four object-glasses, 1½ to ⅛in., mahogany box, with plate. Exchange.—Foine, 11, Clifton-road, South Norwood.

Will Exchange **English Concertina** or Model Engines for ½-plate Camera.—Stanley Hosken, Penryn.

⅜in. **Spark Coil,** with Commutator and Condenser, in exchange for Magneto Machine or Coil Winder.—William Turner, 17, Bishop-street, Dublin.

**Facile Safety Bicycle,** in splendid order, for good Camera or anything useful. By letter first.—C. Box, St. Luke's Hospital, City-road, London.

Wanted, good Microtome. Exchange. Also Botanical Collecting Case.—W. T. B. Ridge, 8, Foley-place, Longton.

Brass-mounted 4 by 1⅛in. **Prism.** Exchange with cash for small Spectroscope, or Cemented Direct Vision Prism.—Coombs, Castle Cary, Somerset.

Open **Steam Launch,** 24ft., good order. Accept in part exchange, good Dining-Room Furniture, or other offers invited; postcards not answered.—Snowdon, Nobel's Bank, Sunderland.

1H.P. horizontal **Launch Engine,** link motion, feed pump, No. 4 exhaust injector, permeater, model-engine, 2 propellers, odd fittings, &c.; offers wanted for any.—As above.

Wanted, Bailey's Planes for cash, or exchange handsome Cockatiel in Cage. Wanted Tools, &c.; also exchange Orchestrionette for small Lathe.—Baker, Colborne Ho., Dartmouth.

Wanted, to exchange solid brass high-pressure Lime-Light Burner, also Guitar, in good tone and condition. Would exchange for anything useful, value 12s.—Parker, 67, Langney-road, Eastbourne.

Cassell's "History of England" wanted in exchange for "Science for All," good as new.—Jas. Gibson, S. Queensferry, N.B.

Wanted, Model Locomotive (slide-valve), finished or partly, or Castings, or other models. Exchange Electric Bells, Vols. English Mechanic, 26 Cassell's "Educator," with cash.—Particulars to Gordone, 47, Arbery-road, Bow, E.

Handsome **Vertical Boiler,** internal firebox and fittings complete, with double-crank Vertical Engine. Safety Bicycle wanted.—Baker, 3, Aveling-road, High Wycombe.

Pair of **Launch Engines,** 3¼ by 4¼, in good order. Exchange for Lathe or offers.—J. Reed, Bridge-lane, Preston, Lancashire.

Tricycle wanted, for 2½in. centre **Bench Lathe** and Slide-rest, ¼-horse Water Motor, Gem Air Gun.—J. Smith, 13, Chelmeley-road, Reading.

26 **Waxwork Heads,** cost £60. Exchange to value £16 for Camera Lantern or anything useful.—George, 1, Albert-terrace, Cloudesley-road, London, N.

**Marionette Negro Troupe,** in evening dress, 12 24in. Figures, cost £18. Exchange to value £6 for Camera Lantern or anything useful.—George, as above.

Book wanted, Forge and Lathe, perfect, good condition. Exchange.—Bedell, Cheadle, Cheshire.

Avery's **Weighing Machine,** complete, with weights up to 2½cwt. Exchange for Mortice Machine.—H. Sharman, Fern Villa, Bower-street, Bedford.

Pair of **Lathe Heads,** 6½ centre, with slide-rest. Exchange Double-Throw Crank, turned throughout.—James Underwood, Leighton Buzzard.

Wanted, full-size Violin, Bow, and Case, in exchange for job lot silk-covered Wire, Engineer's Brace and Drills.—Brown, 22, Hastings-street, Hendon, Sunderland.

Die-Sinker's **Fly-Press,** in good condition. Offers invited. Good make ½ pl. W.A.R.R. wanted.—B., 118, High-road, Kilburn.

**Model Engine,** 2 by 1 cylinder, mahogany lagged, link-motion, reversing gear, for small Lathe for metal, or cash.—A. Adair, jun., Charlotte-street, Stranraer.

Wanted, good Parallel Bench Vice. No rubbish. Approval. Good exchange.—J. Nurse, Belmont-place, Malvern Wells, Worcestershire.

**Dynamo,** shunt-wound, for arc light or incandescent, a splendid turned flywheel, 2ft.; another, smaller, speed indicator by Schaeffer and Budenburg. Piece of circular Swedish iron 3⅛ diameter, 25in. long, suitable for dynamo cores. 150c.p., 55-volt, 6 ampere Sunbeam Lamp. Offers to—W. Tubb, St. Mary's-street, Southampton.

Wanted, Vertical Boiler, to steam timber, to carry 10lb. steam. Exchange. Full particulars by letter.—W.

Bilston-road, Wolverhampton.

**Lathe Bed.** 4ft.; Boiler, 2ft. high, suit greenhouse. Safety and other Bicycle Rims; Avery's Steelyards to weigh 10cwt. Exchange offers.—W. Smith.

New **Copper Boiler,** five 5in. cross tubes, 19 by

Exchange.—Halmshaw, 182, Barkerend, Bradford.

Splendid vertical sheet-iron **Boiler,** 10 by 6½, safety valve and taps. Exchange.—Halmshaw, 182, Barkerend, Bradford.

Strong brass Horizontal **Slide-valve Engine,** 1 by 2, on mahogany stand; Vertical Copper Tubular Boiler, 8 by five tubes, glass water gauge, lever safety valve; Beam Engine, 2½, reversing gear; also Copper Boiler. What offers?—Dewar, care of McGhie, 53, Salamanca-street, Parkhead, Glasgow.

**Quadrant Tricycle,** good condition, pass narrow door. Exchange for small Back-gear Lathe, slide-rest, and chucks.—H., 17, Keogh-road, Stratford, E.

**Galvanic Battery,** 120 zinc and copper cells, with handles, cost 45s. Exchange to 30s., Photographic Apparatus preferred.—Ivanhoe, 10, Brighton-road, Stoke Newington, London.

## THE SIXPENNY SALE COLUMN.

*Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.*

**New Illustrated Price List of Screws, Bolts** and Nuts for Model Work, drawn to actual size, sent on receipt of stamp.—Morris Cohen, 132, Kirkgate, Leeds.

**Millar's Electric Depot, 14,** Deansgate, Manchester.—Best of everything electrical. Large stock. Low prices. Catalogues 3d.

**Wheel-cutting and Dividing** to 12 inches diameter, in brass only.—Clegg, Belinda-street, Hunslet, Leeds.

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**Dr. Allinson writes:**—"Consult Fournet re Eye-sight and Spectacles." Fee 5s.—13, Bentinck-street, Manchester-square.

English Mechanic
WORLD OF SCIENCE AND ART.
FRIDAY, FEBRUARY 6, 1891.

## ADIER'S RESEARCHES ON
## INTENSITY OF TELEPHONIC
## ECTS.

he 8th and 15th of April, 1889, Mons.
Mercadier read two extremely interest-
pers before the French Academy of
upon the subject of telephonic effects.
g recognised the fact that there are
causes which influence the intensity of
effects, he set to work in order to dis-
precisely what those causes are, and,
sible, to determine in what way they
the sounds which are reproduced in
actice of telephony.

whose occupation entails the frequent,
n occasional, use of the telephone must
been struck with the great variations
take place as regards its efficiency for
ss purposes. If some definite infor-
n could only be procured with regard
circumstances which affect the maxi-
efficiency of this instrument, it is
s that telephone makers would find it
ely useful in designing their apparatus,
at the public would soon find that
of the difficulties they meet with in the
ission of messages would be removed.
ur issues for May 17th and May 31st,
e called attention to Mons. Mercadier's
hes, and gave some description of his
d of work, illustrating his results by
. And in these pages those of our
s who bind the back numbers may find
tails. But for the benefit of those who
ot have these numbers at hand for
ce, we may briefly state that the
s of Mons. Mercadier's earlier investi-
s lead to the following conclusions,
y:—

That there is a certain thickness of
agm which yields the best results—
s, the maximum intensity of sound;
ickness depends upon the character of
bstance of which the diaphragm is

Telephones which have iron diaphragms
ch louder than others, a fact which is
due to magnetic induction.

Telephones which possess diaphragms
f copper, aluminium, or some similar
show alternate maxima and minima
nsity to a more marked extent than
e made of iron, and owe their effects
ally to electro-dynamic induction.
iaphragms reproduce the *timbre*, or
r, of articulate sounds very much
than those of iron.

general conclusion that may be drawn
e earlier researches of Mons. Mercadier
t, given a telephone with a certain
tic field, there is a certain thickness of
agm which will give with it a maximum

y practical telephonists have been
ng with some anxiety and impatience
publication of further researches on
bject by Mons. Mercadier; but there
en no communication from him to the
Academy of Science until quite
y.

an. 12th, at the usual weekly meeting
learned society, a final paper was
n which the conclusions deduced from
experiments were summed up.

believed that the effects of the tele-
depend principally upon the thickness
iaphragm, its diameter, the intensity
agnetic field, the form of that field,
the induction coils. These we will
al with briefly.

*he Thickness of the Diaphragm.*—No
information other than that given in
pers read before the Académie des
s on April 8th and 15th, 1889, has been obtained; it may be assumed, therefore, that for a given magnetic field a telephone should possess a diaphragm of a certain thickness, in order to yield the maximum intensity of results.

ii. *The Diameter of the Diaphragm.*—Having determined that thickness of diaphragm which corresponds to the maximum intensity of the telephonic effects, it is possible to vary the diameter of the diaphragm. When this is varied and experiments made to test the intensity, it will be found that the best effects are governed by two reasons:

*a*. The magnetic field of the core only produces an appreciable effect upon a certain limited area of the diaphragm; hence, if the diameter be increased, we increase the mass of the inert part of the diaphragm, and not that of the part which comes under the influence of induction.

*b*. By increasing the diameter gradually, there is no doubt that its general flexibility is proportionately increased—a property which favours its susceptibility to vibration, and therefore its sensitiveness. But on the other hand, to increase the diameter of the diaphragm is to increase its mass, and accordingly also the difficulty of producing those movements which must correspond to the necessarily limited variations of the magnetic field.

It results, therefore, from the above considerations—and the theory may be confirmed by experimental demonstration—that the dimensions of the diaphragm which produce the best telephonic effects ought to correspond to the intensity of the magnetic field—in other words, that the diameter should vary directly as the intensity.

Having granted this theory, it becomes a matter of ease to explain how it is that telephones which are fitted with large diaphragms, and worked with a relatively intense magnetic field like the Gower, Pollard, and other similar instruments, do not produce greater effects in practice than do such instruments as those of d'Arsonval, Ader, Aubry, &c., which have much smaller diaphragms, and in which the magnetic fields are much weaker.

Hence it appears, so far, that to produce the best results in telephony, the proper thickness of diaphragm and the proper diameter must be combined according to the intensity of the magnetic field which is at disposal.

iii. *The Intensity of the Field.*—The influence of the intensity of the magnetic field is by no means as important as one might be led to believe at first sight.

This branch of the investigation has been made the subject of much study and experiment. Mons. Mercadier magnetised the cores of soft iron in the coils by means of an electro-magnet instead of fixing them, as is usually done, at the poles of another magnet. By causing the intensity of the current that works the electro-magnet to vary, it was thus easy to produce magnetic fields of very varied intensity. If the current that is used with the electro-magnet be gradually increased from a small value in a series of experiments, a certain limit is after a while reached at which it will be observed that the intensity of the telephonic effect ceases to vary to any appreciable extent.

When an iron diaphragm is employed it will be noticed that a point will be reached when the mass of the iron becomes rapidly incapable of absorbing all the lines of force of the magnetic field, and then more and more of these lines traverse the diaphragm. This can readily be demonstrated ocularly by strewing upon the surface a small quantity of iron filings. Thus a portion of the magnetic field remains without usefulness, as far as concerns the production of telephonic effects.

It must further be observed that the effects of the telephone are due in a measure to the deformation of the lines of force of the field, and that these resist the deformation arising from the energy of the waves of sound produced by the voice, according as the magnetic field is more or less intense. This energy is necessarily limited. The remark applies equally well to the telephone-receiver when the energy of the voice is replaced by that of the electric "undulations" which the transmitter produces.

By the foregoing considerations it may be explained how it is that attempts which have been made to augment the intensity of the effects of the telephone by increasing the energy of the magnetic field have so signally failed, and how it has been found out by practice that it is best to provide instruments which are of small dimensions with magnets which are relatively weak, such apparatus being much more easily managed.

iv. *The Form of the Field and the Coils.*—In the researches which have been made with the best form of field and coil, it may be said there has been very great labour expended, and that almost every form has been practically tried. But, nevertheless, it is evident, theoretically, that the form in which the lines of force are perpendicular to the direction of the turns of wire in the coil must necessarily be the most suitable. This conclusion has received practical demonstration by Mons. D'Arsonval, who has applied the principle in the well-known telephone which is designated by his name. Mons. Mercadier also has shown the same thing in his own experiments.

The variations in the form of the field may be greatly facilitated by attention to what may be termed the mobility of the magnetic field, and this may be augmented up to a certain limiting point by attention to the mobility of the magnet and of the cores of the coils. This has been practically demonstrated quite recently by Mons. Aubry in his investigations into the nature of telephonic effects. This limit it is not necessary to exceed, nor desirable either, for it gives the maximum effect, and may be determined by experiment.

In conclusion, Mons. Mercadier states that in order to obtain the best results in working the telephone it is necessary that the following four conditions should be realised, namely:—

(*a*) That the lines of force of the magnetic field should possess freedom of movement.

(*b*) That the lines of force of the field should be cut by the greatest possible number of turns of wire in the core; and, further, that they should be cut perpendicularly to the direction in which they run.

(*c*) That the thickness of the diaphragm should be diminished until the diaphragm is just sufficiently large enough to absorb the greatest possible number of the lines of force that may be in its neighbourhood.

(*d*) That the ratio of the volume of the diaphragm which comes under the influence of induction to the total volume of the diaphragm should be increased, which result is realised when its diameter is reduced to a certain limit which may be determined.

The conclusion of Mons. Mercadier's researches have long been looked forward to by those who are interested in telephony. It is to be hoped, therefore, that the information which they supply will soon receive practical application, and that the telephones of the future will all be carefully constructed with a view to embodying those conditions of maximum efficiency which have now been laid down.

J. T. N.

## REVIEWS.

*A Popular Handbook and Atlas of Astronomy.* By WILLIAM PECK, F.R.S.E., F.R.A.S. London and Edinburgh: Gall and Inglis.

ALTHOUGH the various subjects which comprise the science of astronomy are described in a "popular manner" in this work, the author has also presented the student with a volume which he will find of use for reference in the study and while observing, the numerous tables and charts being of especial value. The author, considering that clearness is often lost owing to the small size of charts and diagrams, has chosen the quarto shape for his book, and the many large plates form a most desirable feature in a work which will certainly become a popular textbook of astronomy. Mr. Peck is the astronomer to the City of Edinburgh, and in his observatory at Murrayfield has taken many photographs with a 13in. silver-on-glass reflector—one of the moon forming the frontispiece to the volume. The principal subjects are treated in separate chapters under different heads, for the purpose of facilitating reference; while the atlas proper will be found of great assistance to the observer and to those who wish to acquire an accurate knowledge of the sidereal heavens. The charts are printed on a dark-blue ground, with the stars in white, the magnitudes being indicated by the different forms of the white "dots." In his first chapter Mr. Peck gives his view of the origin of the Constellations; but though that is interesting and decidedly worth reading, it may be as well to withhold criticism, as he promises to devote a special work to the subject. In a brief notice of this work it is impossible to give any comprehensive idea of its contents. It must suffice, therefore, to say that it is admirably adapted to the wants of those starting on the study of astronomy, while those who are already acquainted with the rudiments will find it a valuable help to their observatory practice. The plates and diagrams are mostly the work of Mr. Peck himself; but where they are not, he has gone to the best sources, and all are reproduced in a manner which leaves little if anything to be desired. As we have said, the work is admirably adapted to the wants of the amateur astronomer, and the more it is studied—and used—the better it will be appreciated by beginners.

*Surveying and Levelling Instruments.* By William Ford Stanley. London: E. and F. N. Spon.

The author of this work is well known, by name at least, to all who have in this country much to do with mathematical instruments, using the term in its widest sense; and in this work, which is a useful companion to his treatise on drawing instruments, he has provided students with a textbook to which they can confidently refer for trustworthy information—information of a kind which cannot be found so readily and so handily as in this volume. The work treats of the nature and construction of the instruments employed in actual surveying and levelling on the "field," which term includes those appliances used in mine-surveying &c. Typical instruments are described, while notes on modifications and suggestions are given by Mr. Stanley, who has compared English and foreign work, with due recognition of the value of special features in the latter. It is known that English instruments differ in detail from those produced by Continental makers; but if there is so little to choose between the respective instruments themselves, there is no doubt that the foreign literature of the subject was much in advance of our own until Mr. Stanley brought out this work, in which he acknowledges the assistance he has received from professional friends who are known experts in their respective branches. It would be impossible to criticise in detail the features of this volume in a short space, for in the case of such instruments criticism is nothing if it is not minute. It must suffice, therefore, to say that the student engaged in the operations of surveying and levelling will find the information given by the author of much value, and the skilled professional a work which he can read with interest, and perhaps with profit; for it is often possible to improve what one has to use in daily practice. The illustrations (nearly 350) render the volume especially instructive, and it will, no doubt, be regarded as a *vade mecum* by students of the arts of surveying and levelling.

*The Threshold of Science.* By C. R. Alder Wright, B.Sc. Lond., F.R.S. London: Charles Griffin and Co.

Intended primarily as a revised edition of "The Magic of Science," by the late James Wylde, Dr. Alder Wright found this work growing so much, that he deemed it advisable to produce an entirely new handbook of what may be termed the simple and amusing experiments of science, as they were regarded even at the time when Faraday delivered his famous lectures. Since his day, slowly but surely, the advantage of a knowledge of the elements of physical science has enforced itself on the professional and business mind, and it is now considered at least a branch of a good educational curriculum, while, in many professions, a more or less adequate knowledge of physics is indispensable to success. The present volume is not in any sense a textbook, nor is it altogether a play-book; but the author contrives in something less than 400 pages, to cover a wide field, and to provide the schoolboy and the young student with a combination of sound information, entertaining reading, and very many interesting experiments. It is a capital present for a boy.

*The Philosophical Basis of Evolution.* By James Croll, LL.D., F.R.S. London: Edward Stanford.

This work has, to a certain extent, a melancholy interest, as its author is no longer able to answer any objections that may be offered to his views, for we believe that though not his last work, it was the last he lived to see published. Dr. Croll does not deal in these pages with evolution in the ordinary sense of the term, but with the fundamental principles which underlie that doctrine. The grand principle of evolution is determinism—that is the foundation-stone of evolution. The key-note of the work is the great principle of causality—that everything which comes to pass must have a cause. Dr. Croll examines determinism in relation to Spencerianism and Darwinism, and in relation to theories of life, and what he has to say will certainly meet with the attention of the philosopher.

We have also received *Manual of Assaying Gold, Silver, Copper, and Lead Ores,* by Walter Lee Brown, B.Sc., revised, corrected, and considerably enlarged by A. B. Griffiths, Ph.D. (London: William Heinemann), which is to a certain extent a reproduction, with additions, of a "manual" on assaying which has met with considerable favour in the United States, and has the merit of containing extracts from the best known authorities, given with the permission of the owners of the copyrights. It is a very useful handbook on the art of assaying.——*An Elementary Textbook of Heat and Light,* by R. Wallace Stewart, B.Sc.Lond. (London: W. B. Clive and Co.), is one of the University Correspondence College Series, and is a textbook intended to cover the ground defined by the syllabus of the London University Matriculation Examination, and may be recommended to the student.——*Handbook for Mechanical Engineers,* by Henry Adams (London: E. and F. N. Spon), is the second edition, revised and enlarged, of a work specially written for those who require facts and opinions put before them as briefly as possible, and the information given will be found useful by those who are entering life as mechanical engineers.——*The Building and Mac* *Draughtsman* (Ward, Lock, and Co.) practical guide to the "technical educat of draughtsmen, especially intended novices.——*A Digest of the Law and Pr of Letters Patent for Inventions*, by Cle Higgins, Q.C., and G. Edwardes (London: W. Clowes and Sons, Lim.), second edition of a work which will be to inventors who are proceeding to and to agents and others who may draw up specifications. It is, in useful digest of patent law.——*Astro Lessons*, by John Ellard Gore, F (London: Sutton, Drowley, and Co elementary work intended as an intr to the more advanced works.—— *Spectra*, by W. Marshall Watts, B. (Manchester: Abel Heywood and second and enlarged edition of a work is almost indispensable to those who mak study of spectra. It is, in fact, the reference book for the wave-length tables of the spectra of the elements.——*The Law Relating to Apprentices*, by Evans Austin, M.A., LL.B. (London: Reeves and Turner), is a valuable manual, as it states the law—so far as it is defined—regulating the arrangements between masters and apprentices in such a manner that either of the parties can form an idea of the position when any dispute arises.——*Fuels: Solid, Liquid, and Gaseous*, by H. Joshua Phillips, F.C.S. (London: Crosby Lockwood and Son), is a valuable little work which might be studied with advantage by those who are commercially interested in the consumption of fuel of all kinds.——*The Patentee's Guide*, by H. F. Boughton, M.I.M.E. (London: Simpkin, Marshall, and Co.), is a guide to patent law, the designs, trade marks, and copyright Acts.——*The Physical Properties of Gases*, by Arthur L. Kimball (London: William Heinemann), is an elementary manual of the subject, which will be useful to students.——*Practical Blacksmithing*, by M. T. Richardson (London: Kegan Paul, Trench, Trübner, and Co., Limited), is the third volume of a series we have already noticed, and as we have often quoted the articles when they originally appeared, our opinion can be easily estimated.——*The Birth and Growth of Worlds*, by A. H. Green, M.A., F.R.S. (London: Society for Promoting Christian Knowledge), is an interesting "lecture" with a useful list of works bearing on the subject——*The Useful Calculator*, by Henry Scott (London: William Rider and Son), is a collection of tables which timber merchants and builders will find handy.——*Practical Electrical Notes and Definitions*, by W. Perren Maycock, A.M.Inst.C.E. (London: E. and F. N. Spon), is the second edition, revised and enlarged, of a pocket-book which will be found useful by students, and especially by those engaged in the actual work of electrical installation.——*A Practical Treatise on Handrailing*, by George Collins (London: Crosby Lockwood and Son), is the second edition of a work treating of handrailing and staircase work, the latter branch being an addition in this edition. The volume forms one of Weale's series, and should be found of value to the young carpenter and joiner.——Fresh editions are to hand of those capital little sixpenny handbooks: *Everybody's Pocket Cyclopædia*, *Everybody's Book of Jokes*, *Everybody's Scrap Book of Curious Facts*, and *Everybody's Book of Short Poems* (London: Saxon and Co.), which we have noticed a different times as they were issued, and all o which deserve the extended popularity the have evidently earned. The first has reache its three hundred and fiftieth thousand, an the others are well on the road.

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**The antimony mines of Montignat, in the D partment of the Allier, which had been abandon since the beginning of this century, are now ag being worked successfully.**

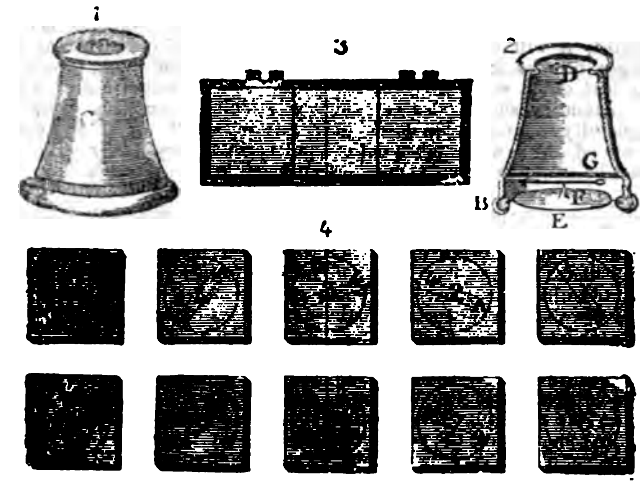


Fig. 1.

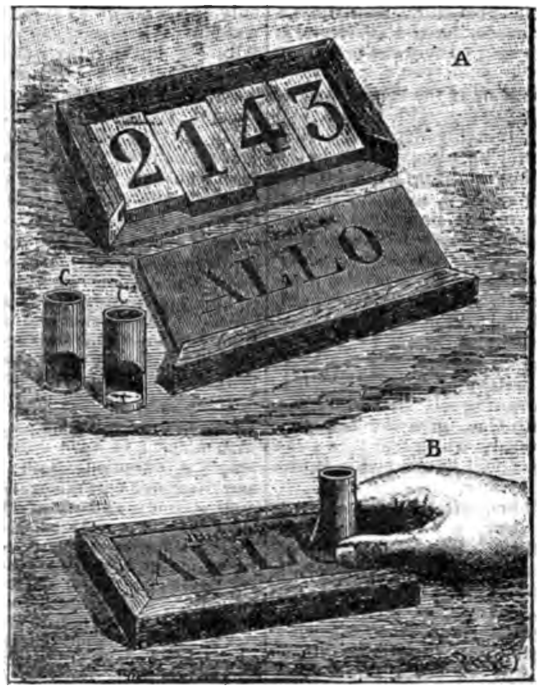


Fig. 2.

varnishing is to keep cool and work with confidence. Too much confidence is bad, but a lack of it is fatal to good results. When one is able to judge the character of the varnish he uses correctly, and when at work keep his mind actively concentrated upon the labour in hand, in sympathy with his brush, the feat of varnishing a coach body isn't such a wonderfully difficult task, after all.

## THE MAGNETIC MAGNIFYING GLASS.

MORE than a century ago M. Guyot, of Besançon, described the magnetic magnifying glass, which has recently been brought out in a modern form. *La Nature* quotes the description of the old form as follows:—"Have an ivory tube turned so thin that the light can pass into the interior of it. Give it a height of about two and one-half inches, and let it be nearly of the form shown in Fig. 1. Let the top A and the bottom B be screwed into this translucent tube C. Let there be at the top of this tube a groove for the reception of a lens or ocular, D, whose focus is 2in. Let the ivory circle B be open in order that there may be placed therein a glass, E, that you will cover within with black paper and a small circle of cardboard. Put a pivot, F, in the centre of this circle, and place thereon a very small magnetised needle, G—that is to say, a little smaller than the diameter of the circle. Cover the latter with a glass, so as to secure the needle and prevent it from leaving the top of its pivot. Finally, let this arrangement be a sort of compass placed at the bottom of an ivory tube translucent enough to allow the direction of its needle to be perceived, and the eyepiece of which serves the better to distinguish the letters or figures that are to be drawn upon the cardboard disc at the bottom of this magnifying glass. Let it have, moreover, such a form as to give this compass the appearance of an ordinary magnifying glass, and make one imagine that he perceives by means of it the objects hidden and inclosed secretly in different boxes, as will be explained in the course of this work. When this magnifying glass is placed at a small distance above a magnetised bar, or any box in which the piece that contains the bar that is hidden, the magnetised needle contained therein will necessarily place itself in the same direction as this bar, and will, consequently, indicate which side is its north or its south. The north of the needle will indicate the south of the bar. . . . It is necessary to observe that the bar should not be too distant from the needle, particularly if it is very small, and that the pivot of the needle must be placed over the centre of the bar, without which its indication might be erroneous, especially when in the pieces there are several bars that may act in unison upon the needle."

After thus describing the construction and effect of the magnetic magnifying-glass, M. Guyot passes in review the different experiments that it permits of, beginning with the box of numbers represented in fac-simile in Fig. 1. This box is capable of receiving three blocks selected from among a collection of ten, upon which are inscribed the first nine numbers and the zero, thus permitting of writing a great many numbers of three ciphers. In the interior of each of these wooden blocks there is concealed a small magnet, the position of which differs in each block, as shown in Fig. 1 (No. 4). After marking the corresponding numbers on the bottom of the compass once for all, it suffices to place the magnifying-glass successively over the centres of the three squares which indicate the place of the three numbers concealed in the box (in which they have been previously arranged in secret), in order to know each of them, and to rapidly read through the cover the number formed.

Fig. 2 represents the modern form given to M. Guyot's device. The experiment is made by means of four rectangular blocks, the place of the magnets that they contain being indicated by the four letters of the word ALLO printed upon the cover. In lieu of a magnifying-glass, two small cardboard tubes are used, one of which, C (the only one offered to the novice), is a simple cylinder closed at one end, for which the experimenter always substitutes another tube, C', of identical appearance, and containing the indicating magnetising needle.

M. Guyot describes no fewer than forty-six scientific experiments that are made for the most part with the magnifying-glass and magnets. Our perspicacious readers will have no trouble in increasing the number of them, by taking advantage of the well-known properties of magnets and the laws of magnetic action.

## CORRECTING THE ERROR OF A SCREW.

THE following method of correcting the error of a screw was described by Mr. C. C. Hill, Chicago, in the *American Machinist*, followed by some comments from the editor's pen, and a note by Prof. John Sweet. As the matter will interest mechanics, we append it in full:—

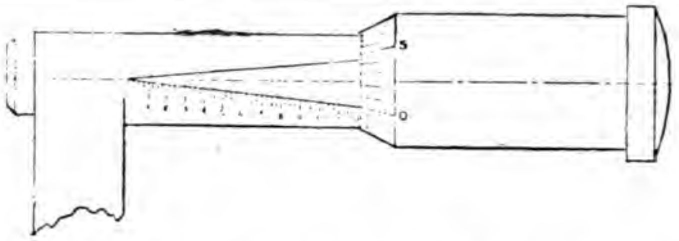
I venture, says Mr. Hill, to assume that some of your readers may derive benefit from the following simple method of securing desirable results in the machine shop. Often I have had the wish to make short measuring screws similar (and for similar uses) to micrometer screws, but have been deterred from the attempt for want of sufficient accuracy in the lead screws of available lathes. On one occasion, however, when my desire for such a screw was more than usually urgent, the solution of the problem presented itself unexpectedly to my mind.

Speaking of the inaccuracy of lead screws, I would mention that the concern with which I am connected has in use eighteen modern engine lathes, sixteen of which are made by one firm. Of these sixteen lathes one has a screw that does not vary more than $\frac{2}{1000}$in. in 4ft. from a "D. B. and S." standard steel rule, while the others vary from $\frac{1}{100}$in. to $\frac{2}{100}$in. in 2ft. Now, an error of $\frac{1}{1000}$in. in 2ft. can, in most work, be disregarded, and a mechanic who is fortunate enough to possess a lathe with so slight an error of lead screw could manage all ordinary requirements very well, and it is for those who cannot get nearer than $\frac{1}{100}$in. or so to the foot that I propose the following method of correction. Indeed, it will serve to correct a screw with an error amounting to five or ten times as much, and enable the manipulator to rival Whitworth in results, if in other respects he be capable. The only precaution to be taken is to see that the lead screw of the lathe is not "drunk."

Having found a lathe with a "sober" screw, no matter how great its error of pitch, proceed to cut the micrometer screw and the taps (roughing and finishing taps). Graduate the index in the usual way, and mount the screw as if it were known to be perfect. Now bring the index to zero and make a mark on the stationary part of the machine; move the screw the distance of 1in. (or such a number of inches as it is intended to measure), and introduce a standard of known accuracy; mark at zero again.

You have now secured the limiting points of your instrument, and all that needs to be done is to produce a regular line (or edge) extending between the points obtained. This line will be of such character as the error of the screw demands. If the screw be of too fine pitch, it will take the direction shown in full lines in the accompanying diagram. If, on the other hand, the pitch of the screw be too coarse, it will take the direction shown in dotted lines.

The editor of the *American Machinist* says Mr. Hill's assumption at the beginning of his letter is an entirely reasonable one, and we have no more doubt as to some of our readers deriving benefit from his communication than we have that he has hit upon a valuable means of correcting the errors of screws which are to be used for micrometer measurements. Mr. Hill is undoubtedly a good mechanic, and the fact that he is evidently unfamiliar with what has been done in this line, and really supposes himself to be the first inventor of the scheme, is of itself good evidence that others of our readers are unfamiliar with it. This is accounted for in part, we think, by the fact that makers of micrometers succeeded in making practically exact screws before micrometer calipers came into nearly so common use as now. Those who have one of the earlier micrometer calipers, purchased when such calipers first were placed on the market, will probably find, by sighting along the line drawn on the barrel, that it is not parallel with the centre line, but is spiral, as indicated by the sketch of Mr. Hill, though, of course, not to the same degree. The latter micrometers have a



ıe, for the reason that, by the use of
hinery, screws are made which are suf-
ar perfect to come within the required
rror for the purpose. Upon receipt of
letter, and supposing, as we did, that
E. Sweet was the first to apply this
correction to a screw, we wrote to him
ticulars regarding the matter, and have
ıe following very interesting letter in
When I first conceived the idea of cor-
imperfection in the pitch of the screw in
g machine in 1870 or 1871, which was
out in the machine at Cornell in 1873 or
posed it was the first time it had been
ter, Mr. John Richards, in reviewing
been done in the line of measuring
allowed that, so far as he knew, it
one in the Cornell machine; but some
ır years ago, in conversation with Mr.
Porter, he informed me that he had seen
ea in a French micrometer at the Paris
in 1867. So that, so far as originality
, like many another stroke of American
len by the French or English a few
e its birth. JOHN E. SWEET."

## LS FOR BRASS-WORK.*

l many tools, ingenious in their way, but
ed for their peculiar work and no other,
of forming the basis for other tools that
ised as necessity calls. Believing that
can be gained from seeing these special
ctures, which may be useful in similar
alterations be used in the different kinds
will endeavour to show a few which may
nterest. In common practice, the Fox
r has gauges of brass—tapped or chased
e, and these are used to chase to—i.e.,
s chased to fit these gauges. These
r from continual use, and so the work
where it belongs, and then the gauges
led—sometimes they are to blame and
not; but all this time adds additional
nanufacture. So we made the hand-
n Fig. 26, and obviated the difficulty.

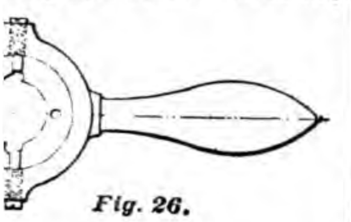


Fig. 26.

is chased about to size, and then, hold-
n the right hand, the lathe hand runs it
read and brings it down to size—no
he gauges wearing; if the work doesn't
the die hasn't been on the work—at
l the way on. Nor is the *size* the only
he *shape* of thread has much to do with
chased work is rarely the same.

l tools (I am speaking of single-point
re ground by the "eye," and then set
mb"; holding the tool point down on
ail, they squint across and guess it is
l set it the same way—hardly the way
work, even after years of practice.
x lathe man I ever saw grind a thread
evened things up by setting it "squint-
s the thumb nail. The die not only
work chased, but straightens the
shape as well, unless, of course, the
oo far away from 60°—have seen some
out 45°—and of course it can't make
nless they allow quite a cut for the die;
ut any "on," am sorry to say. In
ve about one or two hundredths of an
lie.

ints about the die will be in order,
ut makes it quite plain. I first turned
and chased the threads one size on
standard size, to be used as reference
bored and chased the die rings to
l turned the outside and faced them.

After drilling the holes for the cone point screws, and those parallel with the thread for cutting edges, the ring is sawed at the side edges, and filed up the same as any die. There should be either four or eight cutting edges, so as to have one cutting edge top and one bottom, as the "lining up" is all at these points. Instead of this way of making, however, the die ring can be turned up and put in the holder (which has just been bored and is still in the chuck, and has been previously drilled and tapped for the side screws), and bored and chased in place.

It matters not which way they are made, the office they perform in keeping work to a standard is what we are after.

We all know the tendency of tools in general to follow a "cored" hole, and that, could this be obviated, it would admit of having much work cored that is now cast solid. The general plan in such a case is to get the core true, and turn the outside true with the bore, which is oftentimes inconvenient, to say the least. A single point tool, such as a Fox lathe back head tool, is the best means for boring a cored hole when the case demands that the hole must not be followed. This is impossible in much work, on account of expense and inconvenience when the hole is very deep, and we must resort to the turret lathe. The boring tool, then, to be successful, must be as near a single-point tool as possible; but as we usually take the full cut (or nearly so) at once, we use the next best form of cutter, which I have found to be the flat cutter—two points instead of one. I do not claim this form will not follow more or less, but have found it to be more satisfactory for a roughing cutter than the round bar. I make the thickness proportionate with the work, varying from $\frac{3}{16}$in. to $\frac{1}{2}$in. usually.

This brings us to Fig. 27, which was designed to

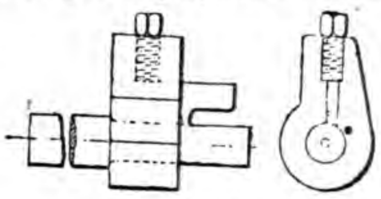


Fig. 27.

mill work so that the outside must be true with the bore, and it accomplishes its purpose well. We first bore the hole with flat cutter, as described, then follow with the guide shown, and the guide, just filling the bore, eliminates all chance of its "running out," and the outside is milled, faced, and chamfered with the cutter shown.

If it was desired to have the bored hole sized out exactly, wide bearing cutters might be inserted in the bar, and by having not over ·02 to cut out, still mill very true; but when the bore is to be tapped, the size need not be exact.

A point of practical value may be given here, and that is, where a piece of work is threaded both inside and out on the same end, run the die on first where possible; for, the die being up to "squeeze" a little, the tapped hole is not altered in size. A little forethought in similar cases will save much work after the pieces are all cut. After having the piece bored and milled true, the tap should not start in sideways, as they are so apt to do on brass, so we guide them whenever possible.

One of the sectional taps shown in my first paper on this subject shows the manner of guiding taps, the guide or "tit," as it is sometimes called, usually being the same size as the tap, *less the thread*, though different work calls for different applications of the same principle. By this method the holes are tapped true, as well as bored in the same manner, and they have the additional advantage of detecting any decrease in the size of the boring cutter due to wear, by refusing to enter the bored hole. The die can be guided by boring out the first two or three teeth from the face, except, of course, where it is required to thread close to a shoulder, in which case the guide could be internal. I have described these operations just the reverse from the way they should be performed—i.e., die first, then tap.

Sizing cutters must, or should be adjustable, and after much experimenting, we find nothing better than the much used form shown in Fig. 28.

We formerly used this for the roughing or first boring bars also, but have abandoned it for the

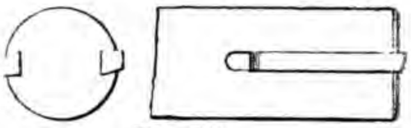


Fig. 28.

plain flat cutter mortised through the bars for the larger sizes, and for the sizes up to $1\frac{1}{4}$in., the plain flat cutter before described. The roughing bar must stand much hard service in the scale of the brass castings, especially in long cored holes, where the sand seems to burn in and rival the emery wheel in grinding qualities; this makes frequent renewals necessary, and it is much cheaper to insert a plain cutter in a bar than fit dove-tailed ones.

Much work and time in the tool room may be saved in many cases by making everything in the cutter line of some standard size steel, so that fitting is unnecessary. Many seem to think that only rough work can be done on the turret, and especially is this true of Fox lathe men; but with proper appliances and tools, and run by a man who is careful and intelligent, it can produce work that is a credit to any shop.

In making a valve seat, the first requirement is that it shall be true and smooth, and this we secure

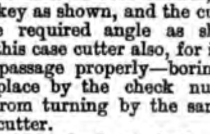


Fig. 29.

by using the finishing tool shown in Fig. 29. The system of guides is here shown once more, and here, as elsewhere, proves its usefulness by producing a practically perfect seat. The seating tool A is really a hollow mill or rose reamer, held from turning by the key as shown, and the cutting edges are made of the required angle as shown. The guide B (or in this case cutter also, for it is used to merely size the passage properly—boring not over ·02″) is held in place by the check nut C on the end, and kept from turning by the same key that holds the main cutter.

By tightening this check-nut both cutters, or cutter and guide, as the case may be, are tightened to place, and the key takes all the strain, so we use a thin nut and fine thread as shown. The advantage of having this tool in two parts must be apparent; for by removing the cutters the seating tool may be ground or oil-stoned at will, and the forward-cutter likewise with a satisfactory result, impossible were it made solid. By grinding every part in a similar manner it is very easy to obtain a valve seat true with all the other parts, and to avoid the cramping that is so often done.

It often happens that we wish to tap coarse square threads in brass, and do it all at one cut. The taper tap—i.e., the tap with the front end

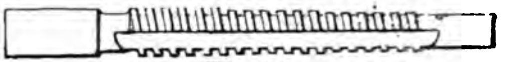


Fig. 30.

tapered off to start easily, is not always satisfactory—it has a tendency to "jam" sideways, and to clog up quite badly. We use a "step" tap (Fig. 30), considerably, and find it an improvement for much of the work, though not a panacea for all the ills that befall this kind of work, by any means. When made correctly, the step-tap is practically a series of strait taps all cut on one bar of steel. First comes a guide—i.e., just the size under the thread—then a thread that is one-quarter or one-fifth, or even one-third of the full depth of the completed thread. The next step cuts the same amount also, making two-thirds or half the depth, as the case may be, and so on, having as many steps as the depth of the thread requires. Where possible, without making the tap too long, each "step" should be about the length of the articles to be tapped. By this means one step just about finishes cutting as the next one starts in, so keeping the strain on the tap about the same during the entire cut. I say "about," because the increasing leverage as the diameter increases adds to the strain so imposed, which can, however, be rectified if desired, by decreasing the depth of cut as the diameter increases. Care must be taken to give the leading edge of teeth on the front of each step a good cutting edge, so as not to bind or jam. In any square or bastard thread tap the sides as well as the bottom of thread should be "backed off" to prevent friction. This is too often neglected, and is a fruitful source of broken taps.

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H. COLVIN, in *American Machinist* (see

# SCIENTIFIC SOCIETIES.

## BRITISH ASTRONOMICAL ASSOCIATION.

THE third ordinary meeting of the above Association was held in Barnard's Inn Hall, Holborn, on the 28th ult., Captain Noble, the President, in the chair.

Mr. Duke read the names of twenty-eight candidates for election.

Mr. J. Evershed read a paper on "Some Notes on the Solar Prominences of 1890." His instrument consisted of a 2½in. achro-equatorial, combined with a spectroscope of six small prisms by Hilger, 1in. by ¾in. surfaces, and giving a dispersion of about 20° between A. and H. Two small sextant telescopes were used for collimator and view telescope. The slit was semicircular, and corresponded exactly with the image of the sun's limb, so that when the latter was brought precisely concentric and the slit was widened, the chromosphere and prominences were beautifully seen for over 100 degrees of the circumference. By this arrangement only four settings of the spectroscope in position angle were necessary to obtain a view of the entire solar profile. In this way the sun had been observed completely on 88 days, and the position-angles of all prominences carefully determined by means of a large position-circle fixed to the end of the telescope. The total number of prominences seen on the 88 days amounted to 436; the mean daily number was therefore 4·96. If the year were divided into two equal portions, the average would be 4·00 per diem for the first half, and 5·54 for the last six months. This increase was mostly confined to the southern hemisphere, and of the total 436 only 190 were northern and 246 southern prominences. The only occasion when no prominences were to be seen was on January 19, when the chromosphere appeared to be undisturbed in every part of the circumference. Many prominences of a moderately quiescent type had been noticed to reappear after a semi-rotation on the opposite limb, or even after one or more entire rotations. Mr. Evershed gave several examples of this action, and exhibited diagrams showing the forms assumed by prominences at their successive returns. The whole of the observations had been made on the C line, as details were not so well seen on F, and still less on G. Refined work had not been attempted, as more powerful instruments would be necessary; nevertheless, it was hoped that the few general facts to be gleaned from a persistent study of the mere forms and positions of the prominences might perhaps connect a few of the scattered links of our knowledge of the solar economy.

The President asked Mr. Evershed how he identified a prominence on its return, for they could not be watched in the interval.

Mr. Evershed replied that they reappeared in the same latitude at an interval of 14 days, so that the same solar longitude was under observation, and that no prominence had been seen in that latitude in the interval.

Mr. Howlett said that many years ago, when visiting Dr. Huggins's observatory, he had noticed in a prominence the same kind of remarkable straight filaments which Mr. Evershed had shown in one of his diagrams.

Mr. Maunder thought Mr. Evershed was greatly to be congratulated on his skill and success with such small instrumental means. He trusted he would find many imitators. The general form of his curve of prominence distribution closely corresponded with that given by Profs. Tacchini and Ricco, observing with powerful instruments and in the clear sky of Italy. With regard to the beautiful phenomenon of the bright straight filaments, he thought they might probably be explained by Prof. Tacchini's observations of the Grenada Eclipse of 1886. He had found that many of the red prominences seen in the spectroscope before the eclipse were capped with white prominences, seen only during the eclipse, as they were invisible in the spectroscope. This showed that the prominences were not so much explosions of heated hydrogen as up-rushes of solid or almost solid matter, which, passing through the atmosphere of comparatively cool hydrogen which everywhere surrounded the sun, and was ordinarily invisible, heated it locally here and there by the speed with which they rushed through it. Some of these solid bodies, falling down to the surface again, would heat the atmosphere of hydrogen by the rapidity of their fall just as they had done in their rise, and would cause these bright, straight filaments. With regard to the reappearance of prominences, the observation of sunspots showed that it was by no means unusual for a group to break out in the precise place where another group had been seen some time before, though there had been nothing to mark the place in the interval. This seemed to point to a deep-seated cause of disturbance, and it was not surprising if a similar condition prevailed with regard to prominences.

The Rev. Mr. Freeman read a paper on "A Transit of Titan over Saturn's Disc." He had carefully watched this phenomenon on the night of January 21, 1891, by means of an equatorial refractor having 6in. aperture and 7ft. focal length, with powers of 150 and 180. Titan could only be seen intermittently when the air was at moments clearer than usual. At 11h. 12m. 15s. Titan projected a little beyond the following limb of Saturn, and was near the N. pole of the planet; by 11h. 22m. 15s., he was fully five-sixths on; at 12h. 6m. 30s. he seemed to touch the limb of Saturn; and at 12h. 34m. 30s. he was well separated by his own diameter from Saturn and shining brightly. Whilst on Saturn, Titan's light was white; when off, bluish. It was to be remarked that Titan was never wholly on the disc of the planet, though, in conjunction, very nearly.

Mr. J. Bartlett, M.A., read Miss Brown's report of the Solar Section.

Mr. Cottam read a paper by Mr. Levander, describing an apparatus which he had designed for the purpose of determining the colours of stars. He remarked that few people, especially of the male sex, were able to discriminate nicely between tints that closely approximated, or accurately describe them in words. A lady would generally match a ribbon exactly by "carrying the colour in her eye," a feat that probably few men would successfully accomplish.

The President remarked that there was an acknowledged idiosyncrasy in the observation of colours. He himself was only able to see as yellow many stars catalogued as red.

Mr. Maunder gave an outline of a paper by the Rev. A. L. Cortie on the "Spectra of Sunspots between B and D." He said that the observation of the spectra of sunspots had been commenced at Greenwich Observatory in 1877, but was not regularly undertaken there until 1880. At South Kensington a similar work was commenced in 1878, and Father Perry, at Stonyhurst, followed in 1882. At Greenwich, the part of the spectrum specially observed lay between *b* and F, at South Kensington *b* to D, though the Greenwich observations sometimes extended down to D and the South Kensington observations often up to F. But at Stonyhurst the work was confined to the more difficult and neglected region, D to B. But not only did the three observatories work on different parts of the spectrum, but they worked in different ways. Yet in one most important particular all three had arrived at the same conclusion—viz., that the lines of iron were most frequently widened in the spectra of spots at the minimum of the solar activity, and least so at the maximum. Mr. Lockyer further concluded that the lines due to unknown substances were most frequently seen widened at maximum; but Father Cortie, on the other hand, found that they were seen at minimum as well as at maximum. Another important observation made by Fathers Perry and Cortie was the discovery of a series of shaded bands in the region of the red, similar to those which the speaker had previously discovered in the green. But Father Perry was able to go further, and show that the bands in the red corresponded to chromospheric lines. Mr. Lockyer had laid great stress upon the circumstances that the lines of iron which were seen in the flames were not the same as those widened in the spots, and that different spots often gave different lines of iron as most widened. His inference from this, and from the further fact that sometimes some of the iron lines would be twisted in one direction, showing that the gas causing them was moving from us, whilst other were twisted in the contrary direction, showing that it was approaching us, was that iron was broken up into several simpler elements by the tremendous heat of the sun. Father Cortie gave another explanation of this in his paper. He also gave another view to a further fact upon which Mr. Lockyer had put great stress. Some lines appeared to be due to both of two or more elements. These were really, Mr. Lockyer suggested, the lines of more elementary substances than we are acquainted with here on earth, and he therefore called them "basic" lines. They should, therefore, be frequent in the hottest parts of the sun, viz., the spots and prominences. They are found there, but the more detailed observations obtained by Father Cortie throw quite a different light on the fact from that given by Mr. Lockyer's statement, for though nearly every basic line in the region examined by Father Cortie was seen at some time or another amongst the most widened lines, such appearances were really rare. Of 407 observations of most widened lines, only fifteen were of the "basic" lines. Each line was, therefore, only seen "most widened" *once* on the average. Further, greater dispersion had enabled us to break up nearly all the supposed "basic" lines into close doubles, and to show that one line was due to one element, and the other to the other. The result of Father Cortie's observations had therefore been to confirm Mr. Lockyer's work on one important point, but to shake it on another.

Mr. Maw, who had lent his lantern for the use of the association, then showed by its aid five astronomical photographs received from Prof. Hold Lick Observatory; nine from Prof. Pickeri Harvard College Observatory; and nine from t Brothers Henry, Paris Observatory. Mr. Maun explained them, and they were much admired the meeting.

Mr. Petrie suggested that the Royal Astrono cal Society or the British Astronomical Associat should acquire a collection of lantern-slides for t purpose of illustrating the papers and lectures, a which could be lent out to members. He had fou it impossible to procure really suitable slides wh lecturing.

The President said that the Council of the Ro Astronomical Society had had the matter bef them, and he thought that he could promise th the suggestion would be carried into effect.

Mr. G. F. Lemmon exhibited and described cheap, home-made apparatus for taking lun photographs.

Mr. T. D. Brewin, F.R.A.S., was duly elected member of the Association.

The meeting adjourned at 7.0 p.m.

## WESTERN MICROSCOPICAL CLUB

AT the last meeting of this club held at the house of Prof. J. F. Blake, M.A., F.G.S., the host took for his subject "The Effects of Pressure on Rock Structure." In non-crystalline rocks the effects of pressure are shown in the well-known phenomenon of cleavage, which is always found to be in a plane perpendicular to the direction of the pressure. This gives us a guide to the relation of the planes that are found in a rock to the pressure to which it has been subjected. Even the planes of lamination in a shale conform to the same law, when we take as the pressure the force of gravity which has drawn the floating particles in closer approximation. A rock which has been subjected to later pressure perpendicular to its planes of lamination, will not be materially affected [illegible] if it should crystallise, and there are always relics left of its original dust which are arra[illegible] the same lines as at first; but a rock, laminated or not, if subjected to pressure [illegible] time of its crystallisation, will show [illegible] this in the *orientation* of the constitu[illegible] We see this even in the case of a [illegible] occurring in dykes, whose walls p [illegible] making the flat face of the crystals p [illegible] sides. In the crystalline schists that is [illegible] and gives rise to one variety of foli [illegible] crystals in these may be more or les [illegible] formed; they may show no signs of cru [illegible] motion, and they have been formed in [illegible] places where we now see them. The [illegible] this case is entirely *statical* in its eff [illegible] names gneiss and mica schist applied to t [illegible] have, unfortunately, a double meaning: th [illegible] plied both to rocks of this character and [illegible] to be noticed further on; but the two kin [illegible] carefully distinguished from each other. [illegible] pressure is brought into play after the cr [illegible] tion, its effects are different. If it be comp [illegible] slight, the effects will be seen in individua [illegible] A crystal of ordinary character, when [illegible] polarised light, has a uniform tint [illegible] throughout, according to the relation of i [illegible] planes with the plane of polarisation; but [illegible] has been subjected to pressure, a sectio [illegible] same thickness throughout is seen to have [illegible] colours in different parts, then producing [illegible] spectrum. Such crystals have been said [illegible] *spectral polarisation*; moreover as it is [illegible] between the Nicols, the band of darkest ti [illegible] to move across the surface like a shadow, [illegible] spoken of as a *strain shadow*. If the pr [illegible] greater, the crystals may be broken up in [illegible] and overlapping fragments forming a mo [illegible] whose colours of polarisation changing gra [illegible] each fragment, make the boundaries obscur [illegible] has been described as showing *microspectral* [illegible] *tion* when the pressure has been of an inte [illegible] amount. A rare appearance is sometimes p [illegible] in which the separation of the crystal i [illegible] parts is not complete; but there are n [illegible] small curved cracks which, when seen by [illegible] light, give the crystal a crape-like appear[illegible] which has hence been called *crape struc* [illegible] many cases pressure has resulted in [illegible] This seems to occur when a plane of least r [illegible] exists oblique to the direction of pressure. If the [illegible] rock be already laminated or foliated, and the [illegible] pressure is oblique to these already existing planes, the latter may serve as planes of least resistance. Any rock which has been so treated will show irregular, undulating, fine cracks, or lines of dust, which curve round the larger obstacles, and die away at either end, thereby differing entirely from the more or less imaginary lines which may be drawn connecting parallel placed crystals—in the already described rocks—or the continuous lines of original dust in laminated rocks. Such curved lines are known as *mylonitic lines*, and the rocks exhibiting these are known as mylonites. In some cases we can find such mylonites placed where one rock has over-ridden another along a thrust-plane; they always show a high degree of microspectral

The National Telephone Company having reduced their terms, have received a considerable addition to their list of subscribers, and by pursuing that policy now that their patents are either expired or expiring, they will put themselves in a very strong position. It remains to be seen what action the Post Office will take, and shortly we may expect some considerable improvements in the instruments. A telephone which would leave a record at each end would eventually take the lead.

The electric heater devised by Dr. L. Burton, of Richmond, Virginia, which we illustrated p. 47, Sept. 13, 1889, has been put to a novel but appropriate use in the Government Printing and Engraving Department at Washington, D.C. Bank-notes are printed from plates which must be warm whilst the ink is rubbed into the lines, and also whilst it is being cleaned off the other parts previously to taking the impression. Gas has hitherto been used for the purpose; but that has obvious objections on the score of health, and the Burton heaters have now been adopted to take the place of the gas stoves without altering the process.

Another use to which electricity has been applied with success in commerce takes the shape of an electric soldering bit, which has been adopted by one of the largest oil refineries in the United States. Many large cans of kerosene, benzoline, &c., are sent away to all parts of the country, and to avoid risk the cans are closed with a cap soldered on. To reduce risk as much as possible, that operation has been performed in a separate building away from fire; but the loss of time in heating the ordinary bits, and the temptation to have them too hot at first, has been avoided by the use of the electric bit, which is worked by a battery that lasts through the day's work.

The Nicaragua Canal looks much like being completed before the Panama. Work has been commenced of a preparatory character, ten miles of broad-gauge railway being already laid, and about 70 miles of telegraph and telephone lines erected. It is stated that the United States Government proposes to purchase a controlling interest, and also to guarantee 100,000,000 dollars in bonds. The work of actual construction will, it is estimated, not occupy more than six years.

At a recent meeting of the Manchester Association of Engineers, Mr. A. B. Blackburn, assistant manager in Messrs. Mather and Platt's electrical department, read a paper on "Dynamos: with the consideration of the Chief Features which regulate their Application." In concluding, the author referred to the improvement which had taken place in the efficiency of dynamos; in recent machines it was rare to obtain a return of less than 80 per cent. and in the best machines it amounted to over 90, sometimes reaching 95 per cent. In general proportion and design the dynamo, he observed, had arrived at a stage at which little radical change could be expected. The efficiency was already so high that increase was scarcely possible, and seeing that high efficiency was accompanied by a reduction in heating, in sparking, and undue strains generally, it betokened a thoroughly sound and trustworthy machine, requiring the minimum of attention. Future improvements will probably chiefly consist in details of construction, labour-saving in production, and perhaps new and less perishable materials for insulation; the most important problem which remained to be solved being the abolition of the variable sparking point.

It is stated that the Yarrow spirit-launch *Snark*, which has now been running about for more than two years, has not required any repairs, and that the insides of the engines have not even been examined.

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When wort is boiled with hops, a certain amount of nitrogenous matter is precipitated; further. substances possessing antiseptic properties, and others possessing a little flavour, are extracted from the hops.

Important seams of smokeless coal exist in the hills fringing the Gulf of Tonquin. According to Mr. William Warren, an engineer, one of the seams is 152ft. thick. The coal is an anthracite, smokeless, and containing 87 per cent. of carbon. The steamer *Fatshan*, making 14 knots, has been successfully tried with it, and the Gulf will be of great service to the French as a coaling station in the Far East.

# LETTERS TO THE EDITOR.

*[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]*

*All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

*All Cheques and Post-office Orders to be made payable to* J. Passmore Edwards.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

## "ENERGY" BY THE CUBIC YARD—METEORITIC DUST IN SNOW—KLEIN'S ATLAS AND STELLAR PARALLAX—REFLECTING MICROSCOPES—CASTING MEDALS—TELESCOPE—LEVEL-BUBBLE—MINIMUM DEVIATION—LENSES FOR TELESCOPE (?)—TO "F.R.A.S."—LONGITUDE OF ST. PETERSBURG—TESTS FOR 3½in. OBJECT-GLASS—AVOIDING WHAT IS DEW—RIGHT ASCENSION AND DECLINATION—REPORT OF THE SUPERINTENDENT OF THE U.S. NAVAL OBSERVATORY FOR 1890—THE LATE MR. JOHN HAMPDEN—HENRY'S COMET—ANEMOMETER—PLANETARIUM—VIEWING THE SUN BY PROJECTION—MAGIC-LANTERN SLIDES.

[32040.]—It is much to be regretted that paradoxers like "S. H. B." (letter 32002, p. 461) do not make themselves acquainted, as a preliminary, with the rudiments of the subjects on which they set themselves to enlighten others. "Energy" is simply and solely *the power of doing work*, and how any such body as the sun can be a mass of the power of doing work must, I venture to think, pass the comprehension of any human being. A force is not a thing in the sense that a 9lb. shot, a cloud, a race-horse, or a cigar-case are "things." How could anyone hope to be understood who should state that the sun consisted of "a mass of the power of doing work" 866,400 miles in diameter? But, as a matter of fact, we know that among the materials of which the sun is composed are iron, titanium, calcium, sodium, magnesium, hydrogen, &c. Doubtless, the different classes of energy present on our own earth have their origin very largely indeed in the sun; but it is itself a mass of materials, some of which I have just specified, and not of light, heat, electricity, or magnetism. The sun is gaseous or liquid, rather than solid. The perusal of Prof. Young's beautiful volume on "The Sun" (XXXIX. in "The International Scientific Series") might furnish your correspondent with some very useful and much-needed information.

In connection with letter 32006 (p. 463), it may not be without interest if I mention that some few years since, at the instance of Mr. Ranyard, I tried the experiment of chemically cleaning a large milk-pan, and placing it out in the middle of one of my fields during a snowstorm. Upon carefully melting the snow, which filled the vessel, and filtering it through filtering paper, I obtained a deposit which was mainly metallic, and the grains of which were attracted by a magnet in a very instructive way, when viewed under the microscope. It is almost needless to add that they must have consisted of meteoritic dust, brought down by the snow from the higher regions of the atmosphere.

I do not possess Klein's star atlas, but if the quantities given by "Julian" (in query 73507 on p. 470) appear in it, they are decidedly wrong. Beginning with the parallax and distance of $\eta$ Cassiopeiæ, I know of no later measures than those of Otto Struve, which were micrometrical. They gave a parallax of ·154″, which would make the star's distance 123,749,000,000,000 miles. Adopting a parallax of ·371″, this distance would be reduced to 51,367,500,000,000 miles. Polaris, according to the splendid photographic results of Prof. Pritchard, has a parallax of ·052″, which would place it 366,487,000,000,000 miles from us. The parallax of 61 Cygni, also measured photographically by Pritchard, is 0·4321″, and hence its distance must be 44,105,000,000,000 miles. Finally, our best determination of the parallax of $\alpha$ Centauri is that by Gill and Elkin, who make it ·750″, or, in other words, place it at a distance of 25,409,800,000,000 miles from the centre of our system.

In reply to query 73508, p. 470, I may tell "Reflector," that reflecting microscopes were made in England between 150 and 160 years ago, and that pretty early in the present century Prof. Amici, of Modena, invented a very perfect and useful instrument of this form, which was subsequently improved upon in this country by Cuthbert and Goring, but the reflectors were too difficult to make and troublesome to manage, and wholly disappeared as the achromatic object-glass developed.

I should like to point out to "Puzzled" (query 73524, p. 471), that under 24 and 25 Vict. c. 99, s. 2, making or counterfeiting any coin resembling, or apparently intended to resemble or pass for, any of the Queen's current gold or silver coin is a felony, punishable with penal servitude. Of course his intention is innocent enough, but he is sailing rather too near the wind. Selling the imitation sovereigns or "Hanoverian Medals," which people used to employ as whist markers, was summarily put down by 46 and 47 Vict. c. 45, s. 2.

The telescope of "Helios" (query 73531, p. 471) is certainly a phenomenal instrument, for I never in my life have heard of a 2in. achromatic of only 11in. focus! It should be 28in. in focal length at least. I really should hesitate to recommend him to get a new eyepiece to such an affair, the description of which reads like that of one of the old "night-glasses" used by sailors, the objectives of which, by the way, weren't achromatic at all, as no necessity for achromatism existed. If, however, he is sure that his object-glass is a double one—is in fact, really achromatic—and he chooses to go to the cost of a new eyepiece, if he had one made with the field-lens 1·1in. focus and the eye-lens ·37in. focus, and placed them ·73in. apart, he would get a power of 20, with which he might see something of the larger sunspots. Perhaps I should add that these lenses would be plano-convex, with, as in his existing eyepiece, the convexities turned from the observer's eye.

"G. W. W." (query 73540, p. 471) must have a new bubble-tube put to his level, as the ether with which it is filled has evaporated through the crack in the glass. I have had personal experience of such evaporation through the (apparently) carefully closed end of a bubble-tube belonging to the delicate level of an astronomical instrument, the contained fluid being extremely volatile.

It is only necessary to say, with reference to query 73545 (p. 471), that at the angle of minimum deviation there is no distortion; but that (as "L." says) when a collimator is used there really is no particular reason for placing the prism at that special angle, save, of course, the tendency to alter the breadth of the lines and, proportionally, the length of the part of the spectrum under examination.

If "P. J." (query 73555, p. 471) would take my advice he would use his lenses to make a camera-obscura, a cosmorama, or peep-show of some sort; but as he is very unlikely to do so, he had better read carefully the numbers of the English Mechanic for the last two months, as he will find directions in them (emanating from enthusiastic and imaginative amateurs) for doing the best possible with the materials at his disposal.

If "F. P." (query 73558, p. 471) does not mind waiting until I go up to London, I will willingly do what I can to help him.

The first query (73561) of "Amateur," on p. 472, scarcely admits of a categorical answer, inasmuch as some of "the various astronomical occurrences (which appear in the Astronomical Notes of the 'E. M.')" are not visible in St. Petersburg at all. But with reference to such phenomena as those of Jupiter's satellites, &c., they occur just 2h. 1m. 1·5s. later at the Academy at St. Petersburg than they do at Greenwich Observatory. For example, on p. 2 I find that you predicted an eclipse of Jupiter's first satellite to happen on Nov. 12th at 8h. 8m. 48s. p.m., Greenwich Mean Time, so that this must have occurred at 10h. 10m. 1·5s. St. Petersburg Mean Time. In the case of occultations of stars by the moon, not only does the notable motion of our satellite herself through the sky come in, but the difference of latitude materially shifts her position with reference to any given star, so that no rule is applicable, and the calculations must be made afresh for your correspondent's station.

Turning now to query 73562, on the same page, "Amateur" should really look through your back volumes, where he will find tests for every size, sort, and description of telescope; but he may try 36 Andromedæ, 42 Ceti, $\epsilon$ Arietis, 6 Cassiopeiæ, $\iota$ Leporis, $\alpha$ Andromedæ, or 49 Piscium. He ought to have a higher eyepiece than his 126 one, though, for some of these objects.

And next (query 73653, p. 472), he should have a long dew-cap over his telescope, consisting of a tin or other metallic cylinder, bright outside, and densely blackened within, which goes over the object-glass; 14in. will not be any too long for this. This will to a great extent prevent dewing. As to the eyepieces, they may be warmed, and kept in the observer's pocket until they are actually wanted for use.

Lastly, query 73654, p. 472 is meaningless, because the Right Ascension and Declination of a and does. Mr. Lockyer doubtless makes mistakes. Has "F.R.A.S." never done the same? To my mind, his attacks bear the unmistakable impress of some personal dislike. I do not know Mr. Lockyer, except from his writings, nor have I any interest in South Kensington; but the professor there has my warm admiration for the dignified and gentlemanly silence with which he meets this perennial torrent of abuse. But it really passes endurance to read in your issue of last week the letter (32020, p. 484) of Mr. Godden, who, apparently thinking that a great man has fallen, comes forth to kick him in the face, and has only succeeded in showing that his want of knowledge is on a par with his behaviour. All I can say is that if Mr. Godden has been even but a "few years" engaged in the study of the heavens, and does not yet know that Vega, the second or third star in the sky, has a small *comes* (at about 40″), the sooner he takes to learning the A B C of the stars the better for him. Mr. Lockyer's book is, it seems, too advanced for him in his present stage. **Indignans.**

### RE ALPHA LYRÆ.

[32044.]—In writing letter 32020 I must have been acting under the confusion occasioned by the indiscriminate use of the same word for two distinct aspects of a case.

To one who has to do his solid reading by brief snatches in intervals of business, clear expression on the part of a writer is a perfect godsend. Prof. Young, in his "General Astronomy," does nicely distinguish between "binary" and "double" stars, while—what carried me off in above letter—Mr. Fowler is reported ("E.M." Jan. 16, p. 438) as saying: "I feel bound to acknowledge that *a* Lyræ cannot be a double star, as I suggested." I have never turned a telescope upon Vega; but I see Proctor's "Half-Hours" makes it not only optically double, but very multiple, when adequately scrutinised. Hence I sincerely regret having called in question Lockyer's accuracy in this matter. But why cannot Prof. Young's method of discrimination be generally adopted by writers and speakers? If "the duplicity of Vega" had been rendered "the binary constitution of Vega," an isolated, hurried reader could scarcely fall into such error as I did. **William Godden.**

43, Hindon-street, Pimlico, Jan. 30.

### THE MOON'S ATMOSPHERE.

[32045.]—I beg to assure Mr. Ranyard (32019) that my theory is not that the molecules of vapour are thrown off with velocity. Of course, they must have motion; but it does not follow that it is their initial velocity that carries them beyond the sphere of the moon's gravity. I have avoided reference to the kinetic theory, and therefore I decline to say anything about it either in attack or defence. It is sufficient for me to perceive that the elasticity of a gas is restrained by the gravity of its molecules, and that this gravity is diminished by distance from the attracting globe.

Of course, I am aware that the strata of an atmosphere increase in volume with their elevation; but I am not aware that their increased spread has anything to do with the pressure of the atmosphere on a given area—the only way in which pressure can be measured. The increase of spread does not balance the decrease of gravity, the two conditions not admitting of comparison. I am quite satisfied with Mr. Ranyard's admission that the decrease of gravity alone would cause an atmospheric stratum to be thickened. This is what I said should be the result, and I am glad to have the accuracy of my perception once more confirmed. I said that the stratum of the lunar atmosphere corresponding to 3½ miles of the terrestrial should be more than 21 miles. It is now increased to 22 miles; but I do not admit that the "successive steps" will be 22 miles each. The second step will be nearer 24 miles, and at the height of about a thousand miles the step will become 88 miles. These quantities are not *négligéables*. The increases in the thickness of the steps are a great help to my theory, bringing, as they do, the molecules of the moon's atmosphere towards the earth and sun by "leaps and bounds."

It should not be overlooked that, with the thickening of the atmospheric strata, the lifting power of the attractions of the earth and sun will be largely increased. That the corresponding lifting power of the sun and moon is exerted on the earth's atmosphere is evident, for if it did not exist, the atmospheric tides would cause great fluctuations in the barometer. Perhaps even the theory of the oceanic tides requires to be supplemented on the same account, so that the pressure on the ocean's floor need not be appreciably greater at high water than at low water. It may even be less, because the transmission of pressure or of its diminution is quicker than the march of the tidal wave.

Feb. 2. **Ja. Ha.**

### TELESCOPE FOCUS.

[32046.]—There are two different questions involved in this—a mechanical and a physical. The mechanical is easily settled, being a mere matter of calculation. If we take A = semi-aperture of telescope, F = focal length, D = distance of moon or other object, and E = elongation of focus as compared with parallel rays, then very approximately in such long distances as the moon $E = \frac{AF}{D} \times \frac{F}{A}$. This differs little from $\frac{F^2}{D}$, and in the case of a mirror 12in. aperture, and 80in. focal length, E amounts to $\frac{1}{2346000}$th of an inch.

But the fact remains that some observers do find it necessary to alter focus for moon and stars, and the explanation is to be sought physically. The pupil of the eye contracts considerably when exposed to the blinding glare of the moon in a large telescope, and this has considerable effect on our perception of focus. I believe also that the focus of the eye does shorten under powerful excitation from quantity of light. It is in this direction the necessity of altering focus of telescope must find an explanation. Of course, with terrestrial objects a very considerable difference of actual focus is found. **Edwin Holmes.**

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[32047.]—Though Mr. G. Calver, in letter 32023, attributes to me statements I never made, and fails to prove anything whatever with his letter, except a long-felt sore, I must reluctantly notice it. He charges me with expressing opinions about telescopes which do not "agree with actual observation, and with *being perfectly wrong*" in disputing the late Mr. Webb's statements (which I never did). My words in letter 32003 are:—"Taken literally, 'Wega' may well be astonished at the statements he quotes. They *seem* (according to his own experience and those of many others)—the words in brackets explain my meaning—unwarrantable conclusions, drawn from abstract theory rather than from actual observation, and in that sense they are true enough." To solve the doubt I suggest further on, that some mathematical contributor should calculate and tell us *how much shorter* the focus of rays from the sun is than that from rays of the moon. Now, I think no other than a *biased* mind could construe these words into an attack on the late Mr. Webb's statements. If anyone questioned them, it was "Wega." As for myself, whatever I thought, I defended them by saying, that in *theory they were true enough*. But Mr. Calver, who has a long-standing grievance to air, says that I describe as an *unwarrantable conclusion* the fact that a telescope requires focussing differently for different objects. That, at least, is the only meaning I can draw from his wording.

But let us suppose, for argument sake, that I questioned the statement that the moon and the stars required *practically* a different focussing. How would Mr. Calver have proved that Webb meant that, or derive the conclusions from *actual observations?* I believe his book was originally intended for observers with *small telescopes*. His later editions, which he knew would be consulted by observers who had fairly large ones, should, according to Mr. Calver, justify the statement the more; and yet, either of his own accord, or at the suggestion of others, he expunges it. What inference does Mr. Calver draw from that fact? But I will go further, and say that it would be very difficult for any *single observer* with a 3in. to 4in. refractor, *to prove* that a slight improvement of the image was due to a movement of the eyepiece in a direction opposite to that of the object. Since that improvement can be due to various other causes, what observer is absolutely certain that his eyepiece is in the best position when he uses high powers on faint objects? *Practically*, the image of an object is never formed in a mathematical plane. The plane in which it is seen has a certain thickness. Some rays form it on the front face, some on the back face, some between them, some before, and some behind it, because the best of the glasses are imperfect, and to the imperfections of the o.g. mirror come those of the two, three, or four lens eyepiece, and the quality and condition of the eye. Altogether, these imperfections leave always the impression of some uncertainty and vagueness. You can move the eyepiece a little forward or backward without noticing much definite change in the image.

As far as my opinion about telescopes not "agreeing with actual observation," why did Mr. C. not object to them when they appeared? Why rake them up now, when the reasons I gave at the time are forgotten? I challenge him to prove that any of my opinions were wrong. The English Mechanic is the amateur's guide *par excellence*. Its Editor, by freely admitting the pros. and cons., serves the interests of the majority, and has no need to be told by interested outsiders what is and what is not legitimate matter for discussion. What turns the beam one way or the other when we meditate on an acquisition is the *pocket*, or the marketable value of the article. I can well understand Mr. Calver's wish to keep that point out of sight. It must be painful to him to see reflectors becoming ugly, abandoned incumbrances in back gardens, or stowed away for months in black corners of auction rooms. I have never felt disappointed by seeing customers applying "to them who know" rather than to me. As long as I can buy 6in. Calvers completely mounted and in good condition at £3 10s., I stand all right (pardon me for taking such a *dealer's* point of view again).

I would not be understood to say a word against the intrinsic merit of a good reflector when in permanent use, and in the hands of a professional observer. They are established beyond question. All I contended was that, in the hands of a bad, shifting amateur with little perseverance, they would soon become undesirable incumbrances, and prove bad investments. **A. Caplatzi.**

### LONG RAYS OF LIGHT VISIBLE AT SUNSET.

[32048.]—Referring to Canon Beechey's observations of a long ray of light visible at sunset, I saw a similar effect a few years since while in the company of my friend, Mr. T. Broughton, at Heaton Mersey, near this city. The ray was quite perpendicular, and apparently proceeded from the place where the sun had set, and remained visible many minutes, and it was so distinct and well marked that it could have been photographed if we had thought of it at the time. We have often regretted that we missed the chance, as the phenomenon was very remarkable.

May it not have been that the comet lately referred to in the papers as only seen on one evening, was an effect of the same kind?

**A. Brothers, F.R.A.S.**

Manchester, Jan. 26.

### JOHN HAMPDEN'S ORIGIN.

[32049.]—I see in "E.M." to-day a short paragraph announcing John Hampden's death, aged 71. A few days previously I had a funeral card, for, strangely enough, the father was rector of Hinton Martel, and the said John (of old) was brought up here, and a neighbour of mine still has one of his published books. He was by no means a fool, but decidedly mad on his one hobby. He also had unorthodox views of the Bible (he was not alone there !), and issued a "Criticism on Daniel's Prophecies."

I knew a Hampden was rector here many years ago, but had no idea it was the same family. Bickersteth, the present Bishop of Exeter, also held this place, so you see that it is a mighty celebrated parish. Being very hilly, too, it is not suggestive of a flat earth. **Jas. Lukin.**

Hinton Martel, Wimborne, January 30.

### GAS-ENGINE.

[32050.]—It seems to me there is a great future for these engines if some enterprising engineer can see his way to produce them at a nominal figure. For a man of small means to talk about £5 or even £7 10s. for an engine is ridiculous—he could not afford it. Gas-engines ought to be made as cheap as dynamos, down to 15s.; but I should be glad to see them made, even rough finished externally, at prices commencing at 20s., with an advance of 10s. to any price they like. There are plenty of caterers for the rich, but seemingly none for the poor. What is the use of advertising dynamos cheap without cheap engines to drive them? They begin at the wrong end of the stick. Let them first supply a cheap gas-engine at 20s., 30s., and 40s., and then thousands can get a really cheap light for next to nothing. The engine would be highly appreciated for small power purposes.

**Regent.**

[Gas-engines will be half their price all round soon. Nobody should buy who can help it just now.—Ed.]

### THE VIOLET FLAME FROM COMMON SALT.

[32051.]—"W. T. N." is apparently one who thinks whatever is printed in a book must be true. I am sorry to be obliged to throw discredit on all works of reference, but coke almost invariably contains small quantities of hydrogen, oxygen, and nitrogen, in all not exceeding 2—3 per cent. Wood charcoal also contains hydrogen, say, 2—5 per cent., which cannot be expelled by any known degree of temperature. He must allow me to point out that red-hot cinders are not coke; the latter is prepared by heating coal out of contact with air. In absence of published analysis of partially-burnt coal, I maintain my expressed opinion that it still contains some hydrogen. If this objection to my theory is the only one that "W. T. N." can urge, I consider it of a trivial nature. If he has others, it remains for him to offer a better explanation of the phenomenon.

Birmingham. **A. Percy Smith.**

### ORGANETTES.—III.

[32052.]—Before proceeding further I had better insert here as a kind of long parenthesis the following suggestion.

Though the method of marking-off and cutting-

and cutters suitable to be used with such a spindle are usually small, and will bear being worked at a good speed. There is plenty of room for a good-sized pulley, say 6in. or 8in., and this, with the band once and a half round it, I think ought to supply power enough for any work the spindle is capable of doing. If I am told the gearing is simply substituted for this large pulley, which, perhaps, is not considered ornamental or expensive enough, that is all I want to know. Those who do not care for the ornament, and are not equal to the expense, will then know where they stand.

Now as to a lathe appliance, I would like to see described, as one out of many I would mention, one for making round-faced circular cutters. Northcott's design I do not care much for: though it may be very good, it utilises no part of the lathe slides, which I think ought to be done.

I have just made a set of patterns for a French plan, described and illustrated by me in "E. M." a great many years ago. But as my sketch was very rough, and I took no notes at the time, I find now there are a good many points on which more information is needed. How are the forms of the guide-plates arrived at?

When writing my letter of ten or twelve years ago on the subject, I was under the impression the guide-plate was of same shape as the face of the blank, when the tracer was a point, but I find this is not the case, and it can only be so when the tracer is of same diameter as the cutter which is used. It is rather late to make the correction of my sketch, but I can only hope, as I have heard no complaints, if anyone attempted to make it, he was not led much astray by what I formerly contributed. And here I may say it is now fully two years since I last wrote on lathe matters. Those who charged me with causing the withholding of innumerable valuable devices and ideas, through fear of my destructive criticism; have had the paper all to themselves to ventilate their ideas, and prove their charges, if they were true. Yet, notwithstanding this long *close season*, during which I have kept my promise that I would not touch, even in the most delicate way, any one of their productions, I think it can hardly be said, till just now, when lathe matters appear to be moving, that the period was marked by the sudden sprouting up of the hidden inventions we were led to believe were only waiting till it was safe to rise above ground. It has seemed to me, on the other hand, that the time has been particularly barren of all matters of interest on the lathe question. But let me hasten to reassure the minds of my false accusers—if any are still readers, though not contributors, to our columns,—though I am now writing and may write again, it is not to such as they I write. They may still propound their schemes, as far as I am concerned, with perfect safety. I shall not have a word to say which would ruffle their self-composure.

Some little time ago, a new style of wheel cutter was illustrated in these pages, and commended. That which was new in it seemed to be its worm gearing, which was rated, I think it was stated, to give one revolution of cutter for three or four of the driving wheel. This seemed to be such an exceedingly slow speed to drive any cutter such as would be suitable for a foot-lathe, I was at a loss, at first, to see on what the favourable judgment was based; but as I have never cut a wheel, though I have done a good deal in the way of milling iron and steel, my ignorance of the reason for recommending so slow a speed for wheel cutting must be excused. When grooving taps, which I have done up to ⅝in., I have always driven cutter, at least, at as fast a cutting speed as I would have driven steel for turning. Why the rate of cutting for wheel teeth should be six or eight times as slow is what puzzles me. Perhaps some one can explain the anomaly. **Fredk. Carre.**

## LOCOMOTIVES AND LOCOMOTIVE RUNNING.

[32055.]—Being a locomotive-engine driver, I should like to offer a few remarks anent "Nun. Dor's." letter (32013, p. 465). I commenced my railway career as a cleaner, and went through all the grades until I attained the position of a driver. The engines on the railway where I commenced were all constructed with air-tubes or holes, which allowed the air to enter the fire-box above the coals, both in front and back, about 14in. above the fire-bars, and some little distance below the fire-door. The fire-bars were level, and we used a level fire about 12in. in depth. When running the fire was always kept about the same depth by adding coals in small quantities, according to the load the engine was pulling. These engines were practically smokeless with careful firing, and the door always shut unless when opened to admit coals. Before the steam was shut off we would shut the damper and apply the blower; then, when the steam was off entering a station, there would be no smoke, and the fire-door shut. If the fire was clear the damper could be left open. This we found to be a great advantage at night, by the cab being kept dark, which allowed us to see signals better. These engines had no brick arch in the fire-box. At the present time we have got engines with a brick arch in their fire-box, which have no air-tubes, only the fire-door to supply air to consume the smoke. These engines have a slope in the fire-bars from the door to the tube-plate, and require a much lighter fire than the air-tubed fire-box. About 8in. is sufficient, and when firing require the coals in much about the same way as the former, only the fire-door must be kept open a few inches to admit air on the top of the coals in fire-box, which is distributed by a baffle-plate set in the top of the fire-door at an angle, to distribute the air on the top of coals right underneath the brick arch, which, with the addition of plenty of damper, tends to burn the smoke when running, and when shut off the door must invariably be opened, the damper closed, and the blower full open to prevent smoke, but which means a scorching heat on the driver's legs, likewise the light from the fire blinds him. I cannot agree with "Nun. Dor's." quotation from "Locomotive Engine Running and Management," by Mr. Sinclair, because the fire must of necessity be augmented; better do it by adding small quantities and often, than by heaping in a large quantity of coals, which will be some time before they kindle properly, which will chill the plates and flues to a greater degree than the former plan.

**R. Esson**, Driver.

4, Bedford-road, Aberdeen, Jan. 26.

## CONTRACTION BY DAMP.

[32056.]—I thought I had explained the matter referred to in letter 32031 on p. 446. A catgut string is twisted when damp, and on drying it retains the twist. When under tension there is a tendency to straighten the coils, which is resisted by adhesion. When the string is damped the adhesion is lessened, and the string elongates. In other words, a hard, dry string offers more resistance to elongation than does a soft, wet string.

In letter 32034, "Analytical Methods," line 10, for *illiterate* read *illiterati*. **Sm.**

## PNEUMATIC CLOCKS.

[32057.]—Living, as I ordinarily do, in the country, I am, perhaps, a little "out of the swim" as regards keeping up with the current of contemporary progress. I was, at any rate, unaware, until I visited Paris recently, that in that city you can lay on your time from a main in the street, just as you lay on your gas or your water. I found that every clock in the hotel at which I stayed was worked on the pneumatic principle. The ordinary works of the clock are removed, and replaced by a little mechanical arrangement which enables a puff of air, coming through a fine pneumatic tube which is introduced at the back of the clock, to propel the minute hand over a minute space on the dial. It is, of course, arranged that the minute hand shall, in its turn, move the hour hand over its proportionate space. The impulse which produces the puff of air comes from a central station in the city once every minute, and is propagated through the various ramifications of the system to the several houses, the several rooms, and the several clocks which are directly or indirectly in connection with the centre of force.

The clocks do not "go" continually. Movement of the hands takes place only once a minute. In the interval the hands are at rest. Of course, all the clocks connected with the pneumatic system mark exactly the same time, which is regulated at the head station. No winding up is required, the clocks have simply to be left undisturbed. They are, however, deprived of their striking apparatus, as well as their escapement works. One misses that audible record of the flight of time, but it is a comfort to know that the clock in your bedroom and that in the hall of the hotel are in exact agreement with that at the railway station.

**C. P. Mason.**

## AN IMPROVEMENT IN THE STRIKING PART OF CLOCKS.

[32058.]—Perhaps space will be allowed me to correct an inaccuracy of statement which occurs in my communication on the above subject which appeared in your last number.

I stated in effect that a "narrow straight bar," as a form for the safety-piece, would answer as well as any other. That is not so, as under one condition only—that is, shortening the lever's arm—can such a form be employed. The arm should be of such a length that its point, when resting against the spur, occupies the position, as near as may be, of the vertex of a right angle formed by lines drawn to the holes of the wheel and lever respectively. Under such conditions a straight bar would not allow a free drop to the arm; and the necessary freedom could be obtained only by under-cutting the side.

I observe that the word "if" has been put to a sentence in the third paragraph, rather tending to obscure the meaning. I do not think I have to own to that mistake. **Jas. Haswell.**

38, Elizabeth-street, Eaton-square, Jan. 31.

## AUXILIARY POWER FOR TRICYCLES.

[32059.]—In answer to "Jack of All Trades" (letter 32039, of Jan. 30), it is perhaps as well that he should know that there are also reducing valves in the market, which can be, and are, attached to these $CO_2$ cylinders—in fact, they can be seen at the bars, or in the cellars of restaurants, hotels, &c., where they are attached to one or more barrels, or to a line of piping, which has branches to the taps of as many barrels as are required for use at the bar. This reducing valve has a gauge attached, so one can adjust it to whatever pressure may be required to force the drink to the required height. It can be set so as to regulate the flow of gas, and keep a uniform pressure in all the barrels, from 1lb. upwards, although the pressure in the cylinder may be over 1,000lb.; it then requires no further attention until the cylinder is empty.

When the liquid $CO_2$ is let flow from the cylinder by opening the valve, it assumes the solid form as snow, which, when pressed between the thumb and finger, raises a blister, and if thrown into water it floats and freezes the water, and quickly covers itself with a coating of ice. I have seen as much as 90lb. of solid $CO_2$ in a lump.

**F. C. S.**

## IS IT POSSIBLE TO CURE BLINDNESS?

[32060.]—I fear that Mr. W. B. Sutton (letter 32025), will find this difficulty (among others) insurmountable—viz., that the living part of the eye—the retina, or fluid media in front of it—must come to an end somewhere, and the surface so formed must be a transparent one. This surface must either be a free one, with a space between it and his apparatus, or must join on to his apparatus by a transparent junction.

The only free, transparent membrane of the living body that can stand the air is the cornea, and this is gone. Everthing else is opaque, or else inflames when next the air. The same may be said of any attempt to get a living fluid, or tissue, to join on to his apparatus, for all transparent living tissues will become changed in contact with dead material except skin, hair, and cornea, &c. If he uses the crystalline lens it would at once form a cataract, and the fluids themselves—aqueous or vitreous—are being continually renewed and are alive, and would almost certainly become cloudy if one side of their living skin were made of dead matter. Of course, besides this, the pressure is regulated on the retina, and numbers of conditions are maintained in each transparent medium of the eyeball, by continuous vital changes and processes, which would be troublesome to deal with. But this one point—how to get a transparent surface to the living part, which shall not be an irritable sore at the same time?—will be a difficulty; the difficulty, as it is now, How to replace the cornea?

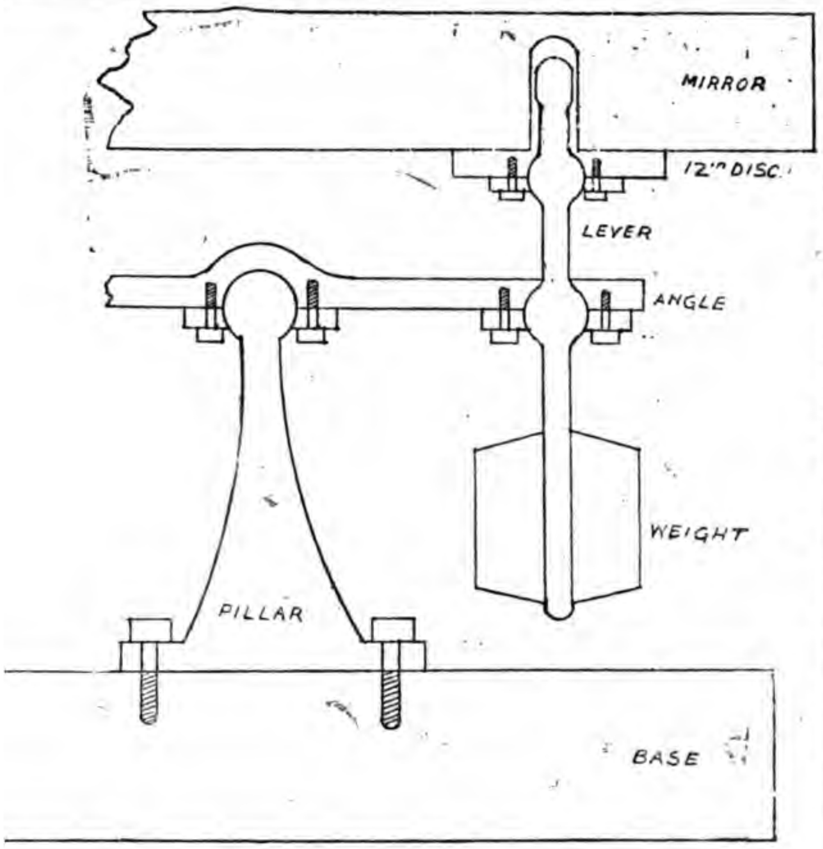
Shanklin, Jan. 30. **H. G. Dixon.**

## SPEECH IN LOWER ANIMALS—THE PHONOGRAPH.

[32061.]—It seems that my remarks on the above subject have displeased "A. S. L." How he can have experimented with the phonograph and not have noticed the change of pitch when the cylinder is turned at different rates, is, to me, inexplicable. That such is the case can easily be proved by anyone having a phonograph.

"A. S. L." asks how it would account for the fact that a smooth cylinder may produce a louder sound than when indented with sound impressions. Although this has nothing to do with the point in dispute, I think there is an evident explanation. When the point rubs on the cylinder there is friction, and when it is smooth the friction is regular. This acting on the point distorts the diaphragm. By and by the tension of the diaphragm overcomes, and the point slides or jumps, and a rhythmic motion is set up, much in the same way as sound is produced from a fiddle-string, the drum taking the part of the bow and the diaphragm that of the string, the vibrating period or note being determined by the vibrating period of the diaphragm. When the stylus lies in the groove of indentations, this regular and rhythmetic action clearly cannot obtain, as the varying pressures on the rubbing surfaces interfere.

I do not agree with "A. S. L." that the making of the recording and reproducing points different is contrary to theory. If "A. S. L." will consider the mechanical exigencies of the case, he will notice that as the office of the one is to cut the wax, so the other should be formed *not* to cut but to follow in the footsteps of the recording one. The latter should, therefore, be made unangular, that is, rounded, and must be made small, so as to be able to enter and follow the varying and minute differences in depth. The reading-off diaphragm should have a very short vibration period—that is, shorter than the wave-period it is desired to reproduce, so that it shall follow the phonographic impressions truly to the bottom. This may be secured by what I may call its tension; but by making the diaphragm small and light, this can be secured without undue pressure on the wax.



rding diaphragm is under different con-
t has the elastic air-waves acting on it,
other has the inelastic wax undulations
; the same office, and so the elasticity has
n the diaphragm. **A. R. Molison.**

## ROVED SUPPORT FOR LARGE SPECULA.

—REGARDING the reflector as the telescope
ture (for sizes, say anything over 5ft.
have conceived what may be considered a
pport for the specula of this form of
and here give a description of same for
of those who may choose to adopt it in
'resuming that specula can be produced
d, say a 10ft. disc, what kind of support
for such a structure?

ready known that a system of three
o disposed upon a base, and arranged so
an equal share of the mirror's weight
points, is a perfect arrangement so far,
orizontal position. But when the mirror
from the horizontal towards a vertical
point will be attained where the mirror
off the angles. To prevent this a band,
arranged round the edge to receive its
ght.

arge mirror, partly supported on its edge
nner, is liable to distortion, especially the
ion, from the pressure of its own weight
and, or rim; the angles at the back will
it one iota to maintain its proper figure,
ir function to allow it to take any form it
moreover, that large structures have not
proportional rigidity that small ones
ther words, a speculum of given dimen-
given imperfect support might perform
well; but a speculum of twice the size
ame conditions would be intolerable—not,
, from its greater magnifying power, but
act of its want of the same proportional
It is just here the mirror requires a better
r its inclined position, or, I may say, its
sition, as it receives its full weight while
its lower periphery, and this better
ıst fulfil the same balanced forces as the
'e when in a horizontal position, or it can
fect. Now the method I am about to
ill, I think, be found to fulfil this, and
more: it will allow for difference of
of the two materials, the glass, and its
rting system, as may readily be perceived
owing description.

uitable base-plate, upon this let there be,
g pillars evenly spaced and bolted thereto,
rcle, say half the mirror's diam.; the
of the said pillars to be spherical, so as
rt of a ball-and-socket joint. Upon the
ese let there be fitted three suitable
ngaging the pillar ends by sockets fitted
ntres, and having a small lateral move-
t a horizontal plane, and balanced also for any position. There being three angles, there are nine arms or ends; at each end let there be sockets fitted, like the centre ones, to receive a counterpoise rod or bar, say about the length the pillars are themselves, with a spherical part on about the middle, this part being engaged by the socket on end of triangles, and having also a small lateral movement. The upper ends of these rods will be somewhat rounded or egg-shaped, and are to be inserted in holes made in the back of mirror directly opposite each counterpoise lever: the holes to be rather deeper than the mirror's half-thickness, and the size rather larger than diam. of egg-end of levers, so that the lever ends may bear upon the side of holes at centre of thickness without at all touching the bottom or any other part.

Now on these same levers, just below the back of mirror, let there be also spherical portions turned upon them, to carry say 12in. discs, also on the ball-and-socket principle, for the back support of the mirror, and on the bottom end of levers balance-weights must be fixed equal in weight to that portion of mirror in which they are in immediate contact and intended to balance. If the mirror be all one thickness, then all the weights will be alike, and added together will equal the mirror's total weight. I might just say it would be better if the egg-end of the lever, and also the faces of the 12in. discs, were sheathed with leather to keep the iron from contact with the glass.

Reference to sketch, where I have shown a section of one of the pillars, with part of its triangle and a counterpoise lever, weight, &c., will convey a fair idea of the whole thing. To describe its movements as it now stands horizontal, it may be said that if a person gave it a slight push in a horizontal direction it would obey that force, and remain when released, and if it stood vertical, or in any other intermediate position, it would do the same. The mirror would be balanced, as it were, in a viscid liquid of its own specific gravity.

I have now described the whole thing, and it may be said that drilling or boring holes in such a structure would likely lead to fracture. That may or may not be true. However, they could be cored in at the time of casting.

Mr. Common has shown how large discs can be built up, and I have no doubt he could point out how holes could be left in them.

In conclusion, let me say a perfect instrument of 10ft. diameter would do something towards celestial photography for the future. **Geo. Whittle.**

61, Walton-road, Liverpool.

## THE AVERAGE OBSERVER.

[32063.]—I AM very gratified to find such authorities as "A Fellow of the Royal Astronomical Society" and Mr. W. J. Grey endorsing my opinion as to the rarity of the "accurate observer." My general attitude of caution in all matters of average testimony secures for me so much misunderstanding, that it is quite refreshing to find my views shared by sounder judgments than my own.

The following record of a series of experiments made to test the reliability of "the average observer" may interest some of your readers, especially as I believe no such data are on record. I suppress the names of the participants, but they are at the disposal of any scientific reader of the "E. M." who desires corroboration of my notes.

The circumstances which gave rise to the experiment were these:—In Jany. 1882, a civil action was tried in the Queen's Bench. In it an important question turned on what really took place at a certain interview at which five persons were present. It was alleged by the plaintiff that on the occasion in question he entered a room carrying in his hand a sheet of foolscap rolled longitudinally; that he laid it upon the table in the sight of all present, and that once during conversation he distinctly indicated it by a gesture. This story was corroborated in the main by two gentlemen, disinterested parties in the action, but was totally denied by two others, equally disinterested. The jury delivered the defendant's version.

These facts, and the discussion they excited among certain friends, induced me to carry out the following experiments one evening after dinner. I asserted the broad proposition that I should enter the room, remain an indefinite number of minutes, perform distinct actions, and make distinct remarks, and that in no case would all of the seven observers present agree in describing accurately, five minutes afterwards, either in writing or orally, all that I did.

To insure accuracy, I drew up privately a detailed programme, describing exactly what I did do, and held it in my hand for reference. The conditions were that I should enter the room twice, performing a distinct set of actions each time, and that after an interval of five minutes from the conclusion of my second entrance, each person should describe in writing whichever of the two entries I indicated. There was to be no prompting, and no amending what was once written. A description of my first entry will give an idea of the character of the experiments.

Entered room, carrying book in right hand; advanced towards table; slightly moved chair; sat down in it long enough to open book; read aloud title-page; remarked, "This is from Jones's collection: I have the original edition, but the bindings are shabby"; rose, carrying book; walked to piano; adjusted music on stand; asked B. if he had heard Pinsuti's latest song; laid book on piano-lid; stood on hearthrug with back to fire; made remark to C.; looked at watch, and, retaining it in hand, left room, laying book on sideboard as I passed, and, in closing door, appeared to have difficulty in turning handle. Time occupied, 4½ minutes.

The second entry was a little more elaborate, the number of distinct actions being 13; time occupied, 6 minutes.

I selected entry No. 1 for description. Result:—No one described all I did; three omitted incident at piano; two omitted remark made on hearthrug; three blundered over order of procedure. None repeated accurately any one remark. In cross-examination, the results were yet more surprising. Here are a few questions I asked, with the number of correct replies:—"In which hand was book?"—three. "With which hand did I remove chair?"—four. "On what portion of the piano-lid did I place book?"—five. "With which hand did I open door?"—four.

Eight other tests were made, and 36 questions were asked in cross-examination. To only three questions were the answers unanimous.

It may, of course, be objected that these were practically tests of memory, and to a large extent this is the case. But what is to be said for the following cases of distinct misperception?

The answers to these questions were not given verbally, but written down. 1. "Where were my glasses?" (*pince-nez* attached in usual way by cord). A. answered correctly. B. said, "In right hand"; D., on nose; E., did not notice; F., uncertain—thought they were on; G., certain they were held in left hand. They were in my watch-pocket.

Question 2. "How long was I in the room?" A., about ten minutes; B., not ten; C., uncertain; D., over ten; E., about fifteen; F., from five to ten; G., uncertain—should say ten minutes; actual time, 4½min.

I may here remark that in only one case did anyone estimate the duration of time within three minutes of exact period in any subsequent test.

Question 3. (Asked at conclusion of 8th entry.) "How many times had I passed within touching distance of a small table situate in corner opposite door?" A., about five; B., ditto; C., three; D., "almost every time"; E., could not say; F., dubious—perhaps three; G., four. I had carefully refrained from approaching within 5ft. of it. In order to insure certainty I placed a mark on the floor. For my fourth and seventh entries I changed my dress coat for a black "cutaway" coat. Two ladies noticed it, but only one gentleman "fancied there was some change." Before 2nd, 4th, and

7th entry I removed my watch-chain—a large and prominent one. In answer to questions put at the end of last entry four admitted having noticed its absence, but no one could specify at which entry it was absent.

It must be admitted by all that the conditions under which these tests were made were unusually favourable for careful and accurate observation, for not only were all on the look-out, but they practically knew what to look for. If under such favourable circumstances the results were so diversified, as the appended analysis shows, what is likely to be the average of reliable results under conditions which are not abnormal? In order to assist in estimating the value of the test I give the profession or calling of each observer.

The number of distinct actions performed was 176, and in the following table of results I divide them thus:—(*a*) Actions unobserved; (*b*) actions misdescribed—i.e., so inaccurate as to convey an erroneous impression of the act; (*c*) actions misplaced in order of sequence; (*d*) actions which were not remembered or not noted with sufficient clearness to be recorded,

| | | | | | |
|---|---|---|---|---|---|
| Land surveyor | (*a*) 3, | (*b*) 4, | (*c*) 1, | (*d*) 5 | Total 13 |
| Stockbroker.... | (*a*) 5, | (*b*) 5, | (*c*) 3, | (*d*) 5 | ,, 18 |
| Newspaper Ed. | (*a*) 2, | (*b*) 5, | (*c*) 11, | (*d*) 7 | ,, 25 |
| Organist ...... | (*a*) 6, | (*b*) 7, | (*c*) 4, | (*d*) 10 | ,, 27 |
| Commercial man | (*a*) 5, | (*b*) 9, | (*c*) 3, | (*d*) 11 | ,, 28 |
| Solicitor ...... | (*a*) 3, | (*b*) 3, | (*c*) 3, | (*d*) 23 | ,, 32 |
| Bank clerk .... | (*a*) 8, | (*b*) 7, | (*c*) 1, | (*d*) 17 | ,, 33 |

An analysis of this list might be interesting if taken in relation to the professional training of the percipients. But for his excessive caution, the solicitor would probably have led the list. With the exception of the bank clerk, all the observers were men over 30, and all appeared genuinely interested in the experiments.

A feature which struck me greatly was the proneness of the observers to connect an action in the later series with some analogous action witnessed earlier in the evening. No one was free from this blunder. The sole misperception in the continuity of actions of which the bank clerk and surveyor were guilty were in this direction: the latter connected an act in the 8th entry with one in the 3rd, the former connected the 1st and 5th entries. The large number of "misses" under the head of uncertainties is explainable by the anxiety of the observers "to approximate a judicial frame of mind" as our legal friend put it.

I may add that the figure in class *b*, in the bank clerk's score is indistinct in my notes. It may be 9, but I give him the benefit of the doubt.

Two ladies were present, but I kept no record of their observations. The little they did confirmed the popular tradition that ladies have keen eyes for detail. Both noticed every change in my appearance.

**D. Blackburn.**

# REPLIES TO QUERIES.

***⁎⁎⁎ In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.***

[72779.]—**Petroleum Furnace.**—I am very much obliged to "H. B." for his offer to post me address of company in Russia using Bray's hydrocarbon burner. He must have overlooked my name and address in your issue of Oct. 31 last. Here it is again.

Dominica, B.W.I. Ed. Fadelle.

[This is altogether against our rules, as even foreign correspondents ought to know. We make an exception, as it is a long way to the Leeward Islands.—Ed.]

[73299.]—**Rhumkorff Coil.**—This query has in effect been answered many times, and the answer to the especial query is that a coil is not suited to give an electric light by means of incandescent lamps, which require a continuous current. If the querist has not back numbers, any textbook will explain. A coil can be used for lighting Geissler tubes, or for any other purpose in which sparks are required. L. M.

[73305.]—**Heating Small Room.**—If gas is used for heating a room in which confectionery is to be dried, it will be advisable to provide means for carrying off the aqueous vapour, for gas in burning produces water. It would be better to use hot dry air, which can be managed easily by means of a coke or charcoal fire. As it is a good-sized room, and the confectionery to be dried is to be manufactured on evidently a large scale, why not rig up a fan to drive dry air through. The air need not be hot, but could be easily obtained from a little furnace or gas apparatus outside the room. Nun. Dor.

[73311.]—**Paint or Enamel.**—Will not printer's ink and a rubber stamp answer this querist's purpose? Perhaps a stencil with varnish ink would do; but how can anyone say when the nature of the surface is not stated, except that it is "glossed or enamelled," which is rather indefinite?

Nun. Dor.

[73313.]—**Cock-boring Machine.**—There are machines in the market which bore the shells of taps vertically several at a time. "Borer" should procure catalogues from makers of machines.

T. L. M.

[73315.]—**Brass Pipe.**—The pipe should have been filled with rosin or guttapercha before attempting to bend. Even sand will do. Now a wire must be soldered to the bottom of the dent and the brass be pulled up to level by its aid. The size of the pipe is not stated, except that it is 2ft. long, which is nothing to the purpose; but even a cane inserted before bending would most likely have prevented the dent, while a coil of spring wire certainly would. The last is better than messing about with rosin, which has to be melted out.

Nun. Dor.

[73318.]—**Electro-Gilding Brass.**—It will be necessary in this case—or, at all events, it will be the easiest plan—to coat the plate with varnish, except where the gold is to deposit. No coppering required, but the surface must be clean which is to receive the deposit of gold. The varnish being set, the circles to be gilt can be "quicked" with strong nitric acid, and the plate immersed in the gilding bath will soon take on the film of gold.

Garnault.

[73328.]—**Transmitted Heat.**—Many years ago I took great interest in the relative heat of pounds pressure of steam. I have referred to my rules and tables. I find that 85lb. pressure per square inch *only* gives 316·1° F. Therefore, answer to your table is No. whatever sized pipes you use. I may add that 200lb. pressure per square inch only gives 381·7° F. of heat, and to get $403\cdot\frac{7}{10}$° F. of heat, you want 250lb. pressure.

Z. Y. X.

[73330.]—**Gas-Engine Oil.**—Owing to the intense heat engendered by the flame of the exploding gases in the cylinder of a gas-engine, it is obvious that animal or vegetable oils leave too much charred matter, but the mineral oils, in similar conditions, decompose into gases which assist in the work and leave little carbon, comparatively speaking. The valves and slides should be carefully cleaned, say, once a week, while every three months the piston should be drawn and thoroughly cleaned, as should the cylinder. The engine should never be run without oil, though very little is required. Nun. Dor.

[73331.]—**Wooden Battery Box.**—Cut the wood to sizes required, and soak in hot paraffin wax. That is about the best thing; but if the solutions are to be hot, why not use porcelain or glass to form the box? E. M. F.

[73342.]—**Saccharimetry.**—Glucose (grape sugar, one of the constituents of sweet fruits, and starch sugar), levulose (sugar of acid fruits), and lactose, derived from sugar of milk ($C_{12}H_{22}O_{11} + H_2O$) by treatment with acid in the same manner as for cane sugar, are all expressed by the same chemical formula $C_6H_{12}O_6$, and all exhibit the same behaviour in the presence of a ferment. Where cane sugar is broken up by means of a dilute acid into dextrose ($C_6H_{12}O_6$) and levulose, the resulting uncrystallisable mixture is called an "invert" sugar.

J. B. E.

[73353.]—**Expansion in Series.**—Thanks to "M.I.C.E." Gauthier Villars, Quai des Augustins, 55, Paris, published at 15fr., Souchon's "Traité d'Astronomie Pratique," in 1883. I am sorry I cannot offer to lend "M.I.C.E." the copy I use: it is a loan to me. The logarithm of $u = \frac{a-b}{a}$ is $\bar{3}\cdot5241069$ if the values of *a* and *b* formed by Bessel 1841 are used. Could show Souchon to "M.I.C.E." if he called upon me: shall I advertise my address to that end? Young, in his "General Astronomy," ed. 1888, p. 527, gives: Length (in mètres) of 1° of meridian in lat. $\phi = 111132\cdot09 - 556\cdot05 \cos. 2\phi + 1\cdot2 \cos. 4\phi$. Also length (in mètres) of 1° of parallel, in lat. $\phi = 111415\cdot1 \cos. \phi - 94\cdot54 \cos. 3\phi$.

Esne Caralita.

[73374.]—**Slade's Universal Micrometer.**—Although this query is especially addressed to Mr. Slade, yet as I have been experimenting in the direction of illuminating the field of view of a small telescope, I venture to offer "Arcturus" the result of my experience in the matter. I recently obtained a Slade's micrometer eyepiece fitted specially for my 2¾in. refractor, which is mounted on an equatorial stand, supported by wooden tripod. Years ago I removed the screws which were for use in connecting the tube with a brass pillar-and-claw stand. This left a small hole about a third of an inch in diameter, fortunately at about the centre of gravity of the tube. A piece of tin about ¼in. wide and 2½in. in length was now obtained; a small piece of white cardboard about ⅝in. in length was secured by thread to one end of the strip of tin. The whole strip was now bent at such an angle that the cardboard end could be inserted in the hole, so that it lay about ¼ to ½in. inside, inclined to the axis of tube at 45° approximately, while the remainder of the strip lay outside and against the tube, to which it was secured by a few turns of fine brass wire wound round the tube externally. Now about the lamp. I first found small oil-lamps exceedingly messy, troublesome, and liable to go out at the wrong moment. A small tin lantern was obtained at an ironmonger's, having four sides of glass, each about 2½in., the height being 6in. This lantern burns a small wax candle, about 6in. long and ½in. diameter, cut in two, and has been found to answer very well. Three of the sides were pasted or covered with brown paper, to shield the eyes from light. A small wooden stand for the little lantern was made as follows:—A grooved piece of wood to slide up or down one of the tripod legs; to this is firmly secured an upright piece about 15in. high, on top of which a small flat piece is secured by a screw so that it rotates freely. The whole is secured to the stand by strapping the grooved piece to the tripod leg with a small leather strap. It is very easy to adjust the position of this stand so that the lamp may be placed on the flat top, close to, but quite free from, the tube, and it will be found the little strip of cardboard will reflect plenty of light down the tube, and show the reticule very clearly. In fact, the great difficulty is too much light, which obliterates all faint stars; but by shifting the position of the lamp a very little the light can be regulated to a nicety, and stars of 8mag. ought to be able to be seen. The reticule affords a capital means of identifying a star, if it is in the same field with a brighter one whose identity is clear. Put the known star on the central wire, after adjusting eyepiece, and note how many small squares and fractions of a square the other is distant N. or S., and convert into arc at so many seconds of arc per small square; a fixed quantity which you must ascertain for yourself by transit of an equatorial star across the reticule. In my telescope a side to a small square corresponds to about 57″. The difference of R.A. can be obtained by noting seconds of time elapsing between the transit of the two stars across any given vertical wire. Of course, the method is only approximate; but it is sufficiently accurate to enable the identification of a star to be secured. There are limits to its application: the hole admitting the light must be more or less horizontal, which confines the observations to within a couple of hours of the meridian E. or W., and the declination of the object must not be too great, as the craning of the neck with a refractor becomes unbearable. As the candle burns slowly down, it becomes necessary to raise the lamp a little. The whole apparatus was obtained at a cost of a very few shillings, and in my case afforded such amusement, that perhaps "Arcturus" may go and do likewise. If he has a pillar stand, he can probably easily design a wooden stand for the lamp embodying my principle. The lamp is always perpendicular. The candles are cleanly, and can easily be renewed. The condition for successful observation is that the telescope remains perfectly still. The eyepiece is a great help where one does not possess graduated circles. E. E. Markwick.

[73392.]—**Ellipse.**—In the solution to this question given on page 467, "Patternmaker" and "Fenton" totally disagree in their results with "J. R. C.," who is evidently right. "Patternmaker" gives the foci as the points of bisection of the shorter sides; but an ellipse drawn with any pair of foci on the line joining them and equidistant from the middle point of it, passing through one of the corners of the rectangle, would pass through the other three also. To find the foci, measure from the centre O in "J. R. C.'s" figure along O V, a distance equal to $\sqrt{2}\sqrt{a^2 - b^2}$ for one focus. A practical method would be to describe a circle with centre T, and radius equal to O V, which will cut O V in the two foci. From this it will be seen that "Patternmaker's" ellipse will be the smallest only in the case when $a = \sqrt{2}\,b$. "Fenton's" two items are quite new to me. The longest diameter of an ellipse is equal to the sum of the distances from each focus to any point in the circumference. D. S. B.

[73394.]—**Clock Trains.**—Tubes being suspended from back of case, pin-barrel is made to revolve (by means of bevel-wheel) parallel with frame-plate. Hammers should be faced with leather, and strike tubes just above point of suspension. Think set of tubes costs about £6. I have a friend in the trade who considers nothing equals M. and H. gongs. Will this firm please advertise their address? Briton.

[73407.]—**Snow Shoes.**—My snow shoes are 6ft. 6in. long by 5½in. wide and ⅝in. thick; made of willow, I think. The leather strap, 1¾in. wide, is nailed to the sides, and forms a stirrup just past the centre forward. I can raise and lower my felt boot easily, the toe of which just jams into the stirrup with a sure fit. I need no other fastening. When I raise my felt boot I do not raise the shoe, *in fact, the shoe must never leave the snow.* The is a parallel slide forward, and the snow two flat tracks with a separating ridge $\frac{1}{4}$in. to $\frac{3}{4}$in. between—not more. The rate of a good sportsman is, on level snow, to $3\frac{1}{2}$ miles an hour, for two or three Experts can hurry their sliding to five miles . But when loaded with gun and ammuni- d sheep-skin coat, I never exceeded $3\frac{1}{2}$ miles in my best days. MARCUS C.

8.]—**Greek Accents.**—Mr. Robinson is n in saying that accents are used in the of Greek poetry, that is to say, if he means ry of the ancient Greeks. On the contrary, erse is scanned by quantity, not by accent. irate, which he appears to class with the is a letter, though, like them, it is written he words. The modern Greeks not only eir language with the accents, as may be reference to any Greek newspaper, but use pronunciation. In fact, a knowledge of ntuation of ancient Greek is as material a the pronouncing as a knowledge of ancient to the reading of the modern language. eless, if anyone is learning ancient Greek life, I should say that, simply for this , the learning of Greek accents would more trouble than it is worth.

P. H. K.

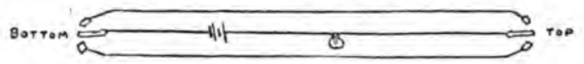
).]—**Heating Water.**—I do not know if owing would be of any use to J. Moon. years ago I fitted up a soup-kitchen, to one-hundred boilers of soup. It is at work d has been every winter since; two years had a new boiler. The boiler is from a -gallon washing copper, with a dome top to s fed by a float-stone apparatus from a about 10ft. above the boiler, so there can more than 5lb. pressure of steam in the The soup boilers are ordinary cast 100- galvanised pans. The steam jackets are f $\frac{3}{16}$ iron, with a ring of 1in. angle iron in. from the top; the pans are merely in the jacket, the rims of the pan resting ngle-iron rims bedded in red-lead cement; ket has a $\frac{1}{2}$in. relief-pipe, with a very light d $\frac{1}{2}$ pipe bent in siphon form to take away densed water; the jackets are encased in work—that keeps in heat. The steam is the jacket about 4in. from the bottom; er is set in brickwork, exactly the same as ng copper, and this is the simple way I at the steam, or without that we should not enough. The steam-pipe is $1\frac{1}{2}$in., rises top of the boiler 18in., on the top a safety- from a tee in the pipe the steam-pipe turns rect into the flue, turns to the left about 2ft. bridge of furnace, and returns with short out 3ft., and thence by branch pipe with to the jackets. It has always worked well, ls the two soup boilers very satisfactorily.

F. G. FRANCIS.

.]—**Field-Magnet Winding of Dy-** —One always learns something new in ' So $\frac{102}{45}$ is actually 2·5! And in com- wound machines with shunt on the termi- lways thought the shunt-coils were wound field-magnet cores), all the current gene- the armature always does go through the nding! I wonder why makers put on the ils at all? Last week I saw a compound- dynamo (Victoria Brush) lighting a single lamp. This dynamo was constructed to The assistant, in pointing out to me a e terminal-board, accidentally disconnected nt wire. Out went the lamp. Why was all the current was going through the series pause for a reply. S. BOTTONE.

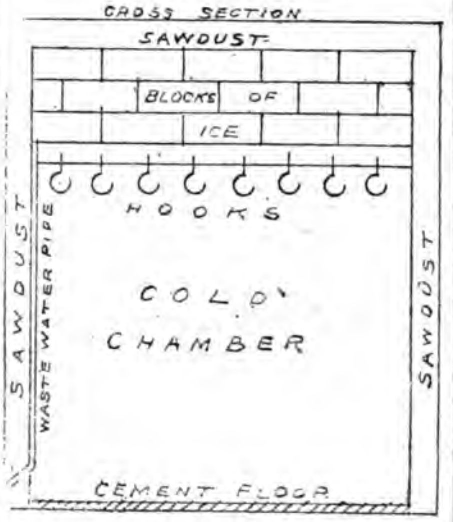
.]—**Two-way Switch for Electric** —To fulfil the conditions required by L."—that any number of people coming t night and following each other, may light by turning a switch at the bottom and put ight by turning another switch at the top, res will be necessary, as per sketch.

gham. J. E. GIBBONS.



.]—**Ice.**—If Mr. Hosie will make a double —a chamber with a passage around—and article to be preserved outside the inner , which is to be reserved for ice, the ure will be found in the passage, all the nd, to be all that can be desired—33° or 34°. e kept many months this way, and provi- ., never taint, the air being dry. Pack the ice with snow or broken ice. Have an drain for ice water. Upon no account door of the ice chamber; that must be ally sealed, and if properly made, ice will in the chamber, when opened to re-pack, months hence. MARCUS C.

.]—**Ice.**—It is a very wasteful method to pile ice round the cold chamber, as that piled at the end and sides does little good. The whole of the ice should be placed on the top of the chamber, and packed as close as possible. Proceed to construct your cold room as follows:—Framework of battens 7in. by $2\frac{1}{2}$in., edges inwards, board inside and outside, with 1in. boards, and fill the 7in. space between with sawdust. Line the inside with sheet zinc, and cement the bottom. Now, one-fourth the height from the top, or not less than 2ft. from the top, run across bar iron joists (preferably galvanised) about $\frac{1}{2}$in. by 3in., and 9in. apart. You may drill some quarter holes in these to carry S hooks to hang the perishables on. On top of the joists lay stout sheet zinc, and on top of the zinc lay wooden battens lengthways: battens 1in. by 3in. by 6in. apart. On these battens slide your blocks of ice, and in front fix two double doors, one to fit the cold chamber, and the other the ice chamber above. See that the zinc floor of ice chamber has a little run to one corner, and here fix a pipe to carry off the waste water. When completed as above, you may imbed in a sand bed or cover with turf, with advantage. The principle is as follows:—As all warm air rises, when you fill the cold chamber with goods to be cooled, the warm air from them rises and comes in contact with zinc ceiling and mass of ice over; it is here cooled to freezing point, and falls to the bottom of chamber, being replaced by other warm air, until the whole chamber is rapidly cooled to near the freezing point with the least possible consumption of ice. I have constructed cold chambers as above with the greatest possible success, and inclose sketch, which speaks for itself. SOLENT.



[73499.]—**Silver-Plating.**—"Amateur" can do no better than to electro-plate the "small brass articles." If about the size of rings, studs, thimbles, and the like, and the quantity be not large, I should advise about one pint of silver solution, cost of which put at 4s. 6d., and battery 3s., pure silver for anode about 4s. 9d., preparing and finishing brushes, &c., from 3s. 6d. If you do not know anything about electro-plating, do not expect success at first trial. Get Watt's "Electro-Metallurgy," 3s., read, and then practise.

S. ROBERT BONNEY, Electro-Plater, &c.

[73502.]—**Hydrostatics: Erratum.**—Allow me to to correct a slip of the pen in my answer of last week. "$\frac{41}{48} \times \frac{312}{5}$" should be "$\frac{41}{72} \times \frac{312}{5}$," which equals $35\frac{8}{15}$lb. The same correction will apply where the fraction occurs before.

CALDEMONE.

[73502.]—**Hydrostatics.**—I think "Hydro" does not distinguish between weight and pressure; and then he thinks it absurd that the pressure on the bottom of the tank is about $27\frac{2}{3}$ tons when the weight of water in it is about $13\frac{1}{2}$ cwt. But let him consider that, as fluids transmit pressure in every direction, there is an upward pressure of about 27 tons under the top of the tank, due to a head of 80ft. of water; and that the pressure on the bottom is made up of the weight of water in the tank plus the downward reaction of the pressure under the top, together about $27\frac{2}{3}$ tons, due to a head of 82ft. J. S. C.

[73505.]—**Electric Clocks.**—This make, at any rate, is a decided case of failure. It has a half-second pendulum, and will use up almost any kind of battery very soon. Mine had a simple gravity one; but it proved useless from the first. Two good Leclanchés drove it for a week, and then failed. Three or four good Daniells may do, but would want constant attention. For once our old friend "Sigma" is at fault: the brass cup must be nearly filled with good paraffin (petroleum) oil. The contact-pieces work beneath its surface, the oil preventing (theoretically, not practically, I found) oxidation. If "Guardian" can ever get it to work satisfactorily—which I doubt—he had better take away the pendulum, cup, and contact-pieces of the other clock, and simply connect his wires with the two end-wires of the electro-magnet. If any of "ours" can describe an efficient battery, he will earn the thanks of many. If I remember rightly, the address of makers was Dixon and Cassey, Coleshill-street, Birmingham. A. E. B.

[73505.]—**Electric Clocks.**—Until "Guardian" makes it clear which of the many forms of Dixon and Cassey's electric clocks he has, it is almost impossible for anyone to assist him. In your issue of 30th, page 491, are two replies to this query, both calculated to mislead the queriest. First, "Sigma" suggests putting mercury into the cup: this must certainly be wrong, as Dixon and Cassey never used mercurial brakes only for experimental purposes. Secondly, Charles A. Jones suggests driving by two Grove or Bunsen cells. In what condition would C. A. Jones expect to find the points of contact in, say, 24 hours with either of the above cells? He also says, even if they only send a current once a second. Would he propose to send the current afterwards? If so, how? In most independent clocks the current is drawn from battery every other second, for companion clocks every second. Two Bunsen cells would give off power enough to drive all the clocks in my place, which are all electric. The secret of building a battery for clock-driving is in trying how much battery power one can do without. A battery driving a seconds pendulum for 18 months and 10 days without attention—neither Grove, Bunsen, nor Leclanché can give these results.

G. W. A. F., Electric Clock Maker.

[73509.]—**Electric-Light Shunt Dynamo.**—Will Mr. Bottone please explain his startling statement that "it is not E.M.F. that produces the light, but the amount of current only"? How does he get current without E.M.F., and how is current "only" energy? I must remind him that lamps do require energy, and we usually speak of the watts required; and is not a watt the unit of E.M.F × unit current? If Mr. Bottone's statement were anywhere near the fact he says it is, perpetual motion would not be in the race. It is not very easy, therefore, to understand Mr. Bottone's self-regulation of shunt dynamos. He actually says the voltage will fall, and if it does so will the lignt, in obedience to natural laws which no increase of current can upset. J. W. W. B.

[73514.]—**Hardening Tools for Chilled Rolls.**—Whatever steel tool you use for a roll of considerable size, that steel tool will possibly, probably, and almost for certain, become dull before the entire cut has been made; and the result of either not grinding or regrinding the tool will be the same—viz., an imperfection in the truth of the cylinder. Now, "carbonado," the amorphous diamond (not the black diamond called coal) will turn steel of any hardness; it will even cut the teeth of the hardest file, and it will not lose its cut. The use of such a tool on hard steel is not to scrape it, but to cut it, producing the finest of shavings. The carbonado is brittle, and, therefore, has to be used gently and tenderly; but when "well used," like many inferior animals, it will do its work thoroughly and well. Z. Y. X.

[73415.]—**Chucks.**—The cheapest chucks of different sizes for wood-turning, called "cup chucks," are made as follows:—You have made one transfer chuck to fit the nozzle of the lathe, taking care to keep the chuck as short as possible. On this cut a thread to fit gas-reducers, used for the purpose of fitting small pipes at the end of large ones. You can buy these reducers at 2d., 3d., and 4d. each, or less. I think there are most sizes from 4in. or 5in. to 1in., in which case the screw on the nose of the transfer chuck will be to fit the 1in., and then you have as many cup chucks as you like. A good many are very useful, as wood is better not finished off at one time of turning. You can also get reductions from 1in. to smaller, and so have cup chucks of $\frac{1}{2}$, 1, $1\frac{1}{2}$, 2, and $2\frac{1}{2}$in., to 4 or 5in. I have used these for years, and have them now. Z. Y. X.

[73518.]—**Submarine Telegraphy.**—The folowing is the mode of working: Let A B be a wire connecting two stations, Europe and America; K an ordinary key, and B a battery at A; C a condenser inserted in that wire, and G a galvanometer at B. Now if the circuit be as arranged, it is evident that it is broken at C; no continuous current can flow from A to B, and thus earth and other extraneous currents are prevented from flowing through the galvanometer. But how can we affect the galvanometer G at B? In this way: When we depress the key K, a current flows into the cable to charge or most of them, will have to be put right before the bell will be ringable:—The pulley is in the wrong place, or the bell is not plumb; the staple is not in the centre; the bell is thin on one side, or thin on the wrong side, so that you require to pull only lightly at the rope's end; or the bell is stocked too short. J. VINICOMBE.

[73626.]—**Church Bells.**—*Imprimis*, if your bells are a heavy ring, the larger ones are almost certain to go up wrong, and what can't be cured must be endured. But the hanging is distinctly faulty if a bell under 19 or 20cwt. does not go up right. A bell with its clapper is a pendulum containing a second pendulum. If the time of oscillation of the two pendula is synchronous, or nearly so, the clapper will remain comparatively—or rather relatively—still until picked up by the lower side of the bell. This is the case when the clapper-bolt is too nearly in a line with the gudgeons, this being caused by the bell being too much tucked up in the stock, or by the crown staple being too short. If your bell turns too quickly—that is, if you have to pull her wide—the former is probably the cause; but if her swing is normal, then the clapper probably swings from a point too near the top of the inside of the bell. But, beware, if you lengthen the crown staple that you shorten the clapper shank an equal amount, so as to cause the ball of the clapper to hit true on the ring bow; otherwise the chances are 99 to 1 that you will crack your bell. C. D. P. D.

[73628.]—**Equatorial.**—J. L. Park says he has a common equatorial stand. Some years ago I made a model for one, and had iron castings made; the circles I turned out of mahogany, and got compass-cards, the centre parts of which I cut out, and mounted the outer rim on to my wooden discs, using a needle-point on dec. axis mounting. This answered fairly well for rough work; but for real comfort in working, your querist ought to have properly-divided brass circles and vernier. I copied mine from my own excellent equatorial by Cooke more as an experiment than for any practical use. H. A.

[73628.]—**Equatorial.**—I am sorry to have overlooked the previous query (73166) by Mr. Park; but will now say, with regard to the footnote on p. 9, "Cel. Obj.," that my circles were simply cast-iron discs, bored to fit their respective axes, and their outer rims turned true. Then I took a slip of paper, same width as rim (about ¾in.), and cut it to the necessary length to go round the circle, afterwards cutting it a trifle shorter (I think it was about ⅛in. on a 6in. circle) to allow for the paper expanding when wet. The paper was divided with pen and ink, carefully spacing the thirty-six long strokes (for every 10° on decl. circle) with a pair of compasses; then I spaced *one* of these divisions, on another slip of paper, as accurately as possible into degrees—this was shifted along the slip to be graduated, and each 10° space marked from it; both slips being meanwhile firmly held in place by drawing-pins on a board. The graduated slip was now coated on its back with hot acetic glue, and immediately affixed to the rim of the iron circle, which had meanwhile been made warm by putting it on the hob. [The "acetic glue" is made by dissolving the best Russian glue in strong acetic acid. When wanted for use stand the bottle in a cup of hot water.] When *quite* dry, the paper was coated with isinglass size, and, after this had dried, with pale paper varnish. I trust these particulars will satisfy Mr. Park; but I should strongly advise him to *buy* "printed" scales, as mentioned in Grubb's catalogue—they would be really *accurate*. If he will write to Sir Howard Grubb, Astronomical Instrument Works, Rathmines, Dublin, he will, no doubt, obtain any information concerning them. W. S. FRANKS.

[73629.]—**Wiring Shunt Dynamos.**—Yes; the proportions given, as specifically stated in my book, refer to wrought-iron cores only. S. BOTTONE.

[73630.]—**Daniell Cells.**—When these cells are left to themselves, the circuit not being closed, the copper sulphate solution very soon permeates the porous cell, and a "mud" of reduced copper coats the zincs. This effect does not occur to anything like the same extent if the circuit is closed. From the fact of your hearing a hissing noise, I should imagine your copper sulphate must be very acid. If the crystals which form on your cells are green instead of blue, your sulphate of copper must be very impure. S. BOTTONE.

[73632.]—**Kitchener.**—I had a stove in my factory which drew very fiercely; but when it was placed in another part it did not draw, and for a long time all our efforts to get it to draw were fruitless. At last I thought that the lower part of the pipe, where it is let into the chimney, ought to be in a horizontal line with the top edge of the stove. When this was done, it only took a few minutes and the stove was red hot. J. H. SCHUCHT.

[73632.]—**Kitchener.**—What a query! Why not try what you suggest? Some things get improved until they get out of it altogether. Has it two up-takes—one direct from fore and over and under, and up back of oven? And is it set right? Because I was called where there was one with three under and over boiler, but the bricklayer had only made one over the oven, and had carted the other fittings in the shape of damper plate and frames away; whether he did not know where to put them, or, thought they were so much useless spare gear, I don't know; but upon Christmas Eve I was called in amongst all the good things to haul it out, and re-set it, for they could do nothing with it, and they were in a fix, as a goodly sample of company was come to prepare for, and this was installed to meet it. JACK OF ALL TRADES.

[73633.]—**Electric Bell.**—Your query is rather confusing. If you work the telegraph and telephone from the same wire, as you say, I presume you have a switch to switch from one instrument to the other. If you wish to have a call-bell at each station, insert one between the line and instrument, which you can plug or switch out of circuit when not required. P. E. L.

[73635.]—**Lock.**—Look up the article "Lock" in the *Encyclopædia Britannica*, if you have access to that work. SM.

[73636.]—**Regilding Old Frames.**—What I wanted to know was: What C. E. Balley had prepared the frame with previous to putting in oil? But, presuming it is all gilded except the burnish, those parts want sand-papering clean, no gold left on, and then three coats of whiting (Paris white mixed with parchment size) rather thick. When dry, paper smooth again, then two coats of matt size, mixed about as thick as cream with parchment size, then two coats of burnish gold size, mixed same as matt (of course, warm). When dry, wet well with clean cold water, and lay gold immediately. Leave all night, and burnish out in the morning. You only put these preparations on the parts to be burnished. If any oil gold-size is left on, and the above go on top, it will shell up; so it will if size is too strong. Hope this will help you. MOUNT CUTTER.

[73637.]—**Switch.**—I do not see any means of calling up the centre station when the line is put through. J. B. E.

[73637.]—**Switch.**—You are apparently one of the end stations. If you are joined up all right on the switch and put at "through," then all stations are in circuit. As a rule, a switch of this description gives a lot of trouble, by the attendant at the central station, who has been speaking to one end and switched the other out of circuit, and gone away and forgotten it. You should have an extra bell at the central station with a switch so arranged that when a station is cut out it is put to earth through the extra bell. P. E. L.

[73640.]—**Electric Light.**—No bichromate battery (single fluid) has ever yet been made which would light a 5c.p. lamp for more than three hours at a stretch, and then the solution must be thrown away, and the cell re-charged. There is no battery in existence (with the exception of the storage cell) that can remain charged, to do the above work, for three or four weeks. S. BOTTONE.

[73642.]—**Portrait Lens and Lantern.**—See my reply to 73427, p. 450. SM.

[73642.]—**Portrait Lens and Lantern.**—If your lens takes a sharp picture, it will make a sharp picture on screen. I don't know anything better than a good half-plate portrait lens for lantern use. The focus should be about the average; this determines size of picture. Don't trouble about condensers so long as you can get your light close up (in focus). The general fault with lamps is that the wicks lie too far back; if this be the case, then have a longer focus condenser. For limelight purposes, the average condenser I believe to be suitable for general work. The slide wants to go close up to condenser, so as to take in all the picture, and to focus with light as coming through the condenser. A long focus condenser might be 5, 6, 8, or 10in. focus, according to requirements, though these would be very large, and the light would be a distance back. An average 3½in. condenser is, I think, 2in. focus. I could give you all particulars if you advertise your address in Address Column. F. G. WILLATT.

THE copper production of the United States last year is estimated at 278,610,000lb., being 33,034,000lb. more than that of the previous year. The Montana mines produced, in round figures, 123,000,000lb., against 105,000,000lb. the previous year; those of Lake Superior 99,570,000lb., against 87,504,000lb.; and the Arizona mines, 34,000,000lb., against 33,000,000lb. The greatest production by any one company was that of the Anaconda, which was 64,046,812lb. The copper exports for the year amounted to 8,548,793dol., against 9,867,212dol. in 1889.

# UNANSWERED QUERIES.

*The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.*

73048. Pulleys, p. 299.
73049. Armour, 299.
73051. Magnum Bonum Pens, 299.
73052. Yorkshire Coalfields, 299.
73054. Walton's 200 c.p. Dynamo, 300.
73065. Gas Engine, 300.
73070. Musical Scales, 300.
73073. Phonograph Cylinders, 300.
73077. Fountain, 300.
73082. Engine for Dynamo, 300.
73086. Firebars, 300.

73302. Waltham Pinions, p. 385.
73303. Watch Dials, 385.
73314. Differential Calculus, 385.

# QUERIES.

[73644.]—**Strength of Field.**—I have a shunt-wound dynamo, the fields of which are excited sufficiently to give, at a speed of about 1,800, 50 volts and 10 ampères. Now, it has occurred to me that if I wind on some coarse wire outside the shunt (in series with the armature) sufficient to carry 18 to 20 ampères without heating, that when the full load is on, provided I have enough turns of coarse wire to equal the effect due to the shunt coils, that I shall get a much more powerful field than before, and from a rough calculation I made I ought to get the same output at half the original speed, which is the point I would like answered. As a guide, I here give a few particulars. The cores are of cylindrical Swedish iron, [illegible] diameter. Armature is charcoal sheets. At about [illegible] volts the fields become magnetised with 5,000 ampère turns, and the R. of them is fully 400 times that of the A. I wish to cut down the speed so as to give the boiler a better chance, and still not to detract from the efficiency of dynamo. I see by an answer recently given in "Ours" that this would not be a proper compounding, as I imagine that when only one lamp was running the A. would travel at a very high speed, whereas when the load increased the speed of A. would decrease, and in a proper compound machine the speed should be almost constant.—SLOW SPEED.

[73645.]—**Electrical Units.**—In a prospectus I have, it is stated that volts and ampères multiplied together equal watts, of which 746 are equivalent to 1 H.P. Is not this rather a loose description? How do you calculate ampères when no resistance is given? For instance, a dynamo has 6 volts pressure with a speed of 1.500 revolutions, and gives 30 ampères current strength. This is not clear to me. Through what resistance does it give 30 ampères, and how many coulombs are there? I want to be able to calculate the kind of dynamo required for the electro-deposition of silver or copper, so as to know how many pounds are deposited per hour. Suppose I wish to electrolyse 1 cwt. of metallic silver, how can this be done with the greatest advantage—viz., surface of electrodes, E.M.F., number of ampères, coulombs, &c.? The E.M.F. for silver in a cyanide bath is, I believe, 2 volts, and 1 coulomb deposits ·001134 Gramme silver.—Q.

[73646.]—**Cotton-covering of Primary Wire of Induction or Spark Coils.**—In answer to question No. 73570 in last week's issue, "Sigma" says that he would advise me not to make a condenser at all for the coil referred to, because it is wound with a double cotton-covered primary, and therefore would not be of any use for spark purposes. I may inform "Sigma" that Mr. Bottone gave me the instruction for the size of wire and covering to use in this coil. Also Mr. Dyer in his book on "Intensity Coils: How Made, &c." recommends the readers to use double cotton-covered wire, and to saturate it with shellac varnish. Mr. [illegible] in his excellent series of papers on "Induction Coils," says that it is useless to use silk-covered primaries, except for small coils. Would "Sigma" kindly state his reasons for using silk instead of cotton? Of course, silk is the best insulation for wire, but as it is so very thin and rather delicate, it is very likely to be rubbed and torn in winding; cotton being more durable and thicker in insulation, is not liable to the faults above mentioned; and by soaking it in shellac varnish of rather thin consistency, or paraffin wax, it is, in my idea, better, or as good as silk-covered wire. The advice for breaking up the coil is ridiculous and foolish, as the party to whom the advice was given might be silly enough to go by it. Perhaps Mr. Bottone and other correspondents would give their opinion about cotton-covering for primary wire, and also about the insulators which are used for coil construction, paraffin wax, rosin, and beeswax, shellac varnish, and guttapercha tissue. I have found the old rosin and beeswaxed paper more insulating than paraffined paper. The spark from a small coil passed through paraffined damp paper, but would not through the rosined paper. The paraffin in use was the double refined quality.—H. E. AUSTIN.

[73647.]—**Optical Mathematics.**—I should be much obliged if "Orderic Vital" would give me information as to the course of mathematics really necessary for a lad to go through, in order to be able to calculate formulæ of achromatic lenses for various purposes—photographic, microscopic, telescopic, &c.? I have a lad now in the middle of Euclid and the earlier parts of ordinary school algebra, who has not time for more than is necessary, but is anxious to master enough to enable him to make his own calculations. And I want to know what he would have to learn, with (if possible), a list or series of textbooks that, understood, would impart it to him.—A FATHER.

[73648.]—**Welding.**—Would any reader inform me how to join some engraved copper-plates at their edges ake larger plates? Brazing is unsuitable as the work might be injured near the joint, and the of a new metal in the joint is objectionable? ectric welding answer the purpose, and if so, ld it be done? Is it in operation commercially? mation would oblige.—Thos. Best.

—**Bronzes on Leather.**—To "Practical er."—I shall feel obliged if you will let me know method of fastening and brightening the bronzes ? Ought I to use some mordant—such as gum-., on the leather, previous to laying on the I should like to know how to produce a silver Can I get bronze powders in London for the pur-annot get all colours, dyes, &c., in this town .—C. W. W.

—**Polishing Brasswork.**—I have some swork which I want to polish and plate myself. y brother-reader who understands the processes orm how to accomplish my ends? I have tried with wet sand and Sheffield lime, but have not essful hitherto. One difficulty being to make stick to the felt bobs.—Alpha.

—**Carriage Windows.**—Can any reader in-what is the usual size and weight of the sliding of carriage doors? What kind of glass is used, and if there is a standard size for carriage which carriage builders work.—T. W. O.

—**Galvanometer.**—What is the particular in making a galvanometer to indicate milli-Will Mr. Bottone or other electrician be good say what's the construction? It is usually made with a needle indicating (for medical purposes) lliamperes.—No Sig.

—**Watchmaker's Lathe.**—What is the best bed for a very fine accurate watchmaker's lathe , and 2in. wide, with a slot preferred? How many ould cone bearings taper, so as not to jam, there tail pin? Should the hole through a hollow be made first or last, to take a ¼in. sliding —G. Hare.

—**Waste of Oil.**—I am running an Otto gas-drive my dynamo, and there is a great waste of this be prevented? I suppose it could not be again—anyway for the cylinder, as good gas-is rather expensive. Should be glad if anyone me, and also tell me the best way of purifying asted.—Engine Driver.

]—**Electric Wind Vane.**—What is the best ent for indicating on a dial the direction of the n time to time? In the case proposed there are s both as to position and direction between the dial which prevent their connection by shafting wheels. No recording apparatus is desired, nor of the wind. Supposing there are 16 points of n a prolongation of the vane axis inside the s to be protected from the weather, the finger of ould be actuated by an electro-magnet so as to d; but if the current were constantly passing, be the case if the vane remained unmoved for a battery would soon run down. Should the nly be allowed to pass at intervals—as every five Is there any such contrivance actually in use? es.

]—**Lazy Gas-Engine.**—We possess a 12H.P. ne—one of Crossley's Otto. Every morning we et it to start for about 20 minutes pulling round. es are in good condition. Can any of your uggest the cause?—Pessimus Res.

]—**Vapour-Tight Piston.**—Is it possible to ch a condition as would keep a vapour under ble pressure absolutely secure (without escape) a week, a month, or a year?—V. P. Y. R.

]—**Guttapercha.**—Can some correspondent ne of any method of hardening guttapercha, injuring its plastic properties? I mean so that e as plastic as usual when hot, but set harder al when cold. Also is there any efficient gutta-ubstitute, possessing much the same properties, per?—G. P.

]—**Electro-Motor.**—To Mr. Bottone—Some you gave the dimensions for an electro-motor for a sewing-machine. They were as follows—.s 4in. by 4in. by ⅝in., 2½in. wiring space, arma-by 1½in.; wiring as follows: 1lb. of No. 18 wire F.M.s., 5oz. of same on armature. Now am I stand by this that I am only to put ½lb. No. 18 limb of field-magnet, as this seems to my inex-d mind very little in proportion to the size of And should this wire be single cotton-covered, ould wire on armature be silk-covered or not? make motor reversible by using a movable rocker ecting with the brushes? Hoping I am not g you too much in asking the above, but my to make an effective machine—Anglo-Saxon.

]—**Watch Magnetised.**—I am very much with my watch. My dynamo magnetises it when ar it. I see Mr. Bottone's advertisements and structions; but is the watch liable to get sed again? Is there any means of preventing tting magnetised?—Amateur.

]—**L. and N.W.Ry. Locos. Crank**.—I should be glad if any of your readers could me how the crank action works on the latest of the L. and N.W.Ry.Co.'s main line passenger ngine—Webb's system?—One Who is Inter-

]—**Book and Paper Case.**—Can any reader a sketch for a bookcase, which can be turned ox for holding books when on the move? I fancy e in your journal some years ago, but cannot find ould also like a convenient receptacle for holding als as they are published (and storing them till bound) in a way that one can be got out with Tidy.

]—**Model Locomotive.**—To "J. H."—I l much obliged if "J. H." will kindly explain ct and style of the "pet-cock" for the pump of er locomotive. Is it similar to what is called a ck" in model makers' catalogues? Also how is on of the pump checked in the event of its over-feeding the boiler? Two brazing flange castings are supplied for the pump, but it seems to me that another is wanted to join on to the check valve piece. This check valve is, I suppose, bolted direct to the boiler without the use of another flange. I am not sure for what purposes castings Nos. 53 and 54 are meant, and shall be glad if he will explain. He has provided for the draining and lubricating of the cylinders; but are not these equally necessary for the steam-chest to prevent rusting of the flat surfaces? I would take this opportunity to thank him for his most interesting description of the model, and for having the castings prepared. I find them excellent, and I trust that we may be favoured with instructions for making a tender to match. Will he also let me know what gauge of brass wire should be used for the safety-valve spring, and on how thick a rod it should be coiled? I have not yet been able to make a spring strong enough—wire about 1-16in. thick coiled on a ⅛in. rod.—A. F. C.

[73664.]—**Ventilator.**—Will any reader kindly inform me the best way to ventilate a small house, there being four rooms with 15ft. frontage?—not to be too expensive. —T. W. G.

[73665.]—**White Etching and Transferring Designs to Glass.**—Can any of our readers tell me how to make the above, and how to transfer the design? I am told the prints are taken from copper plates. I have a small copper-plate, and would like to etch some of my own engravings. Any hints will oblige. Are there any books published on the subject.—Copper Plate.

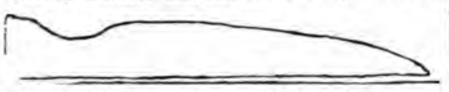
[73666.]—**Brush Arc Light Carbons.**—Why are these invariably coppered, and always over 11 millimètres in diameter? Is it on purpose to reduce the resistance in circuit? If so, what is the object in keeping the resistance low?—F.R.Met.Soc.

[73667.]—**Dry Batteries, Faulty.**—I have three of Wehr's make, of Berlin, that give current all right, but a nasty green fluid escapes from the terminal connected with the carbon plate, which will soon corrode the screws away. Will Mr. Bottone and others who have had experience with these cells please say the best thing to do, as I have not had them in use two months yet? Cells are in dry place.—An Old Mem. Soc. Eng.

[73668.]—**Cold Bedroom.**—My house is one of only two stories. The bedrooms are cold, which I am told arises from the fact of the large open space overhead between the slates and the ceilings of the rooms, although they (the latter) are perfectly air-tight. I shall feel obliged if some one will inform me whether this is the probable reason, and if so, the best way to avert it, either by felting the attic part of the ceiling or covering it with mattresses and the like?—Frigid.

[73669.]—**Stearine.**—Fowne's "Chemistry" states "Stearine crystallises from hot alcohol in milk-white needles which are inodorous, tasteless, and quite insoluble in water." Can any of your readers, whose knowledge of chemistry is more practical than mine, advise me of any process other than above whereby stearine can be rendered inodorous and tasteless in quantities of several pounds?—N. Naws.

[73670.]—**Faulty Engine.**—Would any reader let



me know what is wrong when engine shows diagram same as sketch?—Mechanic.

[73671.]—**Ancient Lights.**—Will any of our legal friends answer this? Some twenty-eight years since I built a room on to my house, with a window looking out on to some waste land. This waste land has now been taken for building purposes. How near can they build to my window? What law is there about ancient lights? It is a bedroom window.—Niobe.

[73672.]—**Electric Light.**—What c.p. dynamo will a water-motor drive with an 18in. wheel with water discharged at it through ⅜in. jet at 40lb. pressure out of a ½in. pipe, and how could I increase power of motor?—Experimenter.

[73673.]—**Square-Turned Balusters, &c.**—Can any reader say how these are fixed, and what is the ordinary sized drum in use?—Mat. Taylor.

[73674.]—**Repairing Iron Bar.**—The horizontal bar of cast iron, connecting the two cast-iron supports of the desk and seat respectively of a school desk, has a clean fracture at one place. Would some one kindly suggest a method of repairing this without removal?—Iron.

[73675.]—**Collotype Plates.**—Could any kind reader inform me how to make collotype plates to be worked by hand or steam?—Amateur.

[73676.]—**Making Carbons.**—I want to make a few carbons for battery (special shape). I have tried pulverised gas carbon and sugar; but I find after they are burned in cast-iron mould, they crumble to pieces. Could you kindly set me right?—Fitter.

[73677.]—**Siemens Armature.**—Will Mr. Bottone kindly say if his 15s. dynamo can be made by rewinding into a machine suitable for small electro-plating work? 1. If I put on 4yds. of thicker wire so as to have 4 volts, and just thick enough to fill up armature, will this not give something like 8 or 9 ampères? 2. What more on F.M. for a series machine, as I suppose a shunt not suitable for electro-plating?—Siemens.

[73678.]—**Dynamo to Five or Six 20c.p. Lamps.**—Will Mr. Bottone kindly give me the dimensions of dynamo—viz., size and quantity of wire on A. and F.M., size of F.M. cores, Edison-Hopkinson type, and size of A?—Electric.

[73679.]—**Mandrel Tube Metal.**—Can any of our friends inform me how the above is made, especially the method of soldering? The writer finds a difficulty with the joints: they split badly. Any hints will oblige.—A Workman.

[73680.]—**Metal-Polishing Pastes and Furniture Paste or Cream.**—I wish to commence the manufacture of above, on a small scale at first. Will your readers kindly advise what plant or utensils are necessary?—Metal.

[73681.]—**Sliding Tool.**—I have a complete self-acting screw-cutting lathe, but want a simple form of sliding tool to fit to a single lathe, as I do not want to incur the cost of another complete slide-rest. I want to cut and face up wooden discs, 9in. maximum diameter. I can turn up any screws to work the tool block. Is there any dodge of modified slide-rest in back numbers?—H. A.

[73682.]—**Gyroscope.**—Taking for the purpose an elaborate instrument, what are the demonstrations and experiments which we can effect? Is there a form which lends itself to a better series of demonstrations than that of Foucault? Where is information—in what books, or society's proceedings?—A. W. L.

[73683.]—**Gilding.**—I have picture-frames which were originally gilt, and which I attempted to renovate by coating with gold paint. This was a failure, as in less than a year the frames turned a dirty brown colour. Is there any means (other than using gold leaf) of regilding them? —Aurum.

[73684.]—**Lathe with Velocipede Driving-Gear.**—It would be extremely interesting if "Rushlight" (letter 32010) would kindly send an illustration of the treadle motion of his American lathe. I am sure it will be a boon to all those who have to stand at their work all day like the—Mechanical Mason.

[73685.]—**Egyptian Tamarind Flowers.**—To "Eos."—Having seen on a piece of waste paper some time since a specific (for piles) called Egyptian Tarmarind flowers, and having asked a few herbalists and none seeming to know of such, any information would be gladly accepted by—One Troubled.

[73686.]—**Electric Lamp.**—Would Mr. Bottone or other kind electrician advise me? I require a small lamp with reflector to examine the throat and teeth of patients. It would be used at slight intervals—perhaps a dozen times every evening, for a few minutes each time. What would be the most suitable lamp and battery? If possible, one that would not want charging more frequently than once a month. I have seen a portable set—eight chloride of silver cells—which gave a good light, and said to last two years. Size of battery no object.—Dentist.

[73687.]—**Accumulators.**—Can anyone give me information how to manage accumulators, as made by the E. P. Storage Co., how to mix the liquid, what s.g. to put it in, how it should act when charging, the reason some cells get to a higher s.g. than others, and any other useful hints? Also if there is any work or treatise on the same, and where to be got.—W. P. P.

[73688.]—**Power.**—I am thinking of laying down new shaft, engine, &c. The plant will include lathe, drilling, shaping, planing, milling machines, and grindstone. Now, from the sizes of these different machines, how do I find force required for driving each with its maximum cut, and so the H.P. for each machine, and then total H.P. of engine required, and then finally necessary size of boiler? This is a very practical question, and one that must be occurring every day. And I should very much like to know how it is usually treated, so as to give satisfactory results. Of course it can be done by guessing by a well experienced hand, but I wished to know how it is done scientifically and accurately, so that you may be quite sure engine will be able to do all the work given it.—No Name.

[73689.]—**Combustion.**—I should be very glad if any experienced in the prevention of smoke would tell me of a simple and efficient method of obtaining complete combustion, and so preventing smoke from a stack, &c., without injury to flue in boiler? The boiler is 20ft. long by 5ft. diameter, and 2ft. flue with Galloway tubes. Admitting air (cold or hot) at bridge soon destroys plate above bridge, I have heard.—No Name.

[73690.]—**Shunt Dynamo.**—Would Mr. Bottone kindly give examples showing the E.M.F. of shunt dynamo, with different resistance in outer circuit? He says in his reply *re* Electric Light, in the issue of Jan. 30, "As the outer resistance falls, so the voltage of dynamo falls, but since the resistance is less, proportionately more current flows round the outer circuit." According to Ohm's law, it requires the same voltage to send 2 ampères through 1 ohm, as it does to send 1 ampère through 2 ohms. Therefore I do not see how a dynamo could work with less E.M.F. through a low resistance than it could through a high one giving proportionately less current.—E. L.

[73691.]—**Harp.**—Can any reader of this paper help me to construct a good harp—single or double action? Is there any book on such? Any information on such will oblige.—Practical Cabinet Maker.

[73692.]—**Swiss Embroidery.**—I have frequently seen tablecovers, trimming, &c., which I am informed is so called. It is too regular and cheap to be done by any hand process, yet appears executed with a single thread, and much resembles hand crewel work. How is this accomplished by a machine?—A. M.

[73693.]—**Clockwork Spring.**—I shall be glad if any reader will tell me if there is a spring to work an upright shafting for a set of roundabouts in the form of clockwork to go 15 minutes, and be ½H.P., to wind up with a ratchet lever handle? I have made a small set, and it works well with the striking part out of clock. If anyone will help me, I shall be glad.—New Reader.

[73694.]—**Sulphuric Ether and Water.**—Will some reader inform me how to make a mixture of sulphuric ether and water, so that the boiling point shall be exactly 104°?—L. Spencer.

[73695.]—**G.N.R. and N.E.R. Locos.**—I would like to have some particulars of the engines which take the 10 a.m. express from London to Edinburgh via G.N.R. and N.E.R.? And also some information as to coal burnt, and water evaporated during the run.—Wm. John Grey, F.C.S.

[73696.]—**Painting Cement Plaster Work.**—Would any reader tell me the best way to make paint stick to cement plastering outside? I have done some repairs to plaster on house-front, using one-half Portland cement, and one-half lime putty which was painted about three months after, and all came off after the first shower of rain. It has been painted twice since, but after rain came off. What is the reason of it coming off, and how best to prevent it? It was sized before being painted. Any information will be gladly received.—Builder.

[73697.]—**Winding Electro-Magnets.**—Would Mr. Bottone kindly tell me size of c.c. wire, weight and best method of winding very soft iron magnets made as follows? Two limbs, each 10½in. long by 1½in. diameter, separated and connected by iron flat piece, 9½in. by 1½in. by ½in., welded on at ends. It is suspended by two bolts to wooden cross-piece. Each limb or both are wanted to have the greatest possible pull through a space of not more than about 1-32 to 1-16in. Would an iron wire be sufficient to connect whatever armature may be used on either or both limbs? Also what battery power would give the best result?—Cotton.

[73698.]—**Telephone.**—I have two round bar magnets, 4in. by ½in., and wish to make a small telephone to speak 100yds. How much No. 36 B.W.G. must I put on each in weight? I have a glass cylinder machine, 12in. by 6in. What size spark ought I to get from it, and what size ought I to make the rubber? Also what is the conductivity power of galvanised iron wire compared with copper wire, and would iron wire do for electric bell work in a house if well insulated, and what gauge would be best?—E. A. L.

[73699.]—**Iceland.**—I purpose doing Iceland this summer with camera, and shall feel obliged if any of "ours" can give me any hints as to the best time, place of departure, sort of accommodation, expense of board, and transit for about 12 or fourteen days, and best things to see in the time. Personal experience, not books, please. —Tit-Willow.

[73700.]—**Condenser.**—Would 150 sheets of tinfoil be sufficient for a condenser to work with a coil giving 1in. spark? Size of tinfoil sheets 3in. square?—Tinfoil.

[73701.]—**Paraplegia.**—Six years ago I acquired the above—not through a blow. I have greatly recovered, but am still weak in the back and lower limbs. I can walk well, but not run. I have tried medicos, who prescribe potassium without result. Can anyone advise, or relate experience in similar case? I am 40, and have good health.—Bruno.

[73702.]—**Nasmyth's 20in. Reflector.**—In the *Journal* of the British Astronomical Association for December, there is a drawing of Mr. Nasmyth's 20in. reflector. I am at a loss to understand its construction, and will feel obliged if any of "ours" can enlighten me on the subject. It is mounted on trunnions, and one of these is used for the eye-tube. No doubt this is a very convenient arrangement, as it enables the observer to sit in one position, no matter where the telescope may be directed. Judging from the drawing, the trunnions are about one-third the length of the tube from the speculum. We will suppose the tube to be 15ft. long. If the diagonal is placed at the trunnions the focus will be length from speculum to diagonal 5ft., half-diameter of tube, say, 1ft., length of eye-tube, say, 8in., giving a focus of 6ft. 8in. This is very short for a speculum of 20in. diameter, and consequently a small magnifying power. Two-thirds of the tube, or 10ft., will be nothing more than a dew cap. Again if there is a plain reflector at the outer end of the tube, which returns the cone of rays back to the diagonal, this must be comparatively large, something like 12in. diameter, which will cut off a circle of this size from the centre of the speculum. This will reduce the reflecting surface from 314 to 113in. I can scarcely think this is the construction, and here I am puzzled.—Amateur.

[73703.]—**Astatic Galvanometer.**—1. I have a Silvertown astatic galvanometer of about 1,000 ohms resistance, which, when in circuit with a Daniell cell, gives a deflection of about 85°. Is that an indication of the current or of the voltage? 2. When above instrument is shunted with one of Mr. Bottone's 1-ohm coils, the deflection is about 70°. This can be reduced by inserting various low resistances, which could not be done when galvanometer was unshunted. Does the introduction of these resistances reduce current, voltage, or both? 3. Using the shunted galvanometer, a resistance frame (giving from 1 to about 45 ohms), and a Daniell cell, I obtained a series of readings, and from them drew a calibration curve. Assuming this to be the absolute curve, how must it be used to indicate currents which are much larger?—Lux.

[73704.]—**Red Phosphorus Matches.** — How is this put on? If in a melted condition (by heat), how are the vapours prevented from causing the poisonous actions peculiar to phosphorus? Are there any records of poisonous results from children, &c., eating the ends of these matches? If so, what are the symptoms and their degree? In what way does this red phosphorus differ from the ordinary stick-white phosphorus, known, I suppose by the chemical formula P? Has the red phosphorus any (if so, what?) medicinal action on animal and human life? Can it enter into chemical union with the lime present when in the stomach in the various foods of man? Would it have a manurial stimulant effect on vegetable plant life? Would it have any chemical affinity for metals as bases? In what form chemically (if changed) would it leave the body, and by what excretory organ?—Agricola.

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The address is included as part of the Advertisement, and charged for.

Advertisements must reach the Office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

## ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

### HINTS TO CORRESPONDENTS

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries, put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Feb. 4, and unacknowledged elsewhere:—

A. B. C.—G. Hughes.—H. Clews.—British Bulldog.—Hard Metal.—A. C. B. — Sirrah. —Lawn Mower.—Wishful to Learn.—S. M. Mechanic.—Walter Herbert. W. J. D.—Model Steamer.—A Country Miller.—Mac.—R. Gough.—Seymour H. Beale.—E. A. S.—On Time.—Analyst. - London River. — A. Morgan. — Sphinx. — C. F. D. Marshall.—F. A. M.—A. S. L.

Tyro. (Descriptions of injectors are given in all the textbooks dealing with steam-engines, and most of the patterns can be found in back volumes. In the No. for Sept. 11, 1885, p. 23, you will find an illustrated description of Gresham's improved injector, and in No. for July 28, 1882, there is an illustrated description of an injector worked by exhaust steam.)—Would-be Engine Driver. (Locomotive men have first to go as cleaners, and work their way up. The primary qualifications are healthy constitution, good physical development, and perfect eyesight. The locomotive foreman at any yard would give you full information, and so, no doubt, would any driver or fireman.)—C. Shorten. (Where did you see the instrument mentioned? There is a cheap little work entitled "Weather Warnings for Weather Watchers," Houlston and Sons, and "Elementary Meteorology," by R. H. Scott, published by Kegan Paul and Co.) - Sigma. (Why adopt the signature of a well-known correspondent? The gas-lighter referred to is described at length in the number for Jan. 9, 1885. It consists of a little influence machine in the handle, which is set in motion by pressing the stud, and the spark passes at the points of the wires.) – G. B (There are several devices for electric alarums illustrated in back numbers: see the numbers for March 2 and May 11, 1888, and the indices of back volumes.) — Electric. (See previous answer, and recent back numbers.)—J. A. Y. (The Leclanché cell has been illustrated and described many times. It consists of an outer jar, in the centre of which stands a porous pot containing a rod of carbon packed round with a mixture of coke and binoxide of manganese in small pieces. When in position, the space between the outer jar is half-filled with a solution of salammoniac, and a rod of zinc being placed in the solution, the cell is complete; but there are several details to attend to, which are given in even recent back numbers.)—Thomas R. Young. (Copal is not readily soluble in either turpentine or alcohol 64 o.p.; but if you powder the gum and an equal quantity of glass, and take for a pound of the mixture a quart of spirit (64 o.p.) and 1oz. of camphor, you will succeed if you heat in a water bath and stir frequently. When solution is complete, decant the clear as soon as cold. It can be dissolved in turpentine in a similar way. The varnish makers fuse the copal and add hot drying oil; boiling afterwards, and subsequently thinning with turpentine.)—Jersey. (Given many times. Grind up best lampblack with turpentine, and add just sufficient oil gold size to bind. Use about as thin as paint.)—O. C. Jones. (We presume you mean the letters, not the original article. See number for Dec. 26 last.)—Velos. (Please see almost any textbook of Physics; but you must study the subject to understand it thoroughly, and we cannot spare space for that just now. 2. This query is rather unreasonable too. Procure lists of books from such publishers as E. and F. N. Spon, 125, Strand, W.C., and Crosby Lockwood and Son, Stationers' Hall-court, E.C. You will find many titles of books on Hydraulics and Water Motors in them.) – R. R. (Briefly, it is due to "fatigue of the eye," which sees the "complementary" to the colour previously "stared" at. 2. The singing sound in the ear is probably due to an accumulation of wax, which also produces loss of hearing; but it may be something that only a surgeon could detect on examination.)—Practical Student. (Most of the well-known firms publish works on Electricity, Macmillan, Longmans, Spon, Crosby Lockwood and Son, Whittaker and Co. If you can, you should procure Sprague's "Electricity," E. and F. N. Spon, 125, Strand, W.C., or such a work as "Electricity in the Service of Man," Cassell and Co., but it very much depends on what you specially require.)—Working Lad. (The best plan is to engrave with proper tools; but an etching fluid for steel or iron is made by mixing 1oz. of sulphate of copper, ¼oz. of alum, half-teaspoonful of salt, with a gill of vinegar and 20 drops of nitric acid. The parts which are not to be eroded must be protected with some protective coating—soap or wax. See answer to S. S., and look in this number.)—Tyro, A. E. L. (Procure one of the guides from the Emigrants' Information Office, 31, Broadway, S.W. Certainly there is a "chance of getting on" to one who will work, and as you have some capital, it would perhaps be advisable to take a situation and look round before embarking the money in a farm, or any thing else.)—R. M. (Look at a diagram on p. 425, and arrange accordingly. Your connections, so far as we can make them out, seem to be wrong. The method has been explained many times.)—Constant Reader, Leicester. (For musical glasses, see p. 534, Feb. 21, 1890, and p. 14, Feb. 28, 1890.) — Constant Reader, S. S. (Cast in a plaster mould. 2. File the milled edge on, or use a milling tool. Use a small drill for the hole, such as watchmaker's use. 3. Nitric acid, covering the articles with wax or soap, and scratching through the film the lines required to be etched. See indices and Replies in this number.)—Fitter. (Cannot be done to any advantage. Cheaper to make a gas-engine at once.)—Zonodo. (In many back volumes, especially the earlier—say from X. to XX. Mr. John Hampden was as "Parallax.")—Ametuer. (You will find something about hand-sewing of boots by "Jack of All Trades" in the number for Aug. 17, 1888; but if you can procure Vol. XXXVI., there are a series of letters from his pen showing, with illustrations, how to make a hand-sewn boot. There is "Boot and Shoe-making," by Leno, Crosby Lockwood and Co.)—Hard Up. (You might try plaster of Paris, or whiting; but what is it for? Treacle is naturally sticky.)—Metal. (It is generally called composition, or compo. Those who put capsules on bottles generally roll it themselves; but metal dealers no doubt supply it in any form.)—Transmitter. (As a rule it is the Blake or the Gower-Bell. If you cannot refer to the earlier volumes, see Mr. Allsop's articles on Telephones: their Construction and Fitting, which commenced on p. 235 last volume. The Blake was illustrated June 27, 1890.)—A. Y. Z. (The articles on "Electro-Magnets" are in the present volume, so that you had better complete that. The previous articles on "Model Loco.-Making" are in Nos. 1312, 1313, 1314, 1315, 1316, 1319, 1321, 1324,—so if you procure the back numbers of this volume you will have both series of articles.)—Charles Curtis. (Your query next week. Raise the discussion you suggest, by all means.)—Rambler. (You could hardly manage the ordinary zinco-process yourself; but scores of houses will make repro-process blocks for you cheaply and quickly, though perhaps not cheap enough for an ordinary paper. The quickest process we know is that of the Rapid Engraving Company, 140, Strand, London, W.C. We often use it in the *Weekly Times and Echo*, and can get a block in a couple of hours. They would make your blocks for you; but whether they would allow you to work the process, or whether you could do so supposing you had permission, we do not know. The drawing is made in relief on a prepared plaster slab, and the stereo block is actually cast from the slab.)—A. C. (The lead pipes burst when the water freezes. Some burst and the rest do not, simply because some are more worn inside, or of inferior metal, or, at any rate, from some cause or other, are weaker than those which escape.)—H. Brown, H. G. Dixon, A. D. (In type).

**Gentlemen.**—If your constitutions are enfeebled through overwork or worry, one of Mr. Harness' Electropathic Belts will speedily restore you to health, strength, and vigour. The mild continuous currents of electricity, which they are guaranteed to imperceptibly generate, will most assuredly vitalise every organ, nerve, and muscle of the body. These are not rash statements, but are actual facts based on many years practical experience, and can be confirmed by thousands of living witnesses. The Medical Battery Company, Limited, publish (gratis) a book containing hundreds of unsolicited testimonials, the originals of which may be personally inspected at their Electropathic and Zander Institute, 52, Oxford-street, London, W. They have been written by all classes of men and women, who have been completely cured of nervous and rheumatic affections, liver and kidney disorders, organic and other derangements, by simply wearing these invigorating, health-restoring appliances. All who are able to call and avail themselves of a free personal consultation should do so as soon as possible, and those who cannot call should write at once for descriptive pamphlet and book of testimonials, which will be sent gratis and post paid to any address on application. All communications are regarded as private and confidential.

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English Mechanic
:LD OF SCIENCE AND ART.
:AY, *FEBRUARY* 13, 1891.

## CONSTRUCT A QUARTER IMING CLOCK.—IX.

### e Striking Gathering Pallet.

shows dimensions, &c. Rough gs in steel can be obtained from ial dealers, from which the

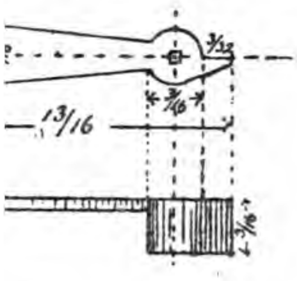


Fig 71

pallets can be filed up. The should be $\frac{3}{16}$in., measured from and the wing $\frac{5}{8}$in. long and about . There is a small, square, in centre, which fits on pallet-. Sometimes the gathering pallet ushed on friction-tight; but it is it on in addition by a removable ould revolve quite free of the will not be too much freedom. hole will, perhaps, puzzle some, of its small size. It may be e ordinary way first, and then by driving in a square-tapered t may be squared by means of a uare file; but perhaps the ama-d the first method easiest. When hape, it must be hardened, tem-polished bright, or blued. Care ken not to leave the edge of harp, or it will cut the rack-

### 3.—The Striking Rack.

hown in Figs. 72 and 73. The steel, forgings for which can be

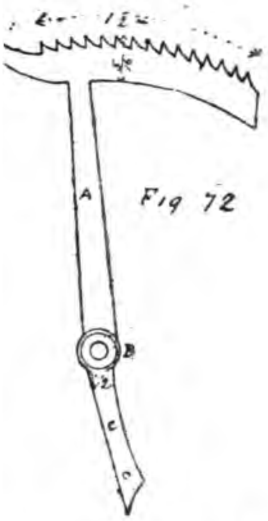


Fig 72

desired, or it can be cut from

ounted upon a brass pipe centre, the part C is fixed. The rack, therefore, consists of three dis-the rack proper, the centre pipe, piece.

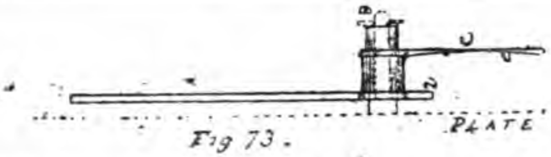


Fig 73.

The rack itself (A) is about 2¼in. long from the centre upon which it turns to the points of the teeth. This brings the centre of motion just below the fusee winding-square, and enough to the right to clear the said winding-square (*and key* when the key is upon it in winding), when the rack falls to its fullest extent.

It has 15 teeth of the form shown in figure. These are marked out carefully, at intervals of $\frac{1}{16}$in., along an arc of a circle struck from the centre of motion, and must be about $\frac{1}{16}$in. deep. Some racks are cut in a wheel-cutting machine, but the majority are, or used to be, filed out by hand; and that is what I recommend readers to do. Each tooth must be afterwards smoothed, either with fine emery or oilstone dust on a polisher filed up to curve of teeth. The part marked 1 had better be left untouched till the rack is pivoted upon the plate. This is done in exactly the same manner as the star wheel, by means of a steel stud. The rack is riveted on to its brass centre. It should be so placed that the points of teeth just clear the *body* of the gathering pallet, and should clear the plate by ⅛in., so as to be entirely *below* the wing of gathering pallet.

The exact position for pin upon which gathering pallet is locked cannot be very well fixed upon till the rack hook is also mounted. When this is done, place the various parts in the position shown in Fig. 1 (page 158). The gathering pallet must then rest upon this pin just at the point where the curve of the wing starts. If this is done, the pressure of wing on the pin will not prevent the rack falling away from under it when released. If the *curve itself* falls upon the pin, an unnatural strain will result upon the rack and upon the pallet-wheel pivot, and if, on the other hand, the flat portion of wing rests on the pin, a resistance is offered to the free falling of rack. This pin should be of hardened steel, well polished, and must be firmly screwed and riveted in. The rack may then be filed up to the shape shown, or, for the matter of that, any other shape that may be fancied. It must be thinned to about $\frac{1}{16}$th thick, or just a shade over, and polished all over. The usual practice is *not* to harden the racks, hooks, &c.; but there is no doubt that, if carefully done and distortion quite avoided, they would wear better and take a higher polish if hardened and tempered. The short projection (2) in the figure is to form a purchase for the brass spring shown in Fig. 1. This spring must be very light in its action, just sufficiently strong to insure the falling of rack when it is released.

The *tail-piece* is of brass, very thin, and well hammered to form a spring, as shown in Fig. 74 by the dotted line. It must be riveted on to the brass centre at such a height as to come above the snail and just free of it, and in such a position that when the rack-hook is in the first tooth of the rack the hole A just reaches the edge of the disc of brass from which the snail is to be cut. A pin, A, is inserted as shown, and sloped off. The object of this is to enable the snail to be driven backwards when the hands are set back, without damage resulting to the rack. Instead of the steps of the snail butting against the pin, they press it upwards, and the elasticity of the tail-piece restores it to its original position the next time the rack falls. The length of the tail-piece from centre to pin-hole is equal to the distance between centres of snail and rack, so that the pressure of pin on snail is tangential at all positions.

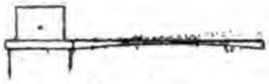


FIG. 74.

### 34.—The Striking-Rack Hook.

This is shown in Fig. 75. It is made from steel, and rough forgings can be obtained if desired. It is pivoted upon a steel stud like the rack, and is made in three pieces, the hook, the brass centre, and the brass tail-piece. The stud is to be fixed in the position shown in Fig. 1, and the hook must be of such a length as to drop well beyond the body of gathering pallet, and hold the rack in such a position that one tooth *just falls back the least trifle* after the gathering pallet has done its work. The tail is made of sheet brass about $\frac{1}{16}$th thick, and must be of such a length as to be depressed upon the falling of the chiming rack, just sufficiently to let the striking rack fall freely. This part cannot therefore be finished just yet. The point of hook may be hardened, tempered, and polished.

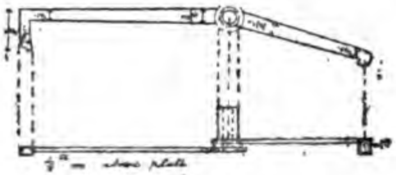


Fig 75

### 35.—The Division of the Snail.

This was left as a disc of flat brass. Now that the rack, hook, &c., are finished, it can be divided and cut.

Fig. 76 shows the way it must be marked off. First draw twelve radial lines at exactly equal distances, then mount the snail, rack, and hook upon the plate. In place of the tail-pin of rack, insert temporarily a sharp steel point, sharpened down *on one side*, the point side next to snail as shown in Fig 77. Place the rack-hook in the first tooth of rack, press the steel pointer in rack-tail, on to the snail brass, and revolve the latter with the finger to the extent of one division. This will trace a curve upon it. Move the rack one tooth, repeat the operation twelve times till all the curves are marked, and cut the snail carefully to these

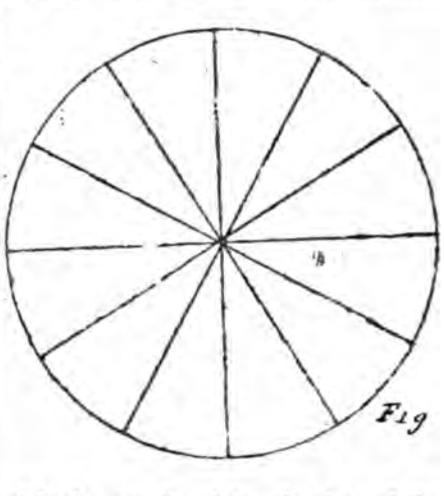


Fig 76

—No. 1351.

lines. Each rise must be sloped off as in Fig. 78.

The great advantage of this eminently practical way is that it corrects any inaccuracies in the cutting of rack-teeth, &c. Of course, if everything in the clock were set out and cut perfectly, the snail could be marked off purely by the compasses according to theory, as follows:

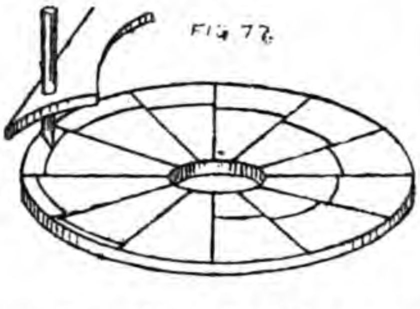


FIG 77

The distance between the highest and lowest steps of the snail is to the distance between twelve teeth of the rack, as the rack-tail is to the rack. It may be stated in proportion thus:—As (length of rack) : (length of tail) : : 12 teeth (11 spaces) : distance required.

Having found this distance, measure it off and draw a circle representing the lowest step. Then divide the distance into 11 equal parts, and draw this number of intermediate circles, each representing one step, as shown in Fig. 78.

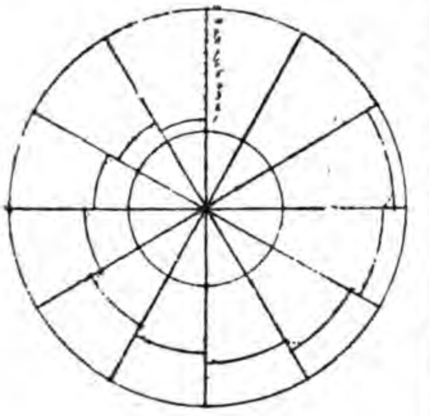


FIG 78

Whichever way is adopted, care must be taken that when the star-wheel is at rest, the pin in rack-tail rests on the centre of one step of the snail. This, of course, all depends on the position in which the radial lines are drawn.

The edge of the brass where the rise occurs between the highest and lowest steps of the snail must be bevelled off on the top as shown in Fig. 1 (page 158). This is to prevent it butting against the rack-tail if the latter should be in the way from any failure of the striking mechanism.

### 36.—The Hour-Warning Lever.

The steel piece (5), Fig. 1, is pivoted as shown, in same manner as the rack-hook, and may be about $\frac{1}{16}$in. thick. It has a projecting piece of hardened, tempered, and polished steel riveted into the end. This piece passes through a slot in the plate, and when the piece is *up* intercepts the pin in warning wheel. But when the piece is *down*, the warning wheel is free to revolve. It is kept raised by means of a thin brass spring, as shown in Fig. 1.

The tail-piece (of brass) cannot be completed till the chiming work is done.

The steel piece must be about $\frac{1}{8}$in. off plate.

### 37.—The Chiming Rack.

Fig. 79 shows the chiming rack. It is made in three pieces, as was the striking rack. The rack proper is shorter, being pivoted *above* the chiming fusee holes. The tail is longer, and is made to spring in exactly the same manner as the striking rack. Seven teeth are cut in the rack, which may with advantage be larger than the striking-rack teeth—say $\frac{3}{16}$in. each. The rack is placed $\frac{1}{8}$in. clear of plate, and is provided with a spring to insure its falling. The tail is made to come just above the chiming snail, and must be equal in length to the distance between the centres of rack and snail. The pin upon which the gathering pallet comes to rest, goes right through the rack, the lower end engaging with the tail of warning lever just described (No. 36), and just holding it down clear of the pin in warning wheel, when the chiming rack is all gathered up. This tail must therefore pass *between* the chiming rack and the plate.

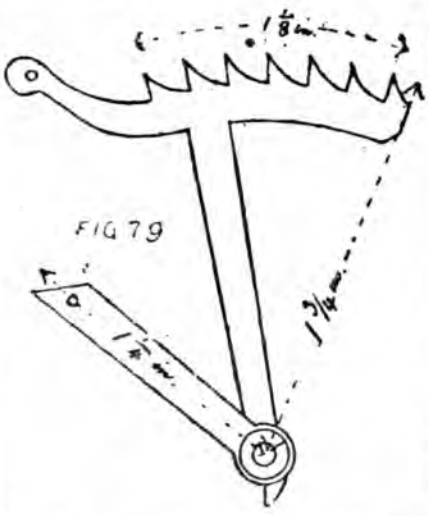


FIG 79

### 38.—The Chiming Gathering Pallet.

This is made in exactly the same way as the striking gathering pallet (No. 32), except that it is a trifle larger on account of the larger-sized teeth of the rack.

### 39.—The Hook.

The chiming rack hook is made of steel in one piece, forgings for which can be obtained, and is pivoted on a steel stud in same manner as striking-rack hook (No. 34). The point must be polished. It is $\frac{1}{8}$in. free of the plate. No spring is required to hold it in position. It falls with its own weight.

### 40.—The Chiming Snail.

This can be divided in the same manner as the striking snail, but having only four steps, it is a much simpler operation. See that the divisions are so placed with regard to the pins in minute-wheel that when the rack falls it shall be upon the middle of one division of the snail; otherwise false chiming may result.

### 41.—The Quarter-Warning Lever, &c.

The piece 8 (Fig. 1) consists of three steel arms fixed rigidly to the same brass centre, and pivoted to the plate by means of a steel stud. The lower arm engages with the pins in chiming snail, each of which raises it slightly, and then lets it drop again as the minute-wheel revolves. This arm is just *below* the snail, and passes between the rack and tail as shown in Fig. 1. The second arm passes upwards to the rack-hook, and raises the hook by means of a pin, and so lets the rack fall each time the lower arm is raised. This arm passes *over* the rack and hook, and just above them enough to insure perfect freedom. In Fig. 1 it is shown *below* the rack. This should not be so, obviously, as the rack and hook are both on level ($\frac{1}{8}$in. above the plate).

The upper arm corresponds to
piece 5 (Fig. 1), and has a project
passes through the plate and eng
chiming side warning wheel. Th
the plate must be of such a len
allow the entire piece to fall wit
weight just free of the pin in warnin
but no further. This third arm
very thin and close to the plate, so
*under* the rack and hook and ha
freedom of action.

## MODEL LOCOMOTIVE-MAK

## XV.

THESE engines are quite differen
and vastly simpler than either
formerly described. These are slide-val
like the others, but with a difference.
no lap nor lead, the ports are not
cylinders—an impossibility in such sm
the cylinders are not bolted to the fr
side flanges, but are screwed to the f
there are no guide-bars nor cross-
piston-rods working in plain guides, a
connecting rods.

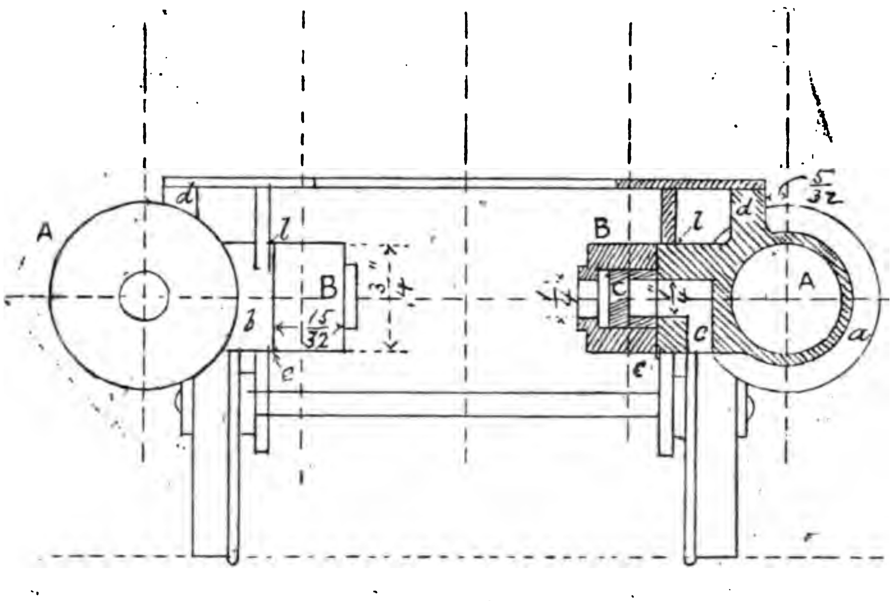
The cylinders (Fig. 70, A) are prov
shallow flanges *a* to receive the covers
with blocks *b* for the passages, and exha
foot *d* for attachment to the foot-plate
will be no difference in pattern and
except that $\frac{5}{8}$in. prints will be put o
centre core. Nothing else is cored. W
bore them—passing a drill through will
slip over a mandrel of wood or metal
centres, and face the flanges. File t
face *e* parallel with the bore, and also
foot *d* on its face similarly. Set
position of the ports *f g g* with
on the valve face, as shown (Fi
square their edges up with set
and scriber, and also scribe their
These will be first started with hole
side by side, and afterwards finished
narrow chipping chisel to about th
shown in the plan view, Fig. 70. Th
ways will be drilled diagonally from the
the cylinder to the block *b* to meet the
Openings will be made from the steam-
the ends of the cylinders by chipping out
of metal between the drilled holes and t
body. The exhaust-way *c* will be dril
the bottom outside face of *b* to meet th
The objection to this drilling is that t
passages are smaller than they shoul
relation to the bore of the cylinder.
is no alternative, casting being only
when made quite a speciality, and the
job few moulders care to tackle. A
case would it be possible to cast ports
together, and so narrow as these.
these ports will convey enough steam to
engine run, with the opening to s
closed before the end of the piston str
that is as much as can be expected in a
this character.

The covers *h j* are just checked slig
the bore, and screwed to the cylinde
with three or four cheese-headed screw
There is the necessary stuffing-box
gland *k*. The glands may be furnis
hexagonal flanges, or they may be cir
milled, very little force being nece
screwing them down upon the packing.

The steam-chests B are merely squ
screwed on the cylinder flanges wit
headed screws, and furnished with ti
bored out for stuffing-boxes, and screw
ceive their glands. Bosses on the bac
chests will receive the steam-pipes.
in the sides of the chests is left thick
hold to the screws by which the
fastened to the cylinders.

The valve C can be chiselled and fi
the solid, or cast with the arch in. It
slide within the sides of the chest. Its
coincide in middle travel with the oute
the steam-ports, so that there is no
and no early cut-off. The valve-rod
screwed into a tapped hole

To fix the cylinders to the foot-plate,
wooden pins to fit the bores, each paral
sufficient length to extend the whole
the engine. The edges of these pins w
the purpose of winding strips for g



END VIEW FIG 70. SECTION

proper position on the piston-rod E by means of the set-screw H, which will be best pointed to enter into a very slight countersunk recess made in the piston-rod.

The opposite end of the connecting-rod is bossed up, and is attached to the driving-wheel by means of a pin *n*, riveted into the boss prepared for it on the wheel, and riveted over the connecting rod boss.

The piston-rod is guided rectilineally in the block J, which is screwed below the foot-plate, and is made thin enough to clear the connecting-rod fork.

The valve-rod K is of steel wire, flattened out at the eccentric-rod end (see Fig. 71), and the block L is pivoted over that end, with a wire riveted over. The only guide to the valve-rod is the steam-chest and its gland. The eccentric-rod M is united to the block L by screwing, and it is also screwed into the eccentric-strap at the opposite end.

There being no lap nor lead given to the valve, the eccentric sheave N is exactly 90° in advance of the crank-pin. In Fig. 71 the centre O is the position of the centre of the sheave N, corresponding with the position of the valve and piston shown in sectional plan, and the arrow shows the direction of rotation. The centre *p* is the position of the centre of the sheave P, corresponding with the position of the piston on the outside view, the piston being in the middle of its travel, $\frac{3}{32}$in. is the amount of eccentricity given to the sheave.

The sheaves and straps are both made in brass. The sheaves will be set in correct positions, and they must be secured with a ring of solder, to prevent them from moving round on the axle from their proper positions. Before soldering, be sure that they open their valves equally at both ends, and that the periods of opening and closing coincide with the extreme positions of the pistons.

J. H.

## MARION'S "RADIAL" HAND CAMERA.

THE "Radial" Camera which Messrs. Marion and Co., of Soho-square, are introducing this season has some points of novelty and usefulness which will commend it to the attention of tourist and other photographers. The invention of Mr. Dickinson, who has protected it by letters patent, it takes its name from the novel method of carrying the plates in radiating grooves, which have their common axis in the centre of the exposing position. When ready for exposure the plate occupies a groove running across the axis of a drum, which is made to revolve with such exactness that it forms a continuation with any of the radial grooves holding the plate. It is thus possible to pick out any desired plate from the "store," so to speak, and when that is received into the drum, the latter is turned until the plate is in the required position for exposing. After exposure the plate is readily returned to its original position, an index regulating and guiding the necessary movements. Fig. 1 is a side view showing the interior arrangements of the camera; Fig. 2 is a horizontal cross section; and Fig. 3 shows the fittings of the base. The camera is "charged" by first fixing the indicator A (Fig. 3) in the notch marked "to expose," removing the end board and screen, and inserting the plates with the film side to the right hand. A card for recording exposures is placed in the frame B, and the camera is closed, and with its 12 plates is ready for use. The lens is moved by an eccentric disc governed by the pointer C (Fig. 3), which indicates the exact focus by figures engraved on the semicircle D. The central drum E being empty, the indicator is turned to the number of the plate it is desired to use, and a slight turn of the milled head H will open the exposing groove into which the plate will slip when the camera is tilted. J and K indicate knobs attached to cords by which the exposure is effected. The illustrations give a good idea of the camera, which is one of the best of the kind.

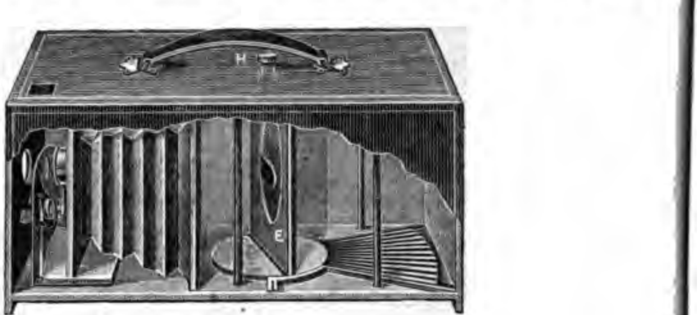


Fig. 1.

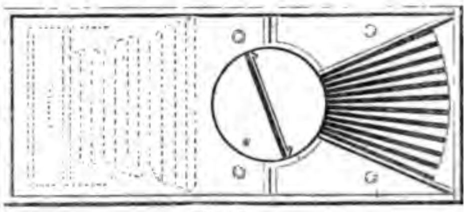


Fig. 2.

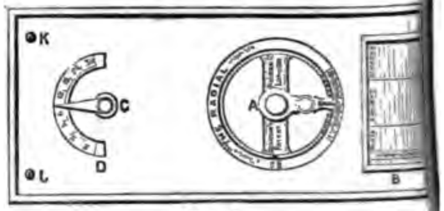


Fig. 3.

## ECONOMICAL EXPERIMENTAL APPARATUS.

By Walter H. Ince, Ph.D.

PIECES of apparatus which can be easily made and cost little for material are always in demand by those who have either limited incomes or who are at a distance from large business centres. The following are descriptions of apparatus which can be made by anyone who possesses a certain amount of ingenuity or mechanical skill. They are by no means to be regarded as temporary makeshifts; on the contrary, many of the pieces described may form trustworthy adjuncts to the furniture of the laboratory. A very little trouble expended may render them quite presentable.

### Blowpipes.

A blowpipe for ordinary use may be made by boring a sound cork laterally three-quarters of its length, and then boring another hole transversely to meet the first in the centre. At the shorter hole place a jet made of hard glass tubing drawn to a point, and at the other a longer piece of soft glass tubing, having the end smoothed by holding in the flame of a Bunsen burner (to avoid cutting the lips), and a bulb blown, as shown (Fig. A), to condense the moisture of the breath.

A burner to be used for this blowpipe may be made by partly closing the extremity of a piece of hard glass, as shown in Fig. B, attached to an ordinary gas-jet by a piece of indiarubber tubing.

A Herapath blowpipe, to replace the use of an air bellows, may be constructed by taking an ordinary bladder—which has been rendered pliant by rubbing with sweet oil—and placing an indiarubber ring round the centre of it (Fig. C). In the mouth of the bladder a large cork, bored with two holes, is firmly tied. Through one of the holes a long glass tube is placed, reaching to the bottom of the bladder and fitted with a Bunsen air valve. This air valve can be made by taking a stout piece of indiarubber and carefully slitting it about 1in. lengthwise in the centre with a sharp knife. One end is then drawn over the end of the glass tube, and the other closed with a piece of glass rod; this allows the air to enter the bladder, but prevents its exit. At the other hole in the cork is placed either an Indiarubber tube leading to a blowpipe, or the blowpipe itself fitted on a piece of bent tube. The nozzle can be made by fixing to an ordinary brass T-piece, by means of a cork, a tube for the blast of air, and at the other opening, at right angles to it, a similar but slightly larger tube for the gas. The Indiarubber band in the centre of the bladder is to give it elasticity, and acts in the same way as the

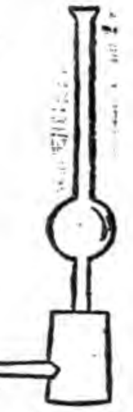


Fig. A.

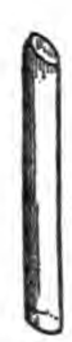


Fig. B.

rubber sheeting in the ordinary foot bellows. vide jet for the air supply be used with low ure on the bellows, lead glass may be very manipulated with this form of blowpipe, and iot be found to blacken. If a fair pressure of is at hand, a good blower may be made as rs:

mall bulb is blown in a piece of glass tubing 6in. long; this is pierced in the upper part by lly heating with the fine point of a blowpipe , and then sharply blowing. The tube above uncture is then slightly narrowed. A large mouthed bottle (Fig. D) is next taken, and with a cork bored with three holes. In the one the above tube is placed, connected with ater supply; in the second, a tube leading to adder reservoir; and in the third, a bent tube ing to the bottom of the bottle, so as to act as ion. The water passing through the centre draws with it air, which is forced into the oir, while the water is carried off through the n. If the water supply be not at hand, the may be saved by filling the bladder by means ordinary kitchen bellows.

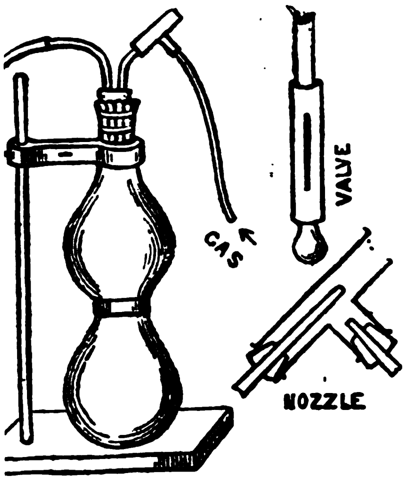


Fig. C

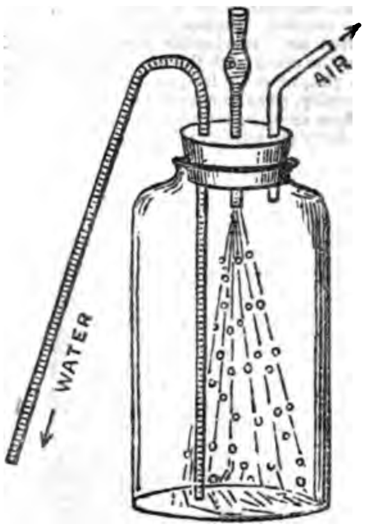


Fig. D

### Bunsen Burners.

simplest of this class of burners may be made nding a bit of ordinary glass tubing at right , and nearly closing one of the extremities. s then inserted into a small cork bored in the and notched at the sides, over which a ly larger tube of hard glass is fixed. The nd of the tube may be supported on a large or fixed into a cork supported on a glass l (see Fig. E).

ther very simple burner to be attached to an ry jet may be made by winding stout brass ound a tube slightly larger than the gas jet, o make a coil about 2½in. long; the inner core acted, and one end of the coil fixed over the r, as shown in Fig. F. Instead of the brass piece of brass or glass tubing may be fixed n ordinary burner by means of two small s of cork at the lower extremity, allowing enough for the air to enter at the sides.

Argand burner may be made by filing slits in a hollow brass door-handle, at regular intervals, and attaching it to the gas supply (Fig. G). An ordinary portable gas jet forms a good starting point for these burners, and may be obtained for 1s. or 1s. 6d. from any gasfitter. In lieu of this, a brass rod, at the top of which a jet has been screwed, may be placed in a bottle fitted with a cork with two holes; in the other hole an elbow tube is fitted for the supply of gas. The bottle is three-quarters filled with lead shot or sand to make it steady (see Fig. H).

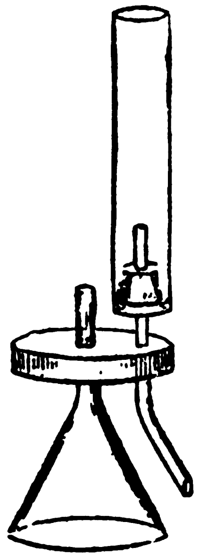


Fig. E.

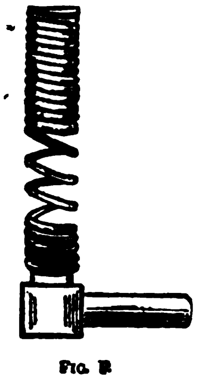


Fig. F

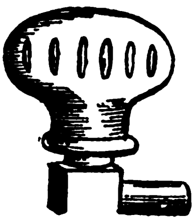


Fig. G

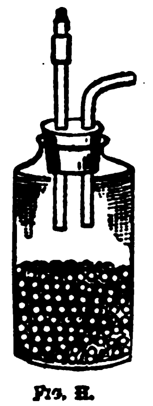


Fig. H.

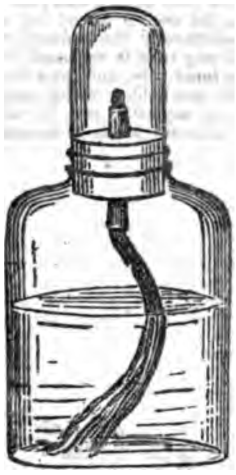


Fig. I.

A spirit lamp is easily constructed by placing a bored cork in a wide-mouthed bottle; in the aperture a piece of glass tubing is inserted (Fig. 1), forming a wick carrier, and the whole is rendered air-tight when not in use by placing a wide test tube over the cork. A small hole must be drilled in the cork, by means of a red-hot needle or wire, to allow air to enter the bottle and replace the spirit consumed. The application of stout tinned iron or brass wire is practically unlimited in the construction of laboratory apparatus. A pair of flat and round-nosed pliers with a file are all that is required for manipulating it. The formation of a Bunsen burner (Fig. F) has already been described. The following are hints which may be expanded at pleasure. Pinch-cocks, tripods, watch-glass holders, pincettes, test-tube holders, filter rings may be mentioned among the many useful things which may be made from wire, as shown in the figures given.

### Steam Apparatus.

A most useful, and often neglected, adjunct to a laboratory is ordinary composition lead gas-piping, which for pliability, rigidity, non-compressibility, and cheapness, may vie with Indiarubber tubing. As a connection between vacuum pumps and desiccators it is unrivalled.

By carefully winding this tubing round a fairly wide glass tube, narrowed at one end, a most efficient condenser may be made, which acts quite as well as a jacketed Liebig's condenser, and if it be japanned it looks equally well. It is, moreover, easier to handle, and more convenient to attach to the water supply. Fig. K shows the arrangement. A hot-water funnel, or steam bath, may be made by winding the composition tubing spirally round a funnel (Fig. L), or in the form of a saucer, on which the evaporating basin may rest. Steam required for this form of apparatus may be generated from a tin flask or can, such as a workman's tea flask. A steam-drying cupboard may be constructed by laying a coil of the composition tubing on the bottom of a box, such as is shown in Fig. M, and conducting both ends through holes bored in the sides of the box to the outside. Steam passed through this coil heats the whole apparatus to about 190 to 200° F., which is quite hot enough for ordinary drying operations, such as drying filters, precipitates, &c.

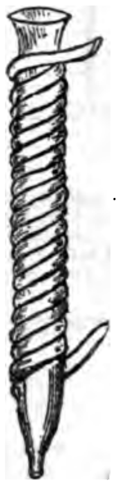


Fig. K.

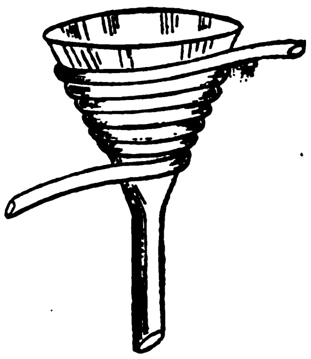


Fig. L

The steam required for one of the above pieces of apparatus will be found to be sufficient for all three, passing it first through the drying cupboard, then through the evaporating pan coil, and, lastly, through the filter warmer. It can then be led off

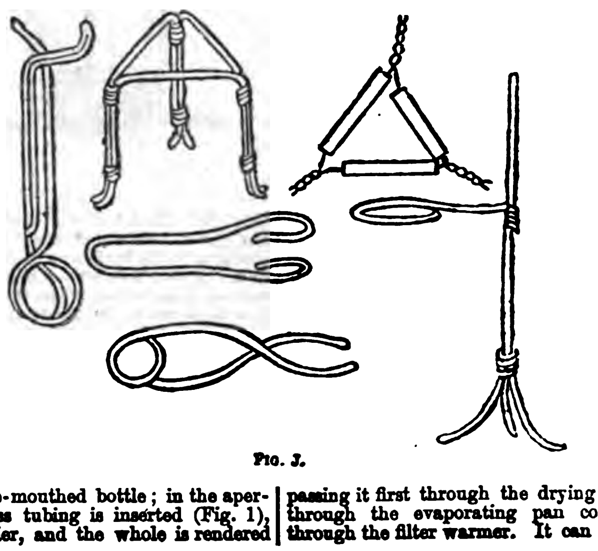


Fig. J.

through a condenser, and used in the laboratory as distilled water.

### Wood Requisites.

The manipulation of wood requires more skill and a few more tools, yet the following will be found by no means difficult to make:

A test tube holder (Fig. N) can be made from two pieces of soft wood. One square piece, 6in. long, is rounded for 2in. at one end, and at ⅝in. from the other end a curve is cut to hold the test tube and prevent it from slipping. The clamp part is formed from a similar piece, but only 4in. in length, 2½in. of which are beveled off in the shape of a wedge, and on the same side a curve is cut corresponding to the curve on the first. The two are joined together by a stout Indiarubber ring, as shown.

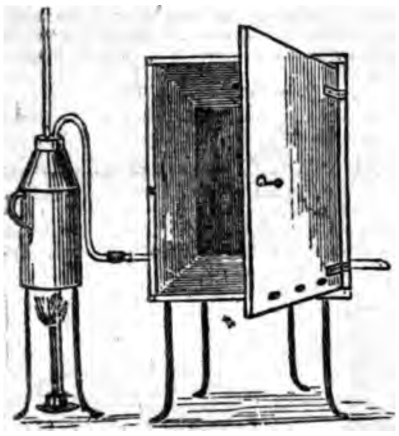


Fig. M.

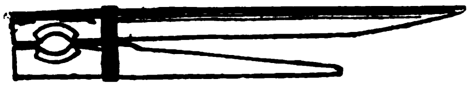


Fig N.

A retort or burette stand (Fig. O) can be made as follows: On a soft wood or deal base an upright of straight close-grained wood about 1in. wide by ½in. thick is firmly fixed. This is cut with a wide saw three-quarters down its length, dividing the upright into two equal ½in. squares. An inch below the cutting a screw is fixed to prevent the wood from cracking and the cutting from extending. At the top the two squares are joined together by a screw having a thumb piece to enable it to be loosened or tightened at will. The clamp part is made by bending a piece of stout tinned iron plate, 10in. by 1in., in half, and hammering the joint, thus making two arms 5in. long. The ends are then bent in rather less than a half circle, to catch any round object which they are destined to hold, and lined with cork. An ordinary brass curtain ring is then hammered so as to form an elongated oblong, and slipped over the clamp. By altering the position of this ring the jaws of the clamp may be extended or contracted. The top screw of the upright is then loosened, and the hammered end of the clamp placed within the slit; on tightening the screw the two sides of the upright will be forced together, and securely fix the clamp in a rigid position. If the clamp be required to be elevated or depressed, all that has to be done is to loosen the top screw, place the clamp in the desired position, and again screw up tight.

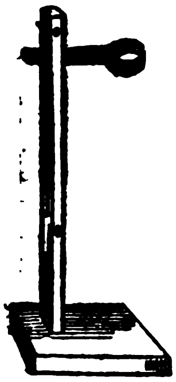


Fig. O.

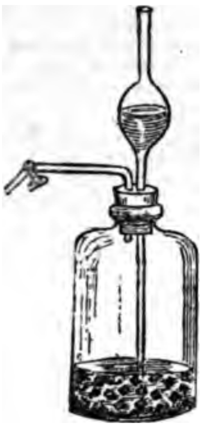


Fig. P.

The whole apparatus may be then stained and the metal parts japanned, which will give it a neat appearance.

### Chemical Apparatus.

Among the many simple forms for the constant supply of sulphureted hydrogen, carbonic acid, or hydrogen, the two following may be mentioned: A 6oz. wide-mouthed bottle (Fig. P) is fitted with a good cork, bored with two holes; in one a delivery tube is fitted, and in the second an upright tube, having a large bulb blown in the centre, reaching to the bottom. The bottom of the apparatus is covered with coarse pieces of glass, and the generating substances placed on this layer. As soon as the stream of gas is cut off by closing the exit tube, the acid is forced into the bulb, and the evolution of gas ceases.

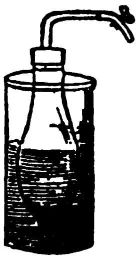


Fig Q.

A second form consists of a wide-mouthed tube, such as a small lamp-glass, closed at the lower extremity with a paraffined cork which has been perforated with four or more holes (see Fig. Q). The sulphide of iron, marble, or zinc, as the case may be, is then placed in the tube, and the other end closed with a well-fitting cork, supplied with a delivery tube.

This is then placed in a wide-mouthed jar half filled with diluted acid; on stopping the current of gas the acid is forced out of the lamp-glass, and consequently the generation of gas ceases till the delivery tube is reopened, when the acid flows into the inner tube, and the action recommences.

A gas-holder, which may equally well be used for an aspirator, can be made by connecting two Winchester quarts by means of an indiarubber tube (Fig. R). Each bottle is fitted with a cork in which are placed two tubes bent at right angles, one reaching to the bottom of the bottle and the other to the base of the cork. The rubber tube connects the two long tubes; when the liquid is required to flow from one to the other, the full bottle is raised, the liquid siphons over into the lower bottle and forces out the gas contained therein. If, however, the apparatus is required as an aspirator, the tube to be aspirated is attached to the shorter of the two tubes of the full bottle, and the other lowered; the water flowing from the upper to the lower bottle causes a diminution of pressure, and thus induces a current of air.

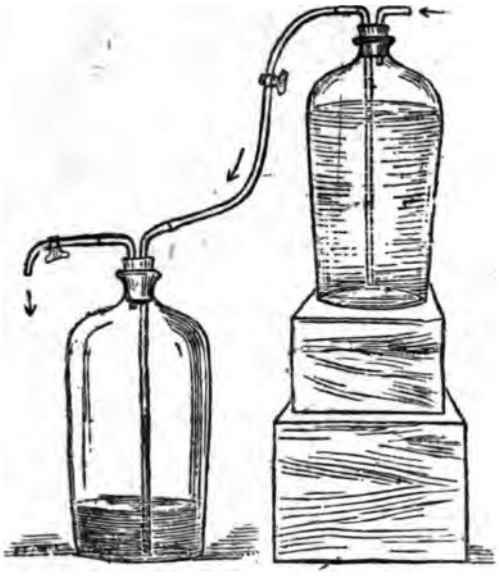


Fig R.

Out of a Winchester quart a serviceable percolator may be made by removing the bottom (Fig. S). This is accomplished by touching the side with a piece of red-hot glass rod at any place at which a division is required. This starts a crack wh
be led in any desired direction by the carefu
cation of a hot rod. A certain amount of
is required to carry this out in a satisfactory
When the bottom has been removed the sha
are roughened by an application of a file,
percolator, reservoir, or gas jar is ready
There are other methods of removing the
of bottles, but none is so safe as the one d
Generally, the bottom will come off prett
by letting a poker or heavy iron bar fall w
through the mouth. Another way is to wra
of wet fiter paper round the part to be seve
plunge the bottle evenly into boiling wat
the paper line. Bottles and wide tubes
divided by wrapping wet filter paper evenl
the glass on either side of the desired line of
leaving a ½in. free. This free space is the
in a Bunsen flame, and on giving a sharp
pull the glass will generally sever along th
portion; but this is by no means an inf
reliable method. Broken flasks and retorts
converted into serviceable evaporating b
leading the crack with the aid of a heated
within 2in., more or less, of the bottom,
horizontally, so as to cut off a saucer-shape
The edges are then rounded in the blowpip
lip made by strongly heating the edge at on
which, when the glass is softened, is slightl
outward with a piece of warmed metal, s
knife blade.

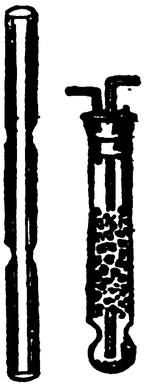


Fig. T.

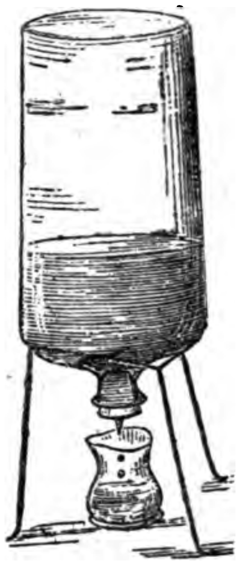


Fig. S.

Drying tubes for pumice stone and sulph
(Fig. T), having a compact and neat app
may be made in the following way:—Ta
glass tube about 12in. long and ½in.
diameter, heat strongly in the blowpipe 5
either end till red hot, and cautiously
making two constrictions, care being take
let the glass in these two places be too thin
heat between the two narrowed portion
white hot remove from the blowpipe an
pull the tube apart, always revolving du
application of the blowpipe flame.

Thus two tubes are produced. By carefu
and blowing, round off the bottom of e
leaving the glass as thick, if possible, as th

## THE HIRLIMANN BATTERY CELL.

THE battery cell shown in the engravings annexed has been patented by Mr. C. J. Hirlimann, of 91, Green-street, New York, and is to be known in trade as "The Champion." The battery is made up in two distinct patterns, the difference, however, being only in the form of the zinc, and it will be seen, by referring to the illustrations, that one of the zincs consists of the ordinary rod Leclanché zinc, while the other is a large surface corrugated sheet zinc. When the rod zinc is employed the battery is most suitable for telephone work and where a constant output of energy is required, while the corrugated zinc is used where large quantities of current for a short time is the desideratum, as in gas-lighting work, electric-bell ringing, &c. In further support of the merits of the battery, an official measurement of the cell by the distinguished electrician, George d'Infreville, is submitted, in which the following figures are set forth:—Electromotive force, 1·4 volt; internal resistance, ·17 ohm; current, 8·3 ampères.

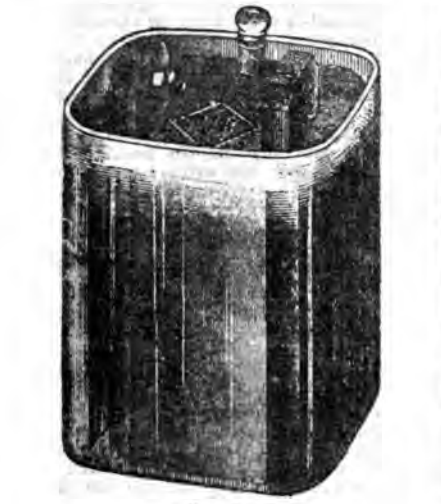


FIG. 1.

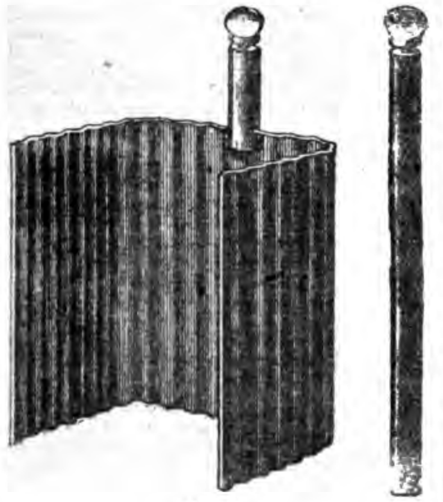


FIG. 2.

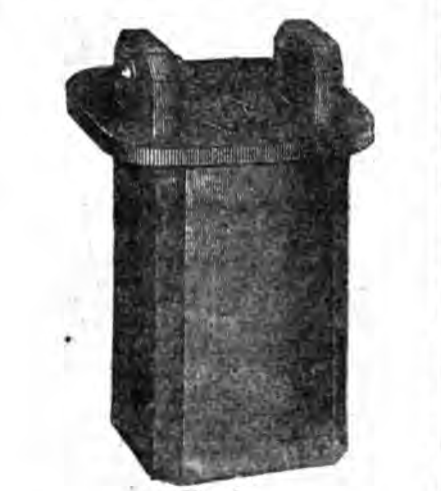


FIG. 3.

Mr. Hirlimann, so far from having any doubts as to those figures, states that, by a special process through which the carbons are put after baking, if anything there will be an increase in the ampèrage of his cell beyond the official report above given. The carbon reservoir is quadrangular in shape, and charged with ingredients under a secret formula, and is provided with a neat top, fitting closely into the glass jar, to prevent evaporation and facilitate sealing.

The illustrations explain themselves. Fig. 1 is the cell complete, Fig. 2 shows the two forms of zinc, and Fig. 3 the carbon reservoir.

# SCIENTIFIC SOCIETIES.

## WESTERN MICROSCOPICAL CLUB.

AT the meeting held Feb. 2nd at his house, Mr. W. Crookes, F.R.S., took for his subject "Electricity and High Vacua." This he illustrated with a series of brilliant and beautiful experiments, which elicited frequent applause and constant admiration, the phosphorescent condition of rubies, diamonds, and certain rare earths—samaria, yttria, &c.—being especially admired.

The electric energy was derived from a large induction coil have some 60 miles of secondary wire, and giving, with two cells of a storage battery, a spark of 4 or 5in., which is equivalent to an electromotive force of about 100,000 volts, sufficient to give a dangerous shock to anyone incautiously touching the uncovered wires.

The high vacua were produced in glass vessels exhausted of air and other gases by means of a complex mercurial or Sprengel pump, and in the experiments described ranged from 75mm. or about $\frac{1}{10}$th of an atmosphere (a very slight degree of exhaustion, as was explained) to $\frac{1}{10000}$th of a mm., or 0·13 millionth of an atmosphere, the residual pressure being measured by the McLeod gauge.

To show the appropriateness of the subject for the consideration of a microscopical club, Mr. Crookes stated that it dealt with the infinitely small—viz., with the ultimate molecules of matter. As an illustration, he observed that if a line one mm. (mm. = $\frac{1}{25}$th of an inch) in length be supposed magnified to the length of the Atlantic telegraph cable, then its molecules would appear like a row of small shot. More exactly, this would be the apparent size of the spheres of influence of the molecules, they themselves being probably very much smaller than this. The kinetic theory of gases teaches that the constituent molecules dart in every possible direction with great but continually varying velocities, coming almost ceaselessly into mutual collision with each other. The frequency with which a particular molecule will collide with others and the mean length of its free path will depend on the number present in a given space, as well as on the temperature.

In ordinary gases the length of the mean free path is very small; hence collisions are frequent, and we thereby get the properties typical of gaseous matter. By greatly reducing the number of molecules in a given space, and so greatly diminishing the frequency of mutual collisions, we may get a mean free path comparable with the dimensions of the containing vessel.

Then the properties which constitute gaseity gradually disappear, and we get the ultra-gaseous or radiant form of matter. Mr. Crookes suggested a swaying crowd of men more or less confined in space as an illustration, and remarked that the speed of the molecules of atmospheric air is about 60 times that of an express train, while their mean free path is but the $\frac{1}{10000}$th of a mm.; but by exhausting to the hundred-millionth of an atmosphere, a point now easy to attain, the mean path is increased to 30ft. Such is the rarefaction of the atmosphere at a height of 90 miles above the earth's surface, whilst at 200 miles above the earth the free path must become about 10,000,000 miles. In the first experiment shown the induction spark was passed through a tube only slightly exhausted, and appeared as a line of light or flexible conductor, which was locally attracted or repelled by an electro-magnet placed beneath. In the next experiment the vacuum was $\frac{1}{10}$mm., and a totally different effect was observed: the electrified molecules passing in straight lines through a small hole in a plate of mica, and making their path apparent by impinging upon a phosphorescent screen: the electro-magnet no longer deflected the path merely locally, but so pulled it down to itself that it no longer reached across to the positive pole.

Hydrogen gas exhausted to 2mm. showed the flexible line of light broken up into a discontinuous, stratified line of discharge of blue, red, and grey discs. At a certain stage of exhaustion all the blue bands move up towards the negative pole, and form a single bright blue disc, due to superposition. The spectroscope shows this to be due to mercury vapour, derived from the Sprengel pump. The grey discs probably indicate carbon, present as an oxide or hydride, the pink alone being due to hydrogen. Mr. Crookes thinks pure hydrogen has never yet been prepared, and probably no one has ever used so many precautions to insure its purity as he himself has.

In explanation of the dark space seen around the negative pole, and first noticed by Faraday, it was suggested that this represents the free path of the molecules increased in length there by electric repulsion; the luminous part next to this being the fighting ground of the incoming and the repelled molecules, producing there greatly increased phosphorescent effects. These effects were well shown with the yttria and samaria, the spectra of both these earths being discontinuous, like that of a luminous gas, instead of continuous, like ordinary incandescent solids.

The phosphoresence of Brazilian and S. African diamonds was shown to differ markedly in colour, and that of a dull and comparatively valueless diamond was shown to be brilliant in the extreme, and the residual phosphorescence unusually great. A peculiar form of zinc sulphide produced artificially in hexagonal crystals, unlike the cubic crystals of the natural form, gave very brilliant effects. The most remarkable experiment of all was the concentration of the molecules repelled from a concave mirror, and directed through a minute aperture on to the vanes of a small windmill of aluminum, which rotated with great speed, the molecules returning from this chamber into the first one through a second aperture, owing to the difference in pressure and setting in rotation another "molecule-mill," as it was called. The vacuum used was the $\frac{1}{1000}$ of a mm.

Further experiments were then shown to disprove the theory advanced by a foreign scientist, named Puluj, that the effects observed are due, not to ultra-gaseous matter, but to minute particles of the electrodes within the glass vessels. Poles were placed outside instead of inside the exhausted vessels, and the same results occurred. Even the theory that the molecules were really parts of the glass vessels was experimentally combated, and shown to be inefficient to explain the effects produced.

PROF. A. WOUVERMANN, of Vienna, has been examining the permanence of water-colours. He finds the most unalterable to be yellow ochre, terra-sienna, sepia, and various blues. Carmine lakes and the carmines generally bleach almost into unrecognisability.

**Dobson's Auger Guide.**—Mr. H. J. Parker Jolly, of Ipswich, sends us a set of Dobson's Auger Guides which have found much favour in America, and which he has patented in this country. The guides are made of solid brass, with centres of soft metal to take the screw-point of any auger without injuring the screw, when reboring or counterboring to a larger size any hole previously made. When applied to lathe augers these guides allow the augers to be used at greater speeds.

**Steam Lifeboats.**—At a meeting of the Society of Arts, Mr. J. F. Green read a paper on "Steam Lifeboats," Prof. Francis Elgar, LL.D., occupying the chair. Mr. Green commenced by reminding his hearers that at the last meeting of the British Association at Leeds he had read a paper on the hydraulic steam lifeboat his firm were building for the Royal National Lifeboat Institution. Since then it had been completed and sent out on real lifeboat service, and therefore he was now in a position to supplement his former paper by giving actual proofs of the great value as a life-saving vessel of the first steam lifeboat ever constructed. The design contained many peculiarities, and the mode of propulsion was the water-jet propeller. The hydraulic system had been adopted because no other method of propulsion would drive a similar vessel at the same speed in anything of a sea. The advantages claimed for the steamboat he had constructed, which, he asserted, had been fully proved by exhaustive trials, were as follows:—The propelling power in the vessel is instantaneous, and as efficient in heavy seas as in smooth water. No racing or injurious effects to the machinery, however much she rolls or pitches. The vibration experienced is very much less than that met with in a screw or paddle-boat. As the engine runs in only one direction, the complication, weight, and wear and tear of machinery are greatly reduced, and there is no loss of time, due to stopping and reversing, for going astern. There are no serious obstacles under water to interfere with her sailing qualities and affect her, if she should take the ground or run foul of ropes or wreckage. Should anything happen to the rudder, she will steer well with the turbine alone: and, with both together, her manœuvring power is far in excess of any other known steering arrangement.

# SCIENTIFIC NEWS.

THE Astronomical Papers prepared for the use of the American *Nautical Almanac* contain a review of the observations of the Transits of Venus in 1761 and 1769 by Prof. Simon Newcomb, A.R.A.S., director of the U.S. *Nautical Almanac*, in which he gives the value of the equatorial horizontal parallax of the sun as 8·79″ with a probable error of ·034″.

Circular No. 29 of the Wolsingham Observatory states that a star 8·5, red III. type, not in the D.M., was observed there Jan. 31, Feb. 1 and 2 at R.A. 5h. 32m. 37s., N. Dec. 31° 57′ ('55). Mr. Espin says "the star is perhaps variable."

Mr. J. E. Gore sends us a copy of his paper (reprinted from the *Proceedings* of the Royal Irish Academy) on "A Catalogue of Binary Stars for which Orbits have been Computed." The catalogue will be very useful to those observers who lay themselves out for star work, as Mr. Gore's labours in this connection are always trustworthy.

Dr. Bakhuysen, director of Leyden Observatory, has issued the fifth and sixth volumes of star observations made in Leyden.

The death is announced of Dr. N. August Otto, the inventor of the gas-engine which bears his name, and which was the first really practical motor of the kind. It was in 1867 that, in conjunction with Langen, he surprised those who visited the Paris Exhibition, and although the old vertical pattern lasted for some years, it soon gave way when Otto brought out what is known as the "silent" engine. Dr. Otto was in his fifty-ninth year.

Mr. Robert Forester Mushet, a steel maker, whose name at least is well known to all mechanics, died recently in his eightieth year. The youngest son of the late David Mushet, he probably inherited from his father, a distinguished practical metallurgist, his love of investigation and experimental research, which took the form of a study of crucible steel at his works, Coleford, Forest of Dean. There, besides the discovery of the value of china clay in the manufacture of crucibles, he succeeded in producing a specially hard steel by addition of tungsten and other elements. His greatest discovery was, however, the application of spiegeleisen in the Bessemer process, which Mr. Menelaus, when president of the Iron and Steel Institute, described as "one of the most elegant as it was one of the most beautiful processes in metallurgy." Through some error in omitting to pay the Patent Office for renewal, his trustees caused much loss to Mr. Mushet; but he received the Bessemer Gold Medal, and, it is stated, was rewarded in a more substantial manner by Sir Henry Bessemer.

News has reached this country of the death of Mr. Cosmo Innes Burton, F.R.S.E., in his twenty-eighth year. He was the first professor of chemistry in the Technical Institute at Shanghai.

Dr. Karl Weihrauch, director of the Meteorological Observatory at Dorpat, died the other day in his fiftieth year.

The annual general meeting of the Geological Society will be held on the 20th inst., and the Fellows, with their friends, subsequently dine at the Hotel Metropole.

At the meeting of the Royal Botanic Society last Saturday, Mr. Sowerby, the secretary, referred to the importance of indiarubber and guttapercha trees. In the society's museum there is a specimen of the first sample of guttapercha imported to Europe (in 1842), and guttapercha shortly after that date was used to insulate the first submarine telegraph cables. Up to the present moment no substitute has been found to take its place. From the wholesale cutting down of adult trees, and the reckless clearing and burning of the forests, the trees furnishing the most valuable kinds of guttapercha are become scarce, and in some localities are utterly extirpated. This is also rapidly becoming the case with the trees which supply the varieties of indiarubber, and sooner or later, says Mr. Sowerby, all natural vegetable products used by man must be artificially cultivated, as the natural supply never keeps pace with the artificial demand. Some few attempts have been made to cultivate indiarubber, but as yet not very successfully.

It is stated that the County Council of Devonshire has voted £3,000 for scientific lectures during the present year. It is proposed to engage four lecturers to deliver twelve full courses on elementary mechanics and chemistry.

Next Tuesday (17th) Mr. F. W. Rudler lectures at the Royal Victoria Hall, on "Our Chalk Hills."

A course of free lectures on matters connected with building is being delivered at Carpenters' Hall, London Wall, on Wednesday evenings, commencing at 8 o'clock.

At the conversazione of the Linnean Society, Mr. Rowland Ward, F.Z.S., exhibited a frog (*Rana*) of the species common in this country, but a singular example of colour. The specimen was full grown, and entirely of white flash tint, the eyes bright ruby, rimmed with gold, as though set like jewels, making it not only one of the most curious, but one of the most beautiful, of the batrachians.

The Rev. Dr. Dallinger, F.R.S., delivered a lecture last week at Westbourne Park Institute, on "Spiders: their Wit and their Wisdom," in the course of which he said that, viewed through the law of creation—which is the law of evolution—all backboned animals are now held to be the outcome of spider-like forms, so that the spider now becomes "a man and a brother." Spiders occupy a high place in the intellectual scale, although their "wit and wisdom" differ with the several species. Their wisdom is more than merely inherited instinct; it is mind, differing only in degree from that of man. Dr. Dallinger exhibited on the screen the series of processes by which a spider makes its wonderful net, an operation said to occupy the spider less than an hour—indeed, Dr. Dallinger has seen a net made in thirty-five minutes.

At the Royal Institution next Saturday, Lord Rayleigh, F.R S., begins a course of six lectures on "The Forces of Cohesion."

At a recent meeting of the Royal Society of Edinburgh, Prof. Rutherford, F.R.S., delivered an address on the "Sense of Hearing," in the course of which he criticised Helmholtz's theory of the manner in which the cochlea is affected by sound-vibrations, and showed the great anatomical difficulties of any theory that regards the basilar membrane as the transmitter of sound vibrations to Corti's cells, and as an analyst of complex sound-vibrations. The basilar membrane is heavily damped by the cellular elements above and beneath it; and, in the case of the rabbit, by its division into two layers with a homogeneous tissue between them, and also beneath the lower layer—an arrangement that must greatly interfere with any localised sympathetic vibration of its fibres. The hair cells of Corti are the true nerve terminations, and are placed in a favourable position for receiving the sound-waves transmitted to them through the superjacent membrane of Corti. Although no hypothesis is free from difficulty, Prof. Rutherford thinks the most feasible theory is that the great extension of the organ of Corti in the mammal is for the purpose of increasing the number of hair cells, so that the appreciation of the qualities of sound may be more acute, and therefore more intelligent; that the hairs of all the cells of Corti are affected by tones of every pitch, and that the sound vibrations are translated by Corti's cells into nerve vibrations similar in frequency, amplitude, and form to those of the sound; and that the different sensations of tone are due to nerve vibrations of different frequency and form.

It is stated that Mr. E. H. Hankin, of St. John's College, Cambridge, has discovered a remedy for Anthrax (splenic fever; wool-sorters' disease). Mr. Hankin had obtained a place in Dr. Koch's laboratory, but as he could not obtain the information he went for, he turned his attention to the discovery of a remedy for Anthrax, a subject he had studied for years. The rat enjoys immunity from many infectious diseases, including Anthrax, and Mr. Hankin's researches resulted in the discovery of a "protective proteid" in the bodies of rats, which, cultivated in the usual method, may be found a remedy not only for Anthrax, but also for diphtheria, a disease that does not attack rats. Mr. Hankin obtains the "fluid" by extracting the spleens of rats with a 50 per cent. solution of glycerine.

In reply to a memorial in favour of decimal weights, &c., the Chancellor of the Exchequer wrote: "I must own frankly for myself that, though I am aware that powerful arguments can be put forward in support of the decimal system, I cannot undertake to recommend its adoption to the country."

An Exhibition for the Geographical Sciences will be held at Berne, August 10-15 next, in connection with the International Geographical Congress. Herr H. Wäber, editor of the *Jahrbuch* of the Swiss Alpenklub, is acting as secretary and commissioner.

A committee has been formed to prepare an ovation to Prof. Helmholtz on August 31, his seventieth birthday.

Prof. Rudolph Virchow completes his seventieth year on October 13th next, and representative committees have been formed in Germany and in this country to commemorate the occasion by presenting him with a testimonial.

The Postmaster General has offered three premiums (£250, £100, and £50) for the best proposals that may be sent to him not later than noon, May 1 next, for an improvement in the apparatus now used for transferring mail-bags to and from trains in motion. A model of the apparatus in use can be seen on application at the office of the Controller of the London Postal Service, General Post Office.

The Liverpool overhead railway will probably be worked by electricity. It is to be a double line for passengers only, and will extend from Fort-road, Seaforth, to the Harrington Dock, a distance of nearly seven miles. Considerable progress has already been made, but the kind of motive power to be employed has not yet been settled.

An electric railway has been projected from Vienna to Buda Pest, a distance of about 150 miles. It is proposed that the speed should be 75-80 miles an hour as a mean.

Rapid transit is attracting attention in New York, where the Metropolitan Underground Railway Company has filed articles of incorporation at Albany. It is proposed to connect New York city and Brooklyn by tunnels, and both places with Jersey city, while New York itself will be tunnelled on the east and west sides from the Battery to Jerome Park. The plans include the building of 42 miles of tunnel at a cost of £12,000,000.

The *Havel*, a new steamer in the Norddeutscher Lloyd, has been placed on the Bremen-Southampton-New York line. She is 9,000 tons, and has triple-expansion engines, driving one screw at 14,000 horse-power, with a boiler pressure of 160lb.

The next meeting of the Royal Microscopical Society will be held at 20, Hanover-square, W., on the 18th instant, when papers by Dr. W. B. Benham on *Eminia equatorialis*, a new earthworm from Equatorial Africa; and Mr. T. B. Rosseter on the Cysticercus of *Tænia coronula* Daj. will be read.

Don't put loose bolts in plate couplings, as this will give no end of trouble in shearing and wearing away of the bolt-holes.

Grey and Wehler, in 1729, first transmitted electricity from one point to another, and distinguished conducting from non-conducting bodies.

**Casings for Electric Wires.**—Mr. Fawkes, of Chelmsford, has published through B. T. Batsford, of High Holborn, a number of designs for Architectural and Enriched Casings for Electric Wires, which may be commended to the attention of those who have to put in electric lighting wires in private houses and other buildings. The grooves in the "casings" are parabolic, and the covers are of sufficient thickness to prevent "curling." Enrichments are made from a tough composition not likely to crumble, chip, or crack.

**A Big Steel Spring.**—A great feat in metalworking, according to the *American Manufacturer*, was recently accomplished at the Superior Mill, Allegheny, Pa. The feat consists of rolling a strip of steel for a spring 6in. wide, ¼in. thick, and 310ft. long. This work was successfully performed, and the spring properly tempered at the first effort. That establishment has since received a large order for such springs, which are designed to enter into the construction of a new car motor, for which a great demand is anticipated. The order had previously been tendered to all the large English and Continental works of Europe, none of which would undertake to do it.

# LETTERS TO THE EDITOR.

*[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]*

*All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

*All Cheques and Post-office Orders to be made payable to* J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

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## THE NEW RED STAR IN AURIGA.

[32064.]—CIRCULAR No. 29 from Wolsingham Observatory announces the discovery of a new red star, with a third type spectrum, not in the D.M., whose position for 1890 is given as 5h. 32m. 37sec. in R.A., and + 31° 57′ in Dec., first seen Jan. 31, 1891. As some of your readers might be inclined to think that this star is a *nova*, I should like to add that it forms one of a list of red and orange-red stars which I have found by accident on various dates, and which are not recorded in any red-star catalogue at present. My first observation is dated Nov. 21, 1890, when it was seen as a beautiful red star with a wide *comes* to the south, of a rich blue tint. Its magnitude was estimated somewhat less than the star D.M. + 31° 1048, 6·4 mag., which lies 30′ south of it. Although it could not be identified in the D.M. charts, I subsequently found in the Catalogue (Zone 31° *Bonner Sternverzeichniss*, No. 2), a star which corresponded to it in magnitude and position so well as to leave little doubt of some error in charting as the cause of the discrepancy. The catalogued star is D.M. + 31° 1049, 6·6 mag. Harding has recorded it in his charts, where it is represented as of the 7 mag. Two or three observations have been made upon it, but no evidence of variation as suggested have been noted. It may easily be found by sweeping 8′ following, and a little south from χ (25) Aurigæ.

It would be well for observers, if a star does not appear in the charts, to refer to the catalogue (from which the charts have been plotted), as mistakes are in this, as in every other work, occasionally found, although on the whole it is a marvel of care and correctness.

London, Feb. 7. **David E. Packer.**

## BETA LIBRÆ.

[32065.]—I DEVOTED some time last year to noting the colours of stars, and seeing that in Webb's "Celestial Objects" this star (β Libræ) is noted as "a beautiful pale green," I observed it several times with my 3in. achromatic, power 110, with the following result:—May 17, 1890, yellowish; May 20, yellowish white; May 21, white; May, 23, 24, and 25, yellowish; May 28, white. All other observations I made of this star showed it as either very light yellow, or nearly white (misty nights excepted). On no occasions did I note it as greenish. **E. Reginald Blakeley.**

## THE INTRA-MERCURIAL PLANET SEEN AGAIN.

[32066.]—ON Thursday, Feb. 5th, at 4.30 G.M.T., I turned my telescope upon the sun, which shone through the haze with a somewhat red light. I was at once struck with the appearance of a perfectly round black spot upon its surface, in diameter, approximately, $\frac{1}{32}$nd of the apparent diameter of the sun. It was so completely different from any sunspot I had ever seen, that I doubted my eyesight, and at last concluded that I was witnessing a transit of Mercury, notice of which had escaped me. I changed the eyepiece several times, and with each higher power found the spot enlarged, but still perfectly circular. The highest power I used was about 250; the telescope an 8½in. Calver, with a nearly new film. The sun soon deepened in colour to blood-red, and I removed my dark glass; but quite distinctly did I continue to see the tiny disc, until at 4.47 the sun sank beneath a too opaque covering.

I at once made a drawing of the positions of the spot, and, upon looking at the almanac, found no record of a transit of Mercury. Is this not possibly the intra-Mercurial planet again?

Sir Robert Ball says "such discoveries have usually been made by persons little familiar with telescope observations," and I am but one of such —an amateur. At the same time, this observation was of, to me, so remarkable a nature, and my mind was so completely ignorant of the fact that others had thought that they had seen something similar at other times, that I have ventured, even in the face of such a cold douche, to send you a note of it.

In seventeen minutes I, of course, could not note a proper motion.

Norwood. **John Bagster.**

## LONG RAYS OF LIGHT VISIBLE AT SUNSET.

[32067.]—THESE, referred to in letter 32048, are not very rare. They are technically known as a "sun pillar." They are, I believe, a variety of halo which passes vertically through the sun—rarely, if ever, seen until the sun itself is hidden by setting.

**G. J. Symons.**

## WOLSINGHAM OBSERVATORY REPORT —THE TWO NEW VARIABLE STARS IN CASSIOPEIA.

[32068.]—WILL you kindly allow me to correct a slight slip in your Scientific News (p. 503)? Miss E. Brooke, and not Miss Brown, presented the meteorological instruments. Since the issue of the report, Miss Brooke has completed the set by the addition of an anemometer and sunshine recorder, generously defraying the expenses of fixing; and the debt on the astronomical instruments has been further reduced by the generous donation of ten guineas from Mr. George Knott.

In reference to Mr. Packer's letter (32041, p. 505), the following are the determinations of magnitude of D.M. + 57·258° made here:—

| | | |
|---|---|---|
| 1885. | Dec. 2 and 5. | Mag. 8·5. |
| | Dec. 11. | Mag. 8·7; smaller. |
| 1886. | Jan. 5. | No alteration in mag. |
| | Nov. 17. | Mag. 9·0. |

It will be seen that this star was at first suspected of variation, but the suspicion was not confirmed.

In reference to the other star, three observations only vary by 0·3 of a magnitude.

**F. T. McIntosh.**

## GLACIATION OF THE MOON.

[32069.]—IN reply to "W. J. S." (letter 32017), who assumes that the sun's rays are potent to melt ice on the moon; and to "B." (32018), who quotes the authority of Pouillet for the same fact, "in the absence of an atmosphere," I beg to be allowed to repeat that the real question, as to whether snow or ice can exist on the moon, unmelted by the sun's rays, must depend, not only on the heating power of the sun, but on the normal temperature of the lunar surface as well, exposed, as it is, to radiation into space.

We do not know what this is; and any assumptions as to what difference the lack of atmosphere makes on the moon with regard to temperature are but assumptions; while our experience of such a condition (as on mountain tops) is too limited to allow anyone to speak with authority on the subject. Therefore, in spite of the authorities for showing that the sun melts ice on the earth, I am bound to answer "W. J. S." in the affirmative, when he asks if I "doubt the power of the solar rays to melt the *lunar* snow?"

"W. J. S." says, truly, that the sun's rays act powerfully on the moon; but he does not show that "the intense cold of space" may not have *more* power there. He says (on line 9 of letter 32017): "Ice is a bad conductor of heat, and the intense cold of space would not penetrate far into it." But the ice is no worse a conductor to "the cold of space"—or, the little heat of space, as I suppose I may understand the words to mean—than to the heat of the sun, and in so far as the one affects, or fails to affect, it, so does the other; and to prove that the sun has more power to melt the ice on the moon, may be but to show that the "cold of space" has the more power to freeze it.

As to where the moon's polar ice-caps are now—supposing it once to have had them—I do not think that when they extended to the Equator, and met there—which, I believe, is Mr. Peal's idea of the method of glaciation—that there would be any necessary difference in the appearance of an ice-cap at the Pole to one at the Equator.

It seems to me as if "W. J. S." scarcely realises that Mr. Peal believes the whole lunar surface to be made of ice and snow, so far as he can see, with meteor dust mixed in. However, there are possible polar ice-caps visible, for if we allow that before tidal action stopped the lunar rotation, and allowed frozen water to collect towards the earth, so as to displace its centre of gravity, or that, for any other reason, the poles have been somewhat shifted since the glaciation took place, we can see that, by placing the S. Pole near Tycho, and the N. Pole in a corresponding position beyond the northern limb, we get that great line of *maria* from the Mare Crisium to the Oceanus Procellarum as an equatorial, watery band of frozen ice; and we have the white, high, southern Polar cap, with Tycho in the centre, covering all the visible surface south of that band; while the white, high ground north of the Sinus Iridium, Plato, or the Sinus Frigoris forms so much of the northern ice-cap as is on our side of the moon. **H. G. Dixon.**

## LUNAR RADIATION.

[32070.]—IN reply to letter 31860, I must inform Mr. H. G. Dixon that the question of lunar heat radiation is one far beyond my powers to solve, and I do not even attempt it.

When working out my theory some years ago, I became aware that Prof. S. P. Langley, of the Allegheny Observatory, was investigating the matter, and on my writing to him he at once very kindly replied, and encouraged me to go on. I am sure he will excuse my quoting some of his remarks in a letter dated June 30, 1884. He says: "My own measurements of the power of the sun to warm, when the radiation of a body into space is quite unchecked, have led me to think that the surface of an airless planet at the earth's distance could not (in the absence of initial heat) retain, even in full sunshine, a temperature, say, greatly above the absolute zero. That the lunar surface under such conditions cannot rise to the temperature where, for instance, mercury melts, I feel little doubt."

Mr. Dixon will find a *résumé* of Prof. Langley's views in the ENGLISH MECHANIC, No. 1004, June [illegible], 1884, p. 340, as stated by Prof. C. A. Young, of Princeton. Also a note on same subject as an appendix to Prof. C. A. Young's book on the "Sun."

As far as I can see, Mr. C. C. Hutchins's thermograph is not nearly so sensitive as Prof. Langley's bolometer, and his remarks that "it seems impossible to conceive that a surface like our moon, upon which the sun has been shining for many days, should suddenly cease to radiate when the sun's light is withdrawn," is not of a particularly convincing nature. His contention is, I see, by referring to *Nature*, that our atmosphere intercepts a large per centage of the moon's radiant heat. *Per contra*, I have it from a very high authority in such researches that "the direct radiation from the moon's surface when heated by the solar rays, not only passes through our earth's atmosphere, but constitutes the larger part of the radiation from our satellite."

It seems, in fact, that during the lunar night of some 340 hours the radiation is so intense that the temperature falls very low, through exposure to the temperature of space, which is estimated at − 273° C, or − 459° F., and hence cannot (and does not) rise to the melting point of snow during the lunar day of, say, 200 hours.

Mr. Ranyard's remarks on this point in *Knowledge*, Oct. 1st, 1889, p. 245, seem to me very clear and conclusive. He points out that if the lower [illegible] miles of our atmosphere were to be removed, leaving our earth nearly airless, like the moon, the surface of our earth (seas included) would be hopelessly frozen. The radiation would be excessive, even in sunshine.

Our invaluable friend "F.R.A.S." not long ago recorded his having witnessed the *crucial* test, in re absence of a lunar atmosphere, where the moon's dark limb passed over a planet without disturbing the detail in the least. The legitimate inference (bolometer excluded) is, therefore, that the maximum temperature is far below zero.

I see on p. 331, "E.M." Dec. 12, a review of Mr. Ranyard's article in *Knowledge*, "Is the Moon covered with Ice?"; but the whole case is vitiated by the researches of Mr. T. Andrews, F.R.S., reported to the Royal Society (see *Nature*, June [illegible], 1890, p. 214), wherein he demonstrates that at low temperatures *ice is not viscous*—it is *rigid*, so that lunar snow and ice would not pass off or subside by glaciers. It seems to me that this is not generally known by those who discuss this question of lunar glaciation. It certainly, as far as I can see, upsets the whole of Mr. Ranyard's case.

"F.R.A.S." invites me to imagine the Himalaya formed of calves'-foot jelly (why, I cannot exactly see). If the lunar Apennines were formed of (lunar) snow, the lower 4,000ft., say of ice weighing but one-sixth of our ice and *non-viscous*, I fail to see why they should subside—why they should not stand as rigidly as the lower layers of our Himalaya do, under 25,000ft. of infinitely heavier material.

Where I think this theory of "lunar glaciation" will be found useful as a working hypothesis, is in its giving the solution for *all* the circular formations, from Messier to Mare Crisium. This, of course, Mr. Ranyard's view does not attempt. The circularity of the forms is the greatest of the many lunar enigmas, and until it is taken in hand and solved, from end to end of the vast series, the enigma will remain insoluble. **S. E. Peal.**

Sibsagar, Asam, India, Jan. 8.

## THE LATE JOHN HAMPDEN.

[32071.]—MY brief note to the Editor last week was not intended for publication, and fails to do justice to our old friend. Having read his pamphlets on the flat earth (now in my hands as a loan) I see that he was not a mere faddist, but an ardent upholder of the literal accuracy of Biblical astronomy. Evidently of an irascible disposition, he wrote in abuse of modern scientists as a body of men wilfully leading the world aside from Bible truth, knowing that their astronomy was based on falsehood. But his pamphlet is most carefully worked out, and it amply supports, and is supported by, the Bible narrative, which narrative we all know to be irreconcilable with modern astronomy.

O. J. L.

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## HINTS FOR EXPERIMENTALISTS.

[32072.]—Recently I suggested a photographic experiment with closely adjacent "pinholes," or very small lenses, behind one of which a plate of colourless glass would be placed (or a coloured medium could be used) having its surfaces ground at such an angle as to refract to a certain extent, while at the same time retarding, rays forming one of the two images of a distant object. Suppose, for instance, we are to photograph the sun by this method; either a double prism may be used, or the two images may be received upon mirrors placed so that their reflections shall be superposed and are projected by a lens, subject to their conditions of mutual interference, upon the photographic film. But clearly our most hopeful course, by which to obtain uniform interference, must lie in some mode of first splitting up, and then re-associating, the rays from a single photographic lens. I give a few random hints for thought, or for experiments, from which in time something useful may be evolved.

In experimenting with a transparent structureless sensitive film, we could throw the image upon a glass plate at such an angle as that it should be partly transmitted and partly reflected. The transmitted and reflected images would be received by mirrors placed opposite to one another, and would be thereby reflected upon the sensitive surface, from opposite sides of it. Or, having a sensitive film sufficiently clear and smooth, we could project the original image upon it at such an angle as that it would be mostly reflected, and but slightly absorbed. The reflected rays, being reflected a second time from a mirror, and refracted by a prism that was corrected for dispersion, could be again reflected to their proper position on the sensitive surface, but from the opposite side of it by a second mirror placed opposite to the first. Or some effect might be got even by the use of a single mirror, returning such a reflection (from a smooth sensitive surface) upon itself. Or we may receive the image on a glass plate, put at such an angle as to partly reflect and partly transmit it, and we may thus receive, say, the reflected image on a prism to refract it, and project it on the sensitive surface, which would lie in a plane nearly perpendicular to that of the glass plate. The other, or transmitted image, being inverted by a pair of lenses, would be similarly refracted and projected upon the sensitive surface. And two other experiments will suggest themselves with such a glass plate and one mirror, both depending for success upon the interference of the rays transmitted at such an angle through the plate, when reflected upon themselves by the mirror.

In any instance we can use the narrow slit, moving continuously and uniformly across the field of view, to give exposures to each point on the plate successively, as will be explained farther on. Reflection and refraction have effects upon the intensity and phase of light-waves, all of which must be corrected or allowed for; and images must be enlarged, reduced, corrected for want of achromatism, &c., by operations which I could not particularise without both study and calculation; nor could I ask space, with this letter, for any detailed drawings. Those of your readers who make such a special study of optical science, and who are accustomed to the construction of such instruments, can examine the subject under every advantage.

To proceed, I suggest using a pair of plane mirrors, arranged as in Fresnel's interference experiment. The narrow slit, which is the source of light, is, of course, parallel with the line of junction of the mirrors. A glass prism, set parallel with this slit, and very near to it, reflects its image, as received from the Fresnel mirrors, on to a second prism, which again reflects it, this time in a direction parallel to the plane of the rays entering through the slit, and perpendicularly to the sensitive plate, upon which the reflected rays now fall. We may interpose before the sensitive plate a screen, having also an adjustable slit, to limit the range of actinic effects as desired. The lens projecting the image through, and perpendicularly to, the plane in which the first-mentioned slit moves, is attached rigidly to the camera box, and so is the sensitive plate. The slit, Fresnel mirrors, reflecting prisms, and adjustable screen are rigidly attached to a frame, which is moved intermittently through a distance equal to the width of the slit, and in a direction which is parallel with the plane of the sensitive plate. But with bi-plates, or a bi-prism, we could effect simpler arrangements of the same nature, and I think that, in particular cases, the photographic results might be valuable. They would take the form of bands of parallel lines upon the negative, the distance from centre to centre of the lines varying according to the colour of the original image at each point.

Having (as usual in all these experiments) secured parallelism of all rays, by means of a lens larger than the sensitive surface that is used, we may interpose, before that surface, a ruled glass "diffraction grating." The image will, in this case, also be broken up into coloured lines, varying in breadth according to the colour that predominates in any given portion of the image. Placing a cross, for a register mark, in the field of view of the camera, let a sheet of white paper occupy the remainder of that field. Illuminate with several monochromatic lights successively, and make negatives behind the diffraction grating in each case. Thus we shall obtain complete maps of the lines due to particular colours, and, with the aid of our register mark, we might afterwards associate these maps in the production of reversed negatives, from picture negatives obtained as above described; or we could use such "maps" as selective screens, to be laid upon sensitive surfaces while first imprinting such photographs, as above described. In these instances the problem remaining to us is the translation of broken lines of varying breadths on the negative into colours corresponding to those breadths on printing surfaces. And I shall offer some suggestions on this point at a future time.

It is expected that in using any such processes as are here described, advantage would also be taken of the discriminative properties of differently sensitised plates. What, it might be asked, would be the object of complicated operations, if specially sensitised plates were still required? The answer is, that although we know of compounds specially sensitive to particular rays, we do not as yet know of any which are sensitive to such particular rays, and to no others.

No matter how simple the optical mechanism involved, we cannot expect that any process will be generally used which necessitates a series of interrupted exposures made by clockwork. But I think that analysis with a refracting prism, or with two simple slits, arranged as usual for diffraction, would be perfectly practicable. Suppose that we have a horizontal prism within the camera, and that we raise or lower it, with uniform motion, in a plane parallel with that of the sensitive plate; and suppose, fixed to the sliding frame which carries the prism, and between it and the sensitive plate, an adjustable shield, which can be set to permit but one coloured band of the light, which is refracted by the prism, to fall upon the sensitive plate—we can thus, by a simple adjustment of this shield, give to each of four or five different plates exposures in light of the several parts of the spectrum, as refracted by the prism in its passage through the field of the image; or we can block out particular portions of the spectrum by such a screen, and recombine the remainder by means of a second prism, also attached to the slide. Of course, between the prism and the camera lenses there must also be rigidly attached to the sliding frame a screen having a narrow slit that is parallel with the prism. In dealing with plates not perfectly orthochromatic, the fan employed to govern the descent of the prism would be regulated so that its rate of motion would be proportioned to the actinic effect of that part of the spectrum acting upon the plate. There is nothing complicated about this mechanism. The adjustment of the movable screen could be readily made, by means of an attached scale, and the method affords absolute resolution of the lights in a picture, that can be carried to any extent desired.

To return for a moment to the idea of analysing our picture by the mutual interference of contiguous rays. Using a polarising rhomb of Iceland spar we can split up either the whole of the image (much reduced, of course), or parts of it. Let us again polarise one of these images, and by suitable arrangements recombine the twice polarised rays, so that differences of phase, and therefore interference, shall be involved.

And again, with an analyser we can employ thin plates of selenite, mica, or quartz, by which means the colours of the transmitted rays will be modified, and equally interesting photographic effects should be obtained.

Were photography in colours a simple problem, as simple, for instance, as that of obtaining a photographic picture in natural colours by lantern projection, these scattered suggestions as to the decompounding or differentiating the active rays could be of no interest. But, as a matter of fact, even if such processes as are now used would yield groups of reversed negatives, showing in proper shades of intensity the proportions of the light belonging to any given parts of the spectrum, we should be little nearer to printing photographs in colours. We could in this case, by coloured lights, show a perfect coloured transparency; but it is a very different matter to interpret such an effect by means of mixtures of pigments to be viewed by reflected light. Although it seems that we are still ignorant of laws to guide us practically in such an attempt, there are already certain empirical methods known which furnish an approximation to the desired result. As we multiply methods by which photographic relations between constituent hues, tints, and shades of coloured lights are disturbed or regulated, we add to the conditions in which a still nearer approximation is made possible.

Although this letter is already too long, yet I will add one or two suggestions on rather different lines. Suppose that we substitute various surfaces of phosphorescent materials for the ordinary sensitive plate in the camera, and photograph these phosphorescent plates immediately after this exposure, to obtain negatives representing distinct colours from the picture, dependent upon the nature of the phosphorescent material used.

Of course, there is a considerable difference between the conditions in photographing landscapes and in copying pictures, &c., and modes of working which would be applicable to the latter may not be at all suited to the former operation. In dealing with a plane object, we can illuminate it with variously refracted or polarised light, and so add to our means of resolving colour. Moreover, we could heighten these effects by using an uncorrected lens, having distinctly different foci, to which we could adjust our sensitive plates in operating for different primary colours. As chromatic aberration does not take place in the axis of a lens, the picture would have to be received upon a portion of one of the halves into which the lens is divided by a diameter.

A. D.

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## PLAIN GLASS RACKWORK SLIDES.

[32073.]—"F.R.A.S." (letter 32040, p. 505) will get the above at a lantern and slide shop. The firm whose advertisement is at the top of third column, p. ix. advertisements in No. 1346, will supply what he wants.

R. C. M.

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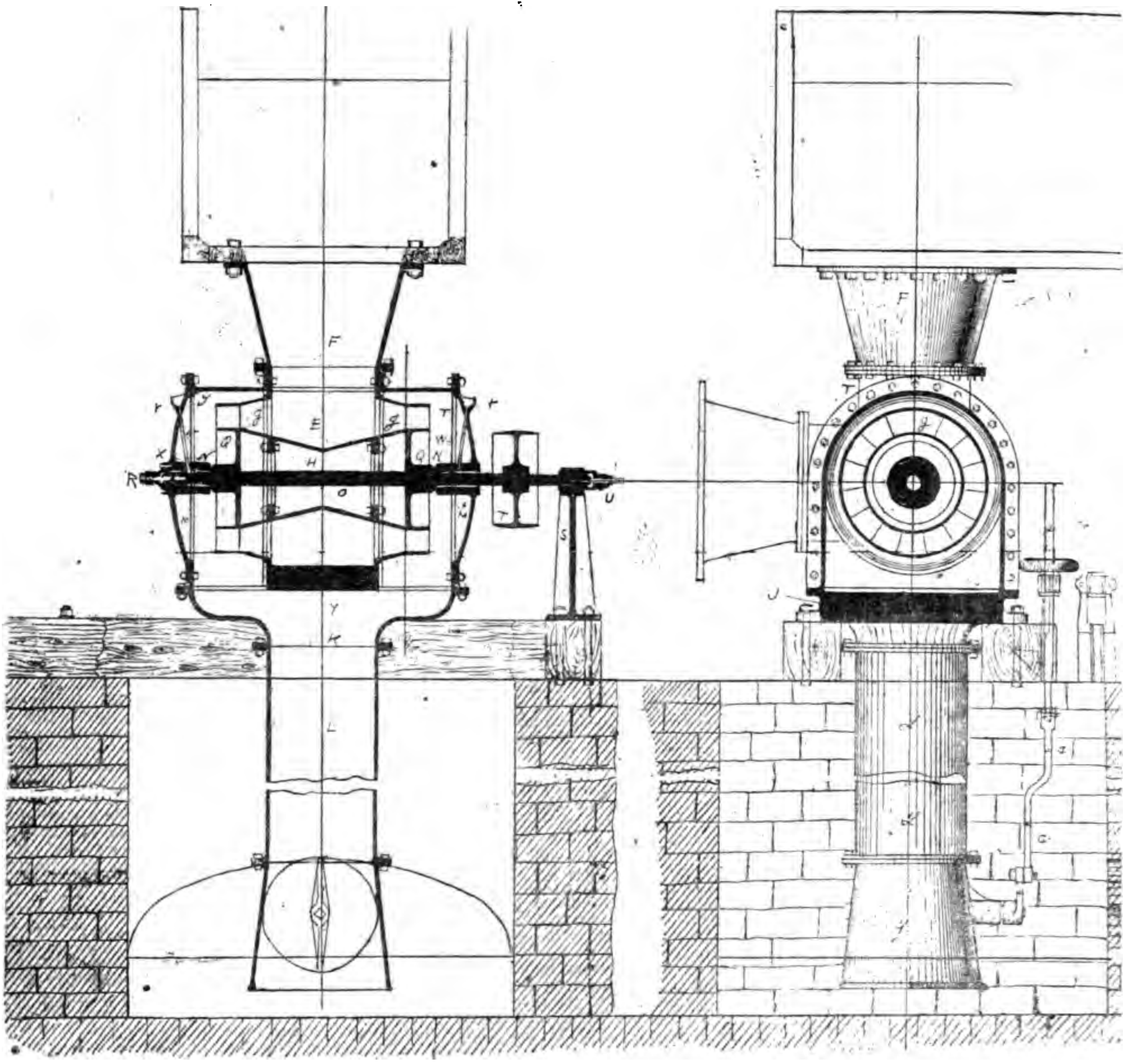
## ELECTRICITY AND ETHER.—VIII.

[32074.]—I need the stimulus of opposition, as it is wearisome to fight shadows (that, by the bye, is the discovery of Richard III. on the eve of battle). So as no one seems disposed to take up the cause of the ether and the new electric theories here, I have opened an attack upon them in the *Electrician*, which will require some change in my intentions as to their treatment here, in order to avoid confusion in carrying on two distinct discussions, and yet not making one a mere *réchauffé* of the other. I mention this to explain any apparent change of my methods. As I have already brought Mr. Heaviside, Dr. O. Lodge, and Prof. S. P. Thompson upon me in the other discussion, readers here may probably get some benefit from it.

The special subject which led to this discussion, that to which I applied the term "Ether Nonsense," is the doctrine that the "so-called conductor does not conduct, not even an impulse," that the energy which, issuing from a battery or other electric generator, does work at a distance, does not travel by the wire (or conductor), but through surrounding space, and is transmitted by a wave-motion, like that of light, in the surrounding "medium." Medium is convenient. By it some mean, or say they do, the insulator; but whatever may be said, under the exigencies of any particular case, the ether always underlies it—if not the free ether of space, it is that mysterious and very adaptable ether which is condensed in the matter. It is easy to clear this up. The fundamental notion is the suggestion of Clerk-Maxwell, that electricity, magnetism, and light were all the same thing.

Now it is so commonly taught that people look upon it as a real fact, that light is always transmitted by ether, not by matter; that glass and other transparent substances do not actually take part in the true transmission of light, which is effected by the ether entangled in them. But in order to fit facts, it is said that the matter has the power of modifying the properties of ether. This is very convenient, because as no one really knows anything about its properties, "wise men," as Mr. Heaviside says, can give it any properties they like to suit their purposes. When these properties refuse to suit, it is quite easy to say that they are modified at that time by equally imaginary properties given to matter, which thus get a sort of brevet rank for the time and occasion. It follows, of course, that light and electricity being the same, when it is said, for instance, that guttapercha conducts the electric energy, it is understood that the real agent is the ether contained in, and modified in its actions by, the material guttapercha.

That is not the only convenient way in which properties can be modified. Clerk-Maxwell suggested the identity of light and electricity, and the ethereal transmission of electricity by wave-motion. We are now told that Hertz has *proved* all this. Clerk-Maxwell also indicated, as a consequence, that inductive capacity is connected with transparency, and conductive capacity with opaqueness. Now, the facts do not agree with this; so, of course, they must be made to appear to do so. Light used to mean a certain range of undulations—a fixed octave of wave-lengths—produced by Nature, and invariable. But Hertz's experiments relate to undulations mechanically produced and controlled; they are not undulations appertaining to a natural



force, as electricity, but are simply successive impulses intentionally set up by periodic acts of electric induction, resembling the similarly-generated sound-waves produced by the Siren (I do not mean that the waves are purely longitudinal, but that their periodicity is deliberately manufactured). They in no degree approach the periods of light-waves; they are nearer to those of sound. Yet they are to prove that light and electricity are identical in nature. If a substance is opaque to light, it may still transmit waves longer or shorter than those of light; so if an opaque body—say guttapercha—has high inductive capacity, the theory is to be made to include the transmission of any sort of vibration. I see no reason why philosophers of this kind should not assert that a log of wood is transparent because it transmits sound-waves. Possibly, also, it may yet be shown that iron must be an inductor, because when white-hot it is partially transparent. I make anyone a present of this little-known fact: that objects may be partially seen through an inch of iron when white-hot—I have often noticed it.

Real science does not play these antics: its terms should have clear fixed meanings. Let us look at real substances: take two very similar in appearance, glass and quartz; both are transparent. They transmit the rays we perceive as light; but quartz also allows the longer waves known as radiant heat to pass, while glass stops them; the same occurs with the quicker actinic rays. What is the ether about in all this? Well, no one knows; so we can say that the particles of the glass modify the ether differently as to waves of different lengths, and differently from those of quartz. And we are to be told that this in an *explanation!* What on earth is it but stating the fact which we do not understand in a set phrase?—a phrase which does not in any degree add to our comprehension of the phenomena. And let it be understood that a vast number of very solemn-looking formulæ have just no more meaning; they express the bare facts in terms, say, of M, L, and T—mass, length, and time; but not one ray of light do they shed on the nature of the facts themselves. They are most useful as working tools: they are nothing more. This is the sort of thing I am trying to guard students of nature against.

**Sigma.**

## CONTRACTION BY DAMP—A HOMELY EXPERIMENT.

[32075.]—I SHOULD have mentioned in my last letter that the strings used in the second experiment were hempen. There are a few points which I do not think "Sm." has yet explained. Given a string of hemp or catgut, the ends not being allowed to rotate, let moisture be absorbed; this should cause each fibre to swell, and the cord being thereby thickened, each fibre would have to stretch in order to wind round the cord the same number of times. The effect would be that the tension would be increased and the note ought to be higher, whereas it is really lower. "Sm.'s" explanation, that the diminished cohesion of the string allows it to unwind, would be applicable only if the ends of the string were free to rotate. It is a curious thing that if some treacle is spread on a thin piece of bread, after a short time the bread will have contracted and become concave on that side which has absorbed the treacle. Another paradox.

**Caldemone.**

## HORIZONTAL TURBINE.

[32076.]—THE accompanying drawing represents a horizontal turbine of 15H.P. for a fall of 17ft. high. There are built and at work eleven of these, from 30H.P. to 10H.P., at the Government Small-arms Factory, Sisterbick, near St. Petersburg. They were put up instead of the old over-shot water-wheels. Turbines of this construction are very convenient, as they take up very little room, work without noise—the power from them being transmitted very conveniently by a belt—and do not require any gear work for transmitting power; work perfectly dry and clean. They can be put up at any height of the fall, and I have go down inside the workshops on the shaft of the turbine being in a horizont and the two driving-wheels placed on t ends of the shaft. The water acts on the tw surfaces of the wheel, and thereby neu weight and pressure of the column of may happen sometimes that the narro of the buckets in the driving-wheel ge bits of dirt brought down by the wate turbine, and as the openings get stop causes an end-pressure on the shaft, pressure is taken up by steel centres pl ends of it. These centres are outside, they begin to heat, it is a sign that an en is on the shaft, which is caused by the o the buckets being filled up, and the whe cleaning, which is easily and soon per taking one of the end-covers off.

The turbine is composed of the followi —E the cylinder with the opening; F for b the water into the turbine—this opening ma on the top of the cylinder as shown in the or at the side, as may be convenient for b the water. The ends of the cylinder E out and the flanges placed true; into placed the two guide cones G G, which place by being bolted to the inside dou cylinder H. To the flanges of the cyli bolted, one at each end, the two cases T have at their outer end circular openings faced; these cases cover the two guide driving-wheels Q. The cylinder E an cases T T are bolted on to a trough-like f plate F, which has an opening in the mi underside K, to which is bolted-on the carrying the water from the turbine. T appertures in the cases T T are closed circular covers M M: they are turned and to fit the aperture. These covers have ca in the centre long sleeves, N N, which are brass bushes, and serve as bearings for t shaft which passes through the two cov *special pulley*, with a long cannon bearing to avoid wear and wobble, both of which, when the drill spindle *only* was running, would be very much in the way.

I will shortly give a description of a new swivelling cutting-frame, to be used for gear-cutting, and also for shaping gear-mills and others; also for fluting mill-drills with round shaped or square ends. I will also describe how to make the formers, or guide-plates.

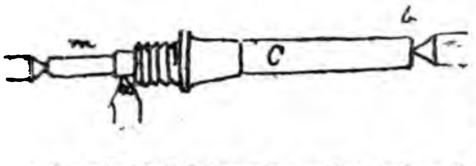
**An Old Correspondent.**

### TAPER FITTINGS.

[32082.]—I AM much obliged to "British Bulldog" for kindly giving his experience of the above. Will he kindly say a little more on the subject? Would he kindly give a sketch of the T-fitting? as I could not quite understand the description. Does he drive out the arbors by the hole for flat tang, or from the tail-end by the bored hole? How does he fit the arbors? Simply turn them and then use a fine file on them while running in lathe? Is the "sacred orifice" soft or hard inside, and will he kindly say how it is trued?

I have tried to measure the taper in a drill holder I was told was the Holtzapffel standard; I make it ·167in. at the smallest end, and ·172in. at largest; about ½in. between the measurements; taper ·005 per ½in., say ⅛in. per foot. But Morse taper is about ⅝in. per foot. Can the working loose of ornamental drills arise from the difficulty of cleaning out the line holes in the driller, or from not driving the drills in, or is it, perhaps, from the difficulty of fitting the cone as well as the little flat at the end? Why should a set-pin interfere with cleaning out the hole, when you can so easily turn back the set-pin?

I gather from a correspondent in the *American Machinist* that if the "sacred orifice" be reamed after boring, it is almost sure to be a little thrown out. A correspondent explained that it was usual to put a taper mandrel *m* into the hole (Fig. 1), and, putting both between the centres, to draw the centre at *b* till the test mandrel ran true at *a*; then to return the mandrel C.



Two well-known English lathe makers use tapers of 1 in 9 and 1 in 12 for their centres, but then they are not intended to hold cutters. **F. A. M.**

### TELESCOPE FOCUS.

[32083.]—OF course "F.R.A.S." and Mr. Holmes are right in saying an intensely brilliant object will affect the eye and somewhat affect its focus. This is because the eye contracts and only utilises the central portion of the object-glass or mirror, and has the same effect as putting a stop over the object-lens. This can hardly be called a "physical" effect, for in reality it acts *mechanically* on the instrument, and I think the constant want of readjustment of focus for objects of different distances cannot be fully explained physically, and I have always felt satisfied it is mainly due to the effect of short focus and large aperture.

With me the effect is the same whether the moon is full or the thinnest crescent, for the change from the moon to the stars or the planents needs readjustment of focus to got the best definition. This seems confirmed also by the fact that if you are using, say, an 18½in. of about 7ft. focus, and you cut off all the aperture except 5in. or 6in. of the centre, and focus this on objects at different distances, the need to refocus is not near so evident; but 2in. or 3in. of the margin of this 18½in. tells quite a different tale when so tried. Of course, I am speaking of what I have experienced. I have noticed that observers are constantly refocusing, and no doubt all will say they do so. Why would they do so, if it was not needed? This must be true theoretically. The question is only if we realise it in practice.

"Vega" may, even with his comparatively long focus and small aperture, test this point. Let him try the 1in. or 1½in. centre of his glass against the marginal ¼in. or so, as we did the 18½in. of 7ft. focus, and he will most likely find the central part will be one focus for all objects, while the margin will need refocussing to get best definition.

**G. Calver.**

### COIL BOILER.

[32084.]—I THINK some of your readers will be interested to hear of the success of a Herreshoff boiler, made according to the description sent by Mr. Cam about two years ago. I was very much taken with the idea, and as the boiler in my launch was unsatisfactory, resolved to give the coil system a trial, much against the advice of several engineers I spoke to on the subject. Two of them condemned the system at once; others, more cautious, would not commit themselves, and though I spoke to about ten practical engineers on the subject, only one of them would give me any encouragement.

The boat is about 25ft. long, and 6ft. 6in. beam. She was not built for a steam-launch, but is a good model. The engine has a 4in. cylinder, 3in. stroke, and with 50lb. steam runs at about 300 revolutions a minute. The propellor is three-bladed, 15in. diameter, and drives the boat, as nearly as I can say, six miles an hour. The coil consists of 65ft. of ⅜in. iron steam-pipe, made in one length, and coiled to order, diameter at bottom being about 22in., and height about the same. There is a space of ¼in. between each lap of the coil. Separator, 2ft. high by 6in. diameter. The feed enters the coil at the top, and the steam leaves at the bottom (where I have put a small cock, by trying which I can see if I have too much or too little feed on), entering the separator through the top. Steam to engine, gauge, whistle, and safety-valve, is taken from top, and at bottom there is a ⅜in. pipe and cock which I can open if I have to stop engine suddenly, &c. I put in two gauge cocks, one close to the bottom of separator, the other about 3in. higher, but have taken out the upper one, finding it unnecessary, and connected the lower one with the feed-tank, which of course saves blowing the boiling water to waste. The boiler is fed by an ordinary pump on the engine, and there is a hand-pump in the tank to use when getting up steam, and as a stand by. The exhaust is 1in. in diameter, and is not contracted at the end in the funnel; but there is a ½in. branch taken out to the feed tank, to act as a feed heater. I have only a single casing round the coil, so that there is a considerable loss of heat there, but with fair coal I have no difficulty in keeping steam.

The former boiler weighed twice as much as this one, and burnt twice as much coal, but would not keep steam. This one has answered my expectations in every respect, and, when I get rid of this boat, I shall have no hesitation in fitting out another bigger one.

Now as to the time taken in getting up steam, I find I can change my clothes, lay and light the fire, take down the necessary tools, &c., screw on the whistle and other fittings, warm the engine, and be ready to start in an hour. I can't understand it being done in much less, because it takes some time to get the fire in good order, and it is no use starting without. **London River.**

## USEFUL AND SCIENTIFIC NOTES.

DON'T attempt to run a shaft in a box that is too large or too small, as you waste time, and fail to secure good results.

**The Jerome Steamship Shaft.**—At a recent meeting of the Civil and Mechanical Engineers' Society, a paper was read by Mr. Horatio Daniell on "The Jerome Steamship Shaft," in the course of which he maintained that in this shaft great increase of strength was combined with flexibility; that the experiments made had shown promise of great results; and that absolute dependence could be placed upon such shafting. The advantages shown of this over solid shafting were that the dead weight was little over half, cost was saved, and the torsional strength was increased 13 times. The shaft being of steel rods or wires (affording both torsional and transverse elasticity), flaws were more easily detected than in forged shaft, where there was no absolute security against imperfections. Whatever the service demanded of it, every part and fibre of a Jerome shaft bore its exact portion of claim.

**Repairing Incandescent Lamps.**—A method of repairing incandescent lamps, the invention of a M. Pauthonier, is described in a recent number of *L'Electricien*. The lamp to be repaired is first taken to a glass-blower, who pierces a hole in the bulb sufficiently large to allow of the old filament being taken out and a new one inserted. From the hands of this workman the lamp passes to a second, who cuts off the ends of the broken filament and removes it, taking care, however, at the same time to leave about 1mm. of the filament at each of the platinum electrodes, and it is to these short lengths of the old filament that the new one is welded. This is done by filling the bulb with a liquid hydrocarbon, after which the new filament, which has been previously standardised, is introduced. One end of the filament is then pressed against the fragment of the old one already referred to, and a current passed through the joint. The hydrocarbon is decomposed, and a deposit of solid carbon occurs round the joint and securely fastens the new filament in place. The other end of the filament is joined to the other electrode in the same way. The next process is the bleaching of the glass, which is so thoroughly done that the glass of the repaired lamps is said to be more brilliant and transparent than that of perfectly new ones. The repaired lamps are said to last quite as long as new ones, to which they are in no respect inferior.

## REPLIES TO QUERIE

**** In their answers, Correspondents are fully requested to mention, in each instance, and number of the query asked.*

[73122.]—**Composition of Gas.**—Purifie gas contains about ·5 vol. of hydrogen, rath than ·3 vol. marsh gas, ·05 vol. of olefines, carbonic oxide. The gaseous impurities may sulphur dioxide, carbon dioxide, hydrog phide, and sulphocyanide and carbon dis The brilliancy of burning paraffin depends purity, rate of combustion, and size of flame do you expect anybody to answer such query?

[73212.]—**British Association List of Screws (U.Q.)**—I have not the back num me, but perhaps the following is what is requ

| No. | Nominal dimensions in thousan of an inch. | | |
|---|---|---|---|
| | Diameter. | Pitch. | Threads p |
| 25 | 10 | 2·8 | 353 |
| 24 | 11 | 3·1 | 317 |
| 23 | 13 | 3·5 | 285 |
| 22 | 15 | 3·9 | 259 |
| 21 | 17 | 4·3 | 231 |
| 20 | 19 | 4·7 | 212 |
| 19 | 21 | 5·5 | 181 |
| 18 | 24 | 5·9 | 169 |
| 17 | 27 | 6·7 | 149 |
| 16 | 31 | 7·5 | 134 |
| 15 | 35 | 8·3 | 121 |
| 14 | 39 | 9·1 | 110 |
| 13 | 44 | 9·8 | 101 |
| 12 | 51 | 11·0 | 90· |
| 11 | 59 | 12·2 | 81· |
| 10 | 67 | 13·8 | 72· |
| 9 | 75 | 15·4 | 65· |
| 8 | 86 | 16·9 | 59· |
| 7 | 98 | 18·9 | 52· |
| 6 | 110 | 20·9 | 47· |
| 5 | 126 | 23·2 | 43· |
| 4 | 142 | 26·0 | 38· |
| 3 | 161 | 28·7 | 34· |
| 2 | 185 | 31·9 | 31· |
| 1 | 209 | 35·4 | 28· |
| 0 | 236 | 39·4 | 25· |

Birmingham. J. E. GIBB

[73333.]—**Magic Lantern.**—The "deta the optical part of a lantern" are given in m the textbooks, and a diagram of the ray obviously depend on the shape of the lenses. only "condition" to be satisfied is an arrang that will throw the clearest and sharpest ima the screen. I would refer the querist to Hepw "Book of the Lantern," Chapter II. of which of the "optical system," and if not sufficient planatory to the querist, will at least enable h put a more definite query. O.

[73334.]—**Varnish for Paper.**—Good s varnish will answer this querist's requirements possibly pale copal will do better, as that will any amount of hot water. Why does not "Ve get a few samples of varnishes in the market try which suits his purpose best. It is al cheaper to buy than to make varnishes on the scale. The querist should have given some id the purpose for which the varnish is required.

L.

[73347.]—**Boiler.**—"Ives" does not give cient particulars, and it is not worth while gues It is easy enough to calculate the size of a b large enough to hold 200 gallons; but does he it to be heated by means of steam outside, or w it do to pass a coil of pipe into the boiler and steam through that? There are many devic suggestive designs in back volumes, but it w be useless to take up space without knowing e what is wanted. Er

[73351.]—**Polishing Copper Plates.**— "Ratio" mean burnishing, or merely polis The latter, of course, can be done with a bob ch with rouge, but burnishing in the lathe woul a round-nosed tool, which could be presse some force on the copper discs—they are d presume. Give some more definite inform and a reply will no doubt be forthcoming.

N

[73355.]—**Heating Churches.**—There better method of heating churches or other ings than by the Polmaise system described paper some years ago. Warm air is dec better than hot-air pipes, and is easily carrie for all that is needed is a furnace and pipes charge the warmed air into the building abou from the floor level. There are stoves made act on the principle. W. M

[73357.]—**Pintsch's Gas.**—This gas is gen

ıade from the shale or dead oils by dis-
ıd is, of course, reduced to the lowest
ssure (like all other gases) before being
here is a company working it, and the
manager would, no doubt, give all in-
The gas has been in use for many
ıbly on railways, and for illuminating
ıa. H. C.

-**Back-Geared Lathe-Head.**—This
" might be recommended to refer to
es, or to any of the works on the lathe.
S.

-**Small Windmill.**—The H.P. of a
epends necessarily on the force of the
some extent; but it is difficult to
a mill of the kind. I suppose the
" is to change the angle the "sails"
the wind, like a feathering paddle-wheel.
T. M. P.

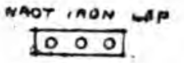
–**Clock Trains.**—Clocks that strike and
ubes generally have the complete set of
, and the pin-barrel is arranged so that
can be the usual peal of eight or the
r chimes at the owner's option, he
and on the dial. The pin-barrel shifts
set of pins to do this. The tubes are
ong the back of the case. They are, for
s, made of a kind of brass only known
er and patentee, Mr. Harrington; for
s they are steel. They are suspended
ıole in one end from a gallows screwed
of the case, by a silk suspension, and this
should not touch the side of the tube, or
e sound. The hammers strike a little
ıole in the tube, and they are plugged
eather. The pin-barrel runs in bearings
p of the frames, and the hammer-block,
mmers, is screwed to the top of these
The pin-barrel is driven from the second
eel by means of an upright arbor, driving
rrel wheel by a contrate wheel, and
ugh a bevel-wheel on its arbor by a
l on the inside of second quarter wheel.
ers would have to lean over, in order
bes may be free of the work at the back.
se clocks for the United States arranged
strike the tubes by means of another
ork, connected with links to the one I
entioned. Also to get the tubes out of
f the back work, the pin-barrel and
ork are sometimes arranged in two cocks,
de of the frame at the back. The ham-
not be close together; they are from
ı. apart, according to the size of move-
nnot tell you the price; better apply to
Charles A. Jones.

– **Faulty Sewing-Machine.** — This
rise from several causes—may be out of
, needle bent, set too high, or too low,
ı, and wants adjusting. See that the
es nearly to the point of looper, and that
r-point comes to needle the eye of needle
point of looper. It will then throw
loop of top thread for point of looper to
J. I. S.

-**W. and W. Sewing Machine.**—
should have mentioned what style of
is. The Wheeler and Wilson Co. make
ds of sewing machines for the various
ork. The old-style one has a curved
rotary hook; but the new-style ones have
needle, and differently constructed
. In either case, if he carefully follows
ions, he may succeed. The needles must
not bent out of shape, nor yet too fine or
for the material. See they are set
bar, and work clear down to shuttle,
ng on the needle-plate. Thread up
nd look from underneath machine, and
ine slowly to see if it is in proper time.
should pass clear down to the shuttle
then raise again, and as soon as it has
it $\frac{3}{16}$in. there should be a loop thrown
eedle, and the point of shuttle (which
rp and smooth) should have just arrived
and the eye of needle should be about
the point of shuttle. The shuttle must
needle as it passes, but the point must
lose to the needle. If the shuttle arrives
efore the loop is properly formed, or if
not arrived at needle until loop is too
t shuttle passes underneath loop instead
it, "Aktis" must alter the time of the
f he cannot, he must describe what sort
it is, and I will give him more informa-
n the needle bar is at its lowest point,
the needle should be fully ¼in. below
shuttle point passes. See needle-plate
bad. Of course, if the machine is badly
quires thorough repairing. If "Aktis"
r the fault, I will tell him the easiest
so if he will give me more particulars
ur paper next issue. I might write a
f faults before I hit on the one, unless I
hine. S. M. Mechanic.

-**Greek Accents.**—The following extract from a letter in the *Times* by Mr. G. Monson, of the British Legation, Athens, may be of interest to the querist:—"Since my official duties made me a resident in this country," says Mr. Monson, "I have been continually more and more impressed with the strangeness of the fact that the proper pronunciation of ancient Greek is a question to which so little attention has been given by English scholarship. Year after year distinguished university men arrive in Athens, and, with the increased facilities for locomotion now at their disposal, extend their tour to every spot where modern research has discovered traces of classic art and architecture. They come with memories well stocked with the results of their study of what they have been taught to treat as a 'dead' language, and wander through a country with whose inhabitants they are unable to converse, but to whom their tongues would very soon be loosed, were it not that the traditions of Desiderius Erasmus have for more than three centuries and a half perverted the original pronunciation of Greek into a usage founded upon the respective sounds of the vernacular of the country in which the ancient language is taught. I do not deny that, in spite of so great a disadvantage, any foreigner, who happens to be a good (ancient) Greek scholar will be able, with a little steady application, to acquire in a comparatively short time considerable fluency in modern Greek; but I cannot but think it much to be lamented that, inasmuch as that modern Greek differs so slightly in structure from the language in use at the commencement of the Christian era as to make the perusal of a Greek newspaper a by no means difficult task to the ordinary scholar, our great centres of learning and education should continue to remain indifferent to the question of the expediency of a change in the pronunciation inculcated . . . . . . To those (and I am sure they are many, even in our great Universities) who have never given it a thought, I commend the study of a pamphlet by Miss E. A. S. Dawes on 'The Pronunciation of Greek,' published by D. Nutt, in 1889." Athos.

[73500.]—**To Grind Lawn-Mower Cylinder.**—To make a machine for this purpose, I send sketch of machine. I worked in large shop where this class of work is done. I think with a little this could be worked on a lathe to run at, say, 800 for 10in. stone fixed in lathe. Have two heads made as shown in Fig. 1 with hard wood stops for cylinder to run in, with cap screwed down tight so as to prevent the least play. Fig. 2 to act as carrier fixed on the end of cylinder shaft, which must run reverse way to the stone. Fig. 3 shows machine in working order.



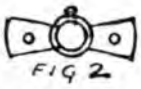


FIG 2

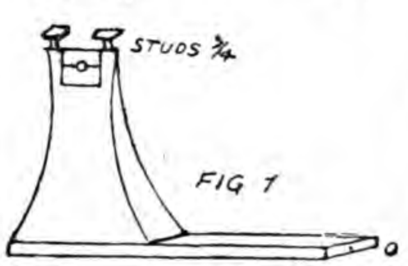


FIG 1

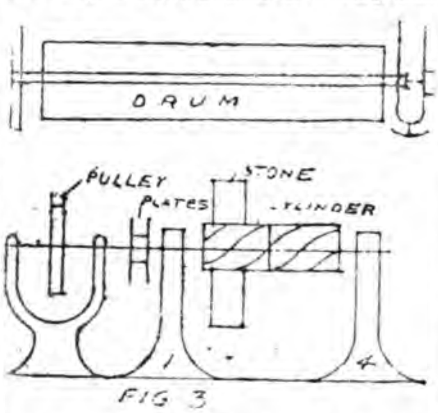


FIG 3

Having ground cylinder, fix in position, see bearings are good fit; bottom blade must be taken off and ground to fine edge, then set to straight-edge on bottom bar. Cylinder must press on bottom blade. Grind up with coarse emery and oil until it runs quite easy; test with tissue paper. If "Fitter" requires more information, and will advertise his address, I will correspond with him.

Lawn Mower.

[73505.]—**Electric Clocks.**—In my answer to this query last week the word *afterwards* should be *oftener*. In your issue of the 6th inst., "A. E. B." asks for an efficient battery. If the battery I referred to last week going 18 months and 10 days without attention will be of any service to "A. E. B.," or others, shall be pleased to send sketch and particulars. I may mention that the construction of brake has much to do with the longevity of battery. I should not care to try three or four good Daniell cells, as mentioned by "A. E. B.," on the best brake I have. Dixon and Cassey's address, when in the line, was 102, Bloomsbury-street, Birmingham.

G. W. A. F., Electric Clockmaker.

[73509.]—**Electric Light Shunt Dynamo.**—"J. W. W. B." asks me to explain my statement of facts. I cannot do so; I can simply re-state the facts—viz., "It is not E.M.F. that produces a light: it is the current which passes through the filament of a lamp; so, also, it is not E.M.F. that deposits copper, or gold, or silver, in a plating vat, but the ampères of current which pass in a given time." S. Bottone.

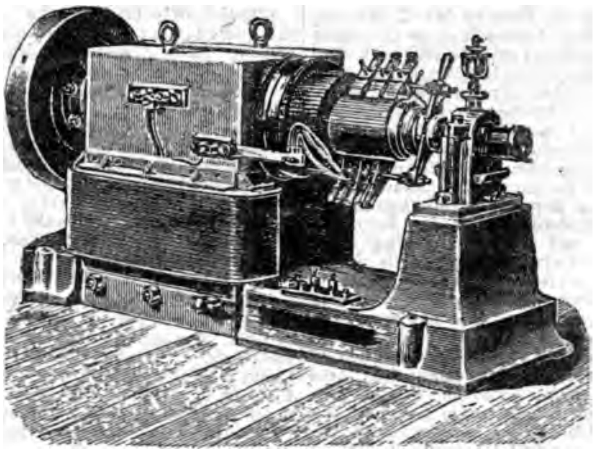
[73515.]—**Hardening Tools for Chilled Rolls.**—If "Roll-turner" will put a handful of salt into a bucketful of hard water, heat his tools to a dark red, then plunge them into bucket, he will find them hard enough. As for Mushet's steel, the first time you tried to grind them would be the last. Don't have it. Mac.

[73524.]—**Casting Medals.**—From what you state in your article, I should imagine that if you wish to obtain any good results by your own hands, the only way is to obtain the usual battery and cells used so extensively by smashers, and which would take weeks of experience to understand, as well as being an act punishable by law. Your query has, I see, been answered by two correspondents; the one most likely to suit you is the one signed by "Eos," in which he mentions that the best plan would be to send to Birmingham. With regard to the press and dies, suggested by both correspondents, the outlay would certainly be far too great to cover the profit. I have seen precisely the same thing as you require manufactured in thousands, and are used extensively all over the country for the purpose you mention. It would certainly be no good you trying yourself, as I feel certain you would never obtain proficiency, the consequence being that you would never obtain any good results as the outcome of your labour. H. C. H.

[73529.]—**Fishing Stockings.**—You will wear woollen ones inside of these, I suppose; and I expect you have wading boots, and you find your feet damp as well as the hose you wear. As your boots are waterproof, and expect that these will obviate this, you are lost upon the subject; but if you have them you must make them out of fine close brown-holland, and to dress them proceed as follows:—Take a tablespoonful, heaped, of linseed, and boil for an hour in a pint and a half of water, strain off the liquor, and then take a piece of curd soap, about the size of a cracknut, and shred up fine and dissolve it in boiling water, and mix this with the linseed tea. When this is cold it should be workable—i.e., not ropy. Dress your job with that outside when dry. Do the same on the inside—that is, turn them inside out when dry; turn back again, and with a polishing iron, or a smooth glass bottle, calender them. Well, then get a pint of raw linseed oil, and dissolve a piece of camphor in it about the size of a large nut. Dress with this outside when dry, dress the inside (don't drown them), put on as thin as you can—two or three coats are better than one; put out in the air to dry, but not in the wet. See that each coat is dry before giving it another; but the first coat takes longest to dry. If you follow these lines, you will have a strong supple waterproof. Jack of All Trades.

[73557.]—**Rain.**—"Sm." asks, in his answer to my query on Rain, where I got my electrical theory in regard to rain. (1) Since the erection of the observatory on Ben Nevis it has been demonstrated that whilst the galvanometer shows that a current of electricity is passing up the wire the weather remains fair, but as soon as the current begins to descend, rain falls. (2) There is, I understand, an electrical plant to be found in Ceylon which during fine weather gives an electrical shock to anyone who touches it, but that during wet weather it is limp, and cannot give a shock. (3) Sir W. Thomson is responsible, I believe, for the remark that vapour in the atmosphere is kept afloat by an envelope of electricity, but that when it is removed the vapour falls as rain. About the dust particles in the air and their influence on rain—will "Sm." perform the following experiments and explain them?—1st. Exhaust a receiver of an air-pump, admit the air again through some cotton wadding to filter it from dust particles; then blow in some steam. The steam will fall to the bottom in small particles, and will not float in the sifted air. 2nd. Now fill the receiver with ordinary unsifted air and admit the steam, which will now cloud the whole interior, thus showing that the dust particles have an influence in holding the water particles in suspension.

S. H. B.



[73510.]—**Dynamo for Electric Lighting.**—To Mr. Bottone.—Sixty gas-jets would probably give about 720c.p. A dynamo to substitute these, and to be capable of working at the same time the four arc lamps, should give at least 50 ampères at 50 volts pressure. Such a machine should have a drum armature 8in. diameter by 16in. long, wound with 12lb. No. 10 wire. The field-magnets should be compound-wound, with about 8lb. No. 10 for the series coils, and 65lb. No. 16 for the shunt coils. I inclose a sketch of the type of machine I should recommend, and must refer you to the seventh edition of my book, "The Dynamo: How Made," for further details as to winding, &c.

S. Bottone.

[73536.]—**Skew Gearing.**—The gearing that "F. A. M." wants amounts to a 7-thread worm and worm-wheel. Taking his distance between centres as 2⅜in,, and the worm-wheel as 28 teeth, 12 pitch, the worm will be 1·834in. pitch, 2·582in. diam., and ·18in. depth of thread. The change wheels would be $\frac{95 \quad 85}{20 \quad 55}$ $\frac{\text{drivers}}{\text{driven}}$, giving the exact pitch of 1·834in. In order to shifting for the several cuts, the carrier end of the mandrel, on which worm is chucked, might be made septagonal. I cannot say how this worm will work if cut with his cutter; but it is usual to give worm-threads straight sides, each side inclined about 15°. The worm-wheel will have its face hollowed to conform to an arc of 1·125in. radius, and will have a diam, at bottom of curve of 2·5in. Depth of teeth, ·18in.; cut with a cutter, 2·608in. diam.; skew of cutter, 13·6°.

British Bulldog.

[73536.]—**Skew Gearing.**—There is evidently a mistake in your figures. You want a pair of skew wheels 2⅜in. diam., 2⅜in. between centres, but one is to turn four times as fast as the other. If one is to be 2⅜in. diameter, then the other must be ⅝in. and 3/32in. only, and the centres will be 1½in. bare. However, that will not prevent my replying to the question in a general way. As the shafts are at right angles, the angles of screw teeth at pitch line will both be 45° with the axes of their respective wheels. The tooth sections, taken normal to the screw teeth, will be alike in both wheels. Or, in other words, the tooth sections taken at right angles to the direction of the threads on the point of contact will be precisely alike in both wheels. But when you speak of the pitch diameter of a spiral gear, you understand that diameter always as circumferential, as in a spur gear, and the relation of the circumferential pitch to the normal is determined solely by the angle of the threads. You can determine their relation by trigonometrical functions, and by a graphic method. Please see my articles on these gears in "E.M.," Vol. XLVI. p. 593, and Vol. XLVII. p. 25, where both methods are described in detail. You will find that a cutter suitable for a spur-wheel will be too wide for a skew-wheel of the same circumferential pitch. Further, you will see that your upper wheel is no more like a worm than the lower one, having exactly the same angle of twist. Also, that the same cutter will cut both upper and lower wheels. You will find it an awkward job to cut these wheels in a slide lathe. It is true worms can be easily cut in slide lathes; but they seldom exceed 10° of angle, and there is a deal of difference between that and 45°. In the latter the rate of traverse of the saddle is very rapid, and great stress is put both upon the change wheels and the cutting tool, tending to break them. If the lathe-mandrel were turned by hand very slowly, the job can be done; but it would be tedious. I think you would do better by rigging up a milling cutter of circular form, of the correct section and of small diameter, not to interfere with the twist of the teeth, set at correct angle in a rest or special gear cutter, and driven from the overhead.

J. H.

[73559.]—**Apparatus for Cold Room.**—Would "Solent" give a detailed sketch and explanation of the aqua-ammonia system which requires no power?

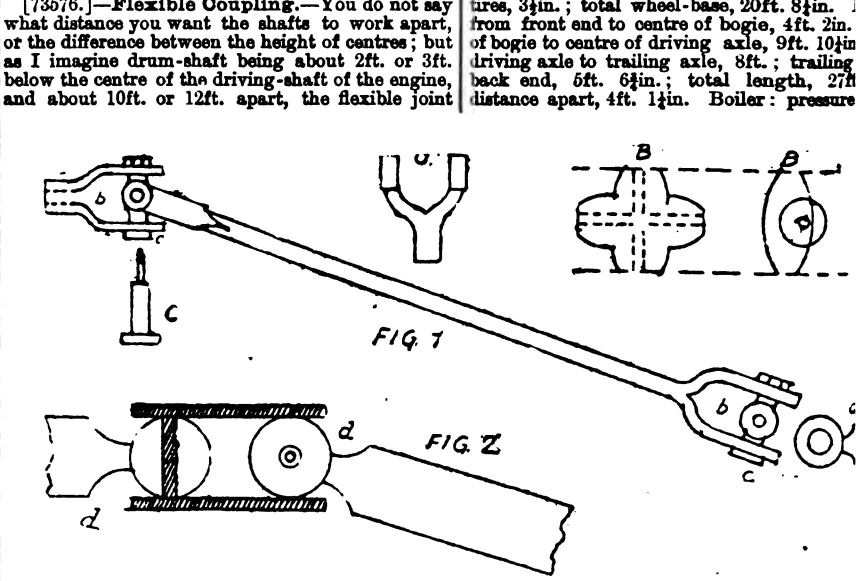
Carino.

[73566.]—**Gongs.**—The pretty little sonorous instruments you describe, of a triangular pattern, come from Burmah. I once obtained a pair of the best class, and suspended them from projecting bars in my sitting-room, as they were objects of interest to strangers. During my absence some thoughtless person must have struck one a heavy blow with a hard substance, for I found that it had become dumb. On close examination I discovered an irregular crack in the metal, which was indented. I sent it to an Indian brassfounder, who understood bell-metal (a very common alloy in the East). It returned to me looking very bright and sound, but silent for ever. It is said there is some process of heating and cooling on which the prolonged musical vibration depends, and of which the Indian founder was ignorant. Chinese gongs consist of 100 parts copper, 25 parts tin; another sort, of 80 parts copper, 20 parts tin, frequently hammered and annealed. Among all Budhistic people great reverence is attached to "bells." The consecration and dedication ceremonies are scrupulously attended by all classes. Coins, personal ornaments, and metallic jewelry—precious and base alike—are crammed into the melting-pot, as votive contributions to the holy construction, thus producing a complex alloy, very sonorous and equally brittle. Probably the surplus material is disposed of by the bell-founders to the makers of gongs and cymbals, hence their surprising tones. A very tightly-wrapped ball of list attached to the end of a drumstick is the proper striker of these small triangular gongs, which should be hung on a whipcord line, not less than a yard long, to increase the vibration and gradual melting away of the notes. I have an idea that the striker-head would be improved if made of a rubber tennis-ball, tightly stuffed with horsehair, on the end of a heavy hard-wood handle a foot long, and shall try it.

Eos.

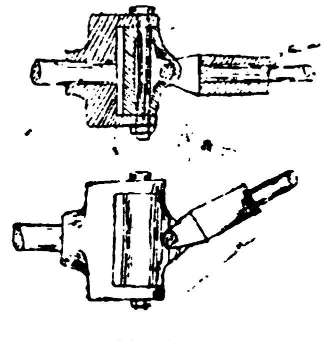
[73576.]—**Flexible Coupling.**—You do not say what distance you want the shafts to work apart, or the difference between the height of centres; but as I imagine drum-shaft being about 2ft. or 3ft. below the centre of the driving-shaft of the engine, and about 10ft. or 12ft. apart, the flexible joint shown in Fig. 1 should suit your purpose. *a* is bored out to suit driving-shaft; *a* 2 is the same thing made to suit the other end, both being keyed on tight—one on the driving-shaft, the other on the driven; *b* is formed in the shape of two bosses, one at right angles to the other; and the coupling-pin *c* forms a shoulder in one side of the fork *a* to keep it from springing in and tightening on *b*, which moves freely on the pin *c* and between the fork *a*. It will be noticed that all joi right angles to each other, which must b at both ends. The joint-pins *c* are faste small side of the fork *a* by means of a outside. Another form of coupling on principle is shown in Fig. 2 (the ball-a joint), the recess *d* at the finish of the b ing the shaft the required clearance for w that position. However, if you want to drum very close to the engine-shaft, I would have to use a straight coupling, up the difference between the centres by spur-wheel and pinion in a frame. A. M

9, Quinn Buildings, Popham-street, Es
London, N.



[73576.]—**Flexible Coupling.**—Here rough sketch of Hook's joint, which I think just the thing for you.

Tredegar.



[73592.]—**Antifluctuator for Gas-En** Thanks for replies. Will Mr. Bonney des working of valve on gas-bag? I have tri ting off gas as recommended by Mr. Gray answers well; but when there is an extr the engine it often works the bag empty. O two bags would do better, but also with e my motto being "One engine, one bag."

Antifluct

[73593.]—**Model Engine.**—You can size of wheels to dimensions named without the general design. Cylinders ¾in. bore stroke will do very well. You can cas plates separately and screw to foot-pla where is the advantage? Better make on of the whole. If you cut out by fretsaw, t arms will have no taper, and won't moul had better follow the instructions give paper. I am cutting wheel patterns out metal. Oscillating cylinders will answer, a show them later; but they can't be dep like slide-valve cylinders.

[73581.]—**N.L.R. Locos.**—The follow the dimensions of the above:—Cylinders: 17in.; stroke, 24in.; centre to centre, 6 Wheels: diam. of bogie-wheels on head, 2 diam. of coupled on head, 5ft. 5in.; thickn tires, 3½in.; total wheel-base, 20ft. 8¼in. from front end to centre of bogie, 4ft. 2in. of bogie to centre of driving axle, 9ft. 10¼in driving axle to trailing axle, 8ft.; trailing back end, 5ft. 6¾in.; total length, 27f distance apart, 4ft. 1¼in. Boiler: pressure per sq. in.; height of centre from rails, 6f length of barrel, 9ft. 9½in.; diam. inside, Firebox: length (bottom), 4ft. 8in.; (bottom), 3ft. 6¾in. Tubes: number of, 18 outside, 1¾in. Heating surface: tubes, 8 firebox, 91sq.ft.; total, 951sq.ft.; gra 16·62sq.ft. Weight in working order: o 14 tons; on each pair of coupled wheels, total weight, 46 tons. Capacity of two prevent your watch being magnetised is to leave it at home. Unmagnetisable watches can now be obtained. Sm.

[73660.]—**Watch Magnetised: Prevention.**—Inclosing your watch bodily in a little iron case will effectually shield it from getting magnetised. A little tinned-iron box, such as percussion caps are sold in, answers admirably; only remember it must be iron. S. Bottone.

[73663.]—**Model Locomotive.**—The object of the pet-cock is to allow of escape of air from the pump chamber just before beginning to work the pump. It is properly a bib-cock. The action of the pump cannot be checked, but the water-gauge shows the height of water, and the blow-off cock can be used if the water rises too high. There should be a brazing-flange in gunmetal, or in wrought iron, for the check-valve. The check-valve is fastened direct to the boiler. The attachment of pet-cocks and lubricators to steamchests is one of those matters I have left open. They are optional, because the greasy steam from the cylinder will lubricate the valve faces, and the accumulation of water in the chests would not be likely to burst them, as it would the cylinders, there being nothing there like a close-fitting piston. If the water should accumulate excessively, then the end cover could be taken off, the water removed, and the faces lubricated. I hope to describe tenders in present series of papers. I should make the spring of steel, well tempered. I am about to have some springs made, and will get one or two to suit loco., and will then give you sizes. J. H.

[73664.]—**Ventilator.**—The cheapest and most effective way to ventilate your house is by making a ventilating opening through the wall into the chimney of each room as close as possible to the ceiling. The chimney ventilators are fixed into the opening with a little plaster of Paris. I have used these or similar ventilators in every house I have inhabited for many years, and everyone is struck by the freshness of my rooms as compared with others. The great principle of ventilation is to remove the foul air where it collects—that is, at the top of the room; the next important principle is to introduce fresh air without draught. In practice I find that it is best to trust to the air coming in round doors and windows for the supply of fresh air, rather than to provide any special openings, as such openings are sure to be neglected. If more air is wanted than will leak in, a window can be opened. A. Gray.

[73666.]—**Brush Arc Light Carbons.**—Very few persons now use coppered carbons, as they always tinge the light more or less. The object of coppering them is partially, as you suppose, to reduce the resistance, but more particularly to lengthen the life of the carbons. The reason for keeping the resistance of the carbon pencils low is that all their resistance is so much useless work on the dynamo and engine. The Brush lamp of 2,000c.p. nom. takes a current of about 10 ampères, and this requires carbons of about 11mm. if they are to last any length of time. Sphinx.

[73667.]—**Dry Batteries, Faulty.**—To Mr. Bottone.—Remove the terminals from the carbons, cast a lead cap on to the carbon, and screw the terminal into that. S. Bottone.

[73669.]—**Stearine.**—If only for the sake of cheapness, why not use methylated spirits instead of alcohol in the recipe given? S. Bottone.

[73669.]—**Stearine.**—The querist has evidently never seen any stearine, or he would not ask how to render tasteless a substance which has no taste. I daresay some people would call it odourless likewise. Sm.

[73670.]—**Faulty Engine.**—I should say that the eccentric had shifted a little behind its true position. This would cause the valve to have not quite completed its travel at the beginning of the next stroke, and the steam being shut out of the cylinder when the valve closes the port would account for the depression in the early part of the admission line. This backward position of the valve would also account for the absence of clearance. C. K. Dumas.

[73670.]—**Faulty Engine.**—It is impossible to tell how this diagram has been produced, and "Mechanic" gives no details either of diameter of cylinder, stroke, slide, or cut-off valve, scale of diagram, or pressure of steam. I should think, to look at the diagram itself, that a defective piston or valve has produced that curious loss of power at the commencement of the stroke; but there appears to be no cut-off, and there is no compression, so I should imagine there would be a rather heavy knock when running. Sphinx.

[73671.]—**Ancient Lights.**—A man may build to the extreme verge of his own land, provided by so doing he does not interfere with the adjoining owner's ancient lights. An ancient light is a window which has for 20 years received its light over the adjoining ground without any interruption; after such an existence it cannot be interfered with by building so as to obstruct it. But "Niobe" must remember that she cannot claim a view after 20 years' enjoyment thereof; it is only the mere access of light and air that cannot be interfered with; and, if this is provided for in the intended building, "Niobe" can claim nothing further.

B. H.

[73671.]—**Ancient Lights.**—If you have had the ancient light 28 years, as you say you have, you have a positive right to it in future. The law says the light cannot be acquired under 20 years, and a twelve months' clear stoppage of such light is the only way to prevent it being so acquired, so that in reality a tenure of the light for 19 years and one day absolutely gives you a positive right to it. Although at first sight this may appear strange, yet on reflection it will be seen that there is no other way of deciding it. The law being that the interruption to the 20 years must continue 12 months, clearly; therefore, a man who commenced to stop a light after the 19 years and a day had elapsed, could not, before the expiration of the 20 years, have interrupted that light for a period of 12 months; and, therefore, as no 12 months' interruption could occur, the Courts would hold that the light was acquired. Your neighbour may build anywhere on his property so long as he does not impede or diminish the volume of light which now enters your premises. C. H. G.

[73675.]—**Collotype Plates.**—Get "Collotype and Photo-Lithography," by Dr. Julius Schnauss, published by Iliffe and Son, 3, St. Bride-street, E.C., price 5s.

Plymouth. B.Sc.

[73676.]—**Making Carbons.**—The paste must be subjected to a very considerable pressure before it is heated in the moulds, and when removed therefrom must again be dipped in syrup or treacle, and again baked, until at last the carbon acquires sufficient density. S. Bottone.

[73676.]—**Making Carbons.**—It is a troublesome job, and rarely satisfactory on small scale. You must first char only partially, packing well in coke-dust; then soak in strong syrup, and char again, and repeat the process until they will bear full heating. Sigma.

[73676.]—**Carbons.**—Finely-powdered and sifted gas-carbon, 4 parts; ditto wood-charcoal, 1 part; syrup, *q.s.* Make into a stiff paste, ram in a mould, which close tightly, and bind with wire; heat to bright redness in sand. The carbon must be prevented from expanding during the ignition, or it will be friable. Sm.

[73677.]—**Siemens Armature.**—Yes, if you put on only 4 yards you will get 4 volts and a longer current. You must also put a correspondingly large wire on the field-magnet. You must not couple in series, otherwise your dynamo will reverse. S. Bottone.

[73678.]—**Dynamo to Light Five or Six 20c.p. Lamps.**—To Mr. Bottone.—Armature 5in. diam. 3in. deep, wound with 3½lb. No. 20; field magnets 2in. diam. wound with 12lb. No. 20, connected in shunt. S. Bottone.

[73683.]—**Gilding.**—There is only one other way, and that is Dutch metal, and that is in the leaf, and goes black in a year or two.

Mount Cutter.

[73683.]—**Gilding.**—Your "gold" paint was apparently made of brass. You can buy pure gold paint; it is usually sold in mussel-shells, but is rather expensive for this work. Gold leaf will be cheaper. Sm.

[73685.]—**Egyptian Tamarind Flowers.**—Patent medicines nowadays practise mystification, and cover simple remedies with high-sounding appellations. The tamarind-tree is very common in the East and West Indies—not indigenous to Egypt. "Tamarindus" is derived from "Tamar"—in Arabic, "a date," "fruit"; and "Indus," "Indian." Dates in Egypt are as plentiful as blackberries here—so, perhaps, this is the solution.

Eos.

[73687.]—**Accumulators.**—Buy the book I have so frequently recommended and advertised in these pages—viz., "Management of Accumulators," price 6s. It is the book. S. Bottone.

[73687.]—**Accumulators.**—You cannot do better than get Sir David Salomon's treatise on the management of accumulators, now growing in successive editions from a pamphlet into a book.

Sigma.

[73687.]—**Accumulators.**—The best books for "W. P. P.'s" perusal would be "Electrical Light Installations and Management of Accumulators," by D. Salomons, published by Whittaker, which is a really useful and practical handbook.

F. Askew.

[73688.]—**Electric Lamp.**—To Mr. Bottone.—A small bichromate battery with lifting arrangement would probably suit your requirements; but no battery has ever yet been constructed that would do any useful work for intervals during two years.

S. Bottone.

[73689.]—**Combustion.**—Better get a practical engineer to examine your furnace to see if it is properly constructed. Automatic stokers prevent smoke, since the amount of coal is supplied at a constant rate; but they are not perfection.

Sm.

[73689.]—**Combustion.**—The simplest and best mode is the judicious management of the coaling, and regulation of the inlet of air above the fire at the fire-door—that means a competent man at the work. The supply of hot air at the bridge should not injure the plate, unless it is so directed as to concentrate the heat of the burning gases on too small a space. If the air is supplied at the door, the combustion is spread all over the fire surface and into the flues. Sigma.

[73690.]—**Shunt Dynamo.**—A shunt-wound dynamo is not, and cannot be, perfectly self-regulating. It can regulate itself, or, to speak more exactly, adapt itself better to variations in the load than the series machine, but only within certain well-defined and rather narrow limits. In the case propounded by "E.L.," let us suppose that a shunt-wound dynamo were built to give a current through a resistance which might vary from 1 to 2 ohms. Now the ratios to be adopted would be R = 1·5 (as the mean between 1 and 2), A = $\frac{1\frac{1}{2}}{20}$ or $\frac{3}{40}$, and F.M.'s 20 × 1·5 or 30 ohms. Now, when 2 ohms are in the outer circuit, only $\frac{1}{16}$th of the total current will, by the law of divided currents, pass round the F.M. coils. If only 1 ohm is in the outer circuit, the current is doubled; but only $\frac{1}{30}$th of the current passes through the F.M. coils. S. Bottone.

[73693.]—**Clockwork Spring.**—If "New Reader" is in earnest, he must have little knowledge of machinery if he expects to use to advantage a spring that would be capable of giving off ¼H.P. for a quarter of an hour. In the first place, he could not get a spring strong enough to do it; but as it is theoretically possible to get any amount of power out of springs (if a sufficient number be used), he could, of course, do the work with some unknown number and at some unknown cost. In the next place, there must be something of the nature of a fusee between the springs and the work, in order to equalise the power throughout the whole time they had to work. That, too, is perhaps possible. Next, how is the ratchet lever handle to be worked? If one man had to wind up the springs, he would have to exert his whole power steadily for about one hour in order that ¼H.P. might be given off for 15 minutes, or if something like ¾H.P. were exerted for 15 minutes in winding up the springs, they might then be capable of giving off ¼H.P. for the same time. But if such a power were available, it would be simply absurd to waste it by winding up springs at all, when it could be more usefully employed by driving the round abouts direct. Is it possible that "New Reader" is in the belief that more power can be got by the uncoiling of a spring than is expended in winding it up? If so, he had better realise the impossibility of it at once, and so save himself any further trouble in the matter, for if he wants to do sixpence worth of work with a spring, he must first expend perhaps ninepence-worth of power, somehow, in winding it up.

G. H. S.

[73694.]—**Ether and Water.**—Ether boils at 35·6° C., and dissolves in about 9 parts of cold water. When you heat the water the ether is volatilised.

Sm.

[73694.]—**Sulphuric Ether and Water.**—Sulphuric ether scarcely mixes with water at all—one part of water dissolves about $\frac{1}{12}$th part of ether. Even if it did, it is very unlikely that such a mixture would boil constantly at any temperature. The cases of "mixtures" of different liquids possessing definite and constant boiling points are rare. The temperature 104° is presumably on the Fahrenheit scale (=40° C). Ethyl bromide and methylene dichloride both boil about this temperature; but of course they would be expensive to use.

Director R.B.L.

[73694.]—**Sulphuric Ether and Water.**—A mixture of sulphuric ether and water boiling at 104° Fahr. would consist of 92 per cent. of pure ether and the remainder water. It is prepared by distilling rectified spirits with sulphuric acid, always keeping the S.V.R. in excess. The equation representing the change is—

$$C_2H_5HO + H_2SO_4 = C_2H_5HSO_4 + H_2O$$
$$C_2H_5HSO_4 + C_2H_5HO = (C_2H_5)_2O + H_2SO_4$$

More S.V.R. is allowed to flow into the retort as the ether distils over. The first quantity of $H_2SO_4$ is all required to keep the process going when once started. You can buy it much cheaper than you can make it, which I should advise you to do, unless you desire to make it for experiment.

Frederick Davis.

86, Newington-causeway, S.E.

Probably I could get many of the parts cast if I knew how to set to work.—WISHFUL TO LEARN.

[73715.]—**Electrical.**—Will someone kindly explain the following? I connected a second-hand detector galvanometer to a No. 3 Leclanché cell; it registered 24°. Then I tried it with 24 pint bichromate cells in series, when, of course, the needle was deflected, and struck with considerable force against the stop at 90°. But the strange part is: that on reconnecting to Leclanché, it registered 44°, and has continued to do so ever since. Another peculiarity is, that it is deflected more one way than it is another by the same current, although when not in use it stands at zero. Perhaps it may be of interest to some of your readers to know that I have obtained some capital results with a galvanometer constructed something after the style of one described by Mr. Bottone on page 109 I connected two stout copper wires to it, covered the end of one with a piece of moistened blotting paper, and on that placed an iron tack. On touching the tack with the other wire, I obtained a considerable deflection of the needle.—WALTER HERBERT.

[73716.]—**Blackening Steel Wire.**—Would any reader inform me the best way to stain or colour very fine steel wire dead black? Or any method to deaden the bright surface, so as to ;make it less liable to reflect light would do. The wire is subject to some slight friction.—E. A. S.

[73717.]—**Machine for Enlarging Drawings.**—A few years ago an apparatus was devised for enlarging drawings, &c., from a facsimile on a rubber or elastic surface, which material was capable of expanding or contracting unformly in every direction. Will some reader be kind enough to give name and particulars of the apparatus, and say if it is used in England?—ON TIME.

[73718.]—**Vertical Dynamo.**—Would Mr. Bottone please say how field-magnets in a dynamo of the vertical type, as shown in Fig. 49, in his book, "The Dynamo," are arranged, so as to prevent the iron foundation plate from acting as an armature, and short-circuiting the magnetism?—ENGINEER.

[73719.]—**Waterproof Glue.**—Kindly inform me as to the quantity of bichromate of potash be put to a pound of glue to make it waterproof. I want it for organ bellows leathering for a damp place.—W. W. W.

[73720.]—**Small Loco.**—I have a small loco. with pair single-action oscillating cylinders, which does not work well: it runs a few yards, and then stops. Does it matter which cylinder is put on one side? In what position should steam block be, and what position should the crank pins be with regard to one another? The information on the above will much oblige.—TWICKENHAM.

[73721.]—**How to Make a Musical-Box Comb.**—I am desirous of making a new comb for my musical-box, to replace a broken one which is 9¼in. long. Any hints as to how I should proceed will help me.—MUSICAL.

[73722.]—**Laboratory.**—Will some of our readers kindly aid me as to the best means of fitting up a fume closet in a laboratory, the best materials to use and construction, where such appliances as may be obtained by draught with a fan driven by power is not available?—ZENO.

[73723.]—**Oil Hardener.**—Would some reader very kindly oblige me with the name and quantity of some ingredient which, when added to olive-oil, would make a coating of the latter firm and glossy without much injuring flavour?—A. B. C.

[73724.]—**Surgical Dressings.**—Can any of our pharmaceutical friends inform me if there is any book published or information obtainable in England, France, Germany, or America on the manufacture of surgical dressings, hospital usages, and pharmaceutical preparations generally?—H. CLEWS.

[73725.]—**Cleaning Carpets.**—Can anyone tell me the best way (or preparation) to clean carpets, other than the ox-gall process?—G. HUGHES.

[73726.]—**Metal Casting.**—Will any reader kindly tell me what is the hardest composition that will melt up in an iron ladle for casting perforated plates, about 12in. by 8in. by ¼in.? It must be very hard and dense, and not too brittle.—HARD METAL.

[73727.]—**Lithanode Cell.**—I have four of these cells, each one consisting of glass outer measuring 2in. by 4in. by 6in. high, containing two plates of lithanode 7in. by 4in. by 3-16in. Between them is placed an amalgamated zinc plate of same dimensions—all immersed in a dilute solution of $H_2SO_4$. There is a space of 3-16in. between zinc and lithanode plates for liquid to circulate. What I want to know is, What voltage is each supposed to give, also internal resistance of same? How long would the lithanode last if they are working a 5c.p. lamp three hours every day? Can the lithanode be recharged after it is exhausted? Does local action occur on open circuit? Any information would oblige.—G. E. S.

[73728.]—**Wimshurst Machine.**—Would ebonite sheet 19in. diameter, and 1-32in. thick, do for making plates for Wimshurst machine, or would they be too thin for the purpose? Would ebonite work as efficiently and last as long as glass plates? What length of spark would plates of this size give? Would cardboard plates give same length of spark?—G. E. S.

[73729.]—**Planetary Theory.**—Can anyone tell me what is the extreme amount of variation in the mean distances of Jupiter and Saturn from the sun, produced by that part of their mutual actions arising from the mean motions being as 5 to 2 nearly, or in the earth and Venus from the mean motions being 8 to 13 nearly, or in Neptune and Uranus from being 1 to 2 nearly? Also can anyone clear up the following? Suppose two planets have their mean motions exactly in the ratio of two integers; then we are told that the corresponding term in the disturbing function ceases to be periodic, and causes secular variations in the elements of the orbit. Still it seems to me that it acts differently from the ordinary secular part of the disturbing function. In the ordinary part if $a$ be the mean distance, we have $\frac{d\,a}{d\,x} = 0$; but in this part, $\frac{d\,a}{d\,x}$ is not $= 0$. Hence this produces a secular variation of the mean distance. Now the ordinary proof of the stability of the eccentricities and inclination of the planets depends on the assumption that there is no secular variation of the mean distance; but this assumption seems to me not true, provided that we can only find two integers such that their ratio is the ratio of the mean motions of two planets. And how can we be sure that such integers could not be found in every case? Hence the proof of the stability of the planetary orbits seems to me an unmitigated failure. If two planets have their mean motions in the exact ratio of two small integers, what will their orbits be? I see dimly that, if the ratio be 1 to 1, one planet will be a satellite of the other; but let us take as an example the ratio 1 to 2.—AMATEUR MATHEMATICIAN.

[73730.]—**To Mr. Bottone.**—I have made a unidirection machine 8in. by 1in. by 1in., and armature 2in. long, which I have wound with 1½oz. of 24 B.W.G., but it will only ring a bell, and gives no shock. If I wound it with No. 36 B.W.G., could I get a shock? Also I am constructing a shocking machine with magnet, 8in. by 1in. by 1in. What amount of wire ought I to put on bobbins, and what size bobbins ought I to have? What size porous pot ought I to have to a pint cell (in answer 73532 last week)?—E. A. L.

[73731.]—**Dressing Millstones.**—Would any practical stoneman kindly give the best dress for 3ft. 10in. Peak millstone, grinding foreign barley? At present we are putting nine harps, two furrows to the harp, and about five cracks to the inch on face. Any other information as to how to get the most work through same would greatly oblige.—A COUNTRY MILLER.

[73732.]—**Motion Wanted.**—I should be obliged if any of your readers would suggest some simple means of converting the reciprocal rotary motion of a punkha wheel into a continuous rotary motion. My object is to connect an electric bell (placed near the punkha coolie) in such a way that when the coolie pulling the punkha slowed or stopped, the bell would ring and would continue ringing until the punkha pulling was resumed to its required speed.—R. MONTEATH.

[73733.]—**Dynamo Difficulties.**—I intend making a dynamo, Manchester type. I should like to arrange it so that I may have two armatures interchangeable one with another; one to give a high E.M.F. with a small current, the other to give a large current with a low E.M.F. Is it possible to do so without altering the wiring of F.M.'s at each change? Will you kindly give me dimension and wiring of armatures (toothed rings or plain) and field-magnets to get best results with a ½H.P. steam-engine? Also revs. per minute?—THOTMES.

[73734.]—**Mechanical Punt.**—Does any reader know of a scheme, either by electricity or otherwise to propel a shooting-punt along when shooting with a large gun, instead of sculling, say, in about 18in. of water at times? An engine and boiler not convenient, as everything possible must be kept out of sight in punt.—MECHANIC PUNTMAN.

[73735.]—**Polaris.**—How many degrees is Polaris from true north on Vancouver Island in lat. 49½?—B. C.

[73736.]—**Telegraph.**—Would Mr. Bottone tell me if there is a wire which could be put on the ground through the forest for telegraphic or telephonic communication? Overhead lines cannot be maintained even at an expense of £180 per annum, or £3 per mile, and underground line would be out of the question from prime cost. There would be no danger of mechanical injury. What would be the cost and weight of the cheapest satisfactory cable per mile, f.o.b. London?—B. C.

[73737.]—**Water Power.**—Will some one give the formula for finding horse-power of a stream from the following data only? Width of sill in inches, depth of water in inches, measured at the top of curve formed by the outflowing water, height of fall in feet. Also say what proportion of power would be obtained by an over-shot water-wheel? Sorry I cannot refer to back numbers or books.—B. C.

[73738.]—**Raising Water.**—I have a large rain-water tank underneath wash-house and a capacious cistern at the top of house. The present mode of raising the water is by means of a 2¼in. bore force pump, a slow and laborious process which my man shirks as often as possible. Recently we have had a water tower erected in the neighbourhood, and have a good force of water, but too hard for washing purposes. Could I utilise this force either by means of a turbine or other appliance for raising the soft water? What could you suggest as being most efficient, cheapest, and without taking up too much room? A sketch would help.—A PARSON IN PERPLEXITY.

[73739.]—**Tube Drawing.**—Would any kind reader inform me the right way to draw tubes? Also how to put them in, and what tools I should require for a seven-horse portable with ferrule at fire-box end?—ONE IN A FIX.

[73740.]—**Locomotive Rails.**—Will some reader please tell me the best way of making above for model magneto-electric railway?—BLAYNEY.

[73741.]—**Furnace for Flint Glass Works.**—Will some reader kindly give a description of the most improved form of furnace for a flint-glass works?—PRACTICAL.

[73742.]—**Squares.**—

| | | | | | | |
|---|---|---|---|---|---|---|
| 5 | 7 | 4 | 12 | 6 | 3 | 11 |
| 2 | 10 | 0 | 19 | 0 | 0 | 8 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | 31 | 0 | 0 | 0 | 0 |

The above is copied from a cross-plate on back of small pocket sundial; the original is about one inch square. Perhaps some of your readers can explain the working of it.—J. A. L. C.

[73743.]—**Tangye Gas-Engine.**—I have a ½H.P. horizontal gas-engine (Tangye) which I cannot get to work. I do not know how to arrange the escape valve. Let 1 be the position of the piston rod when quarter of the way out, 2 when it is half-way out, 4 when full out, 6 when half in, and 9 when fully in again. Then what ought to be the position of the piston rod when (1) the gas supply opens, (2) when it closes, (3) the escape valve opens, (4) closes, (5) when the exploding port opens, (6) when it closes?—SMITH.

[73744.]—**Model Launch Boiler.**—Can anyone tell me how to make it 9½in. long, 6in. wide, and 6½in. deep, tubular, and with steam, dome for 3½ft. boat? What thickness of copper to use, and size of rivets?—G. R.

[73745.]—**Rusting of Steel.**—I have steel scale of millimètres, &c., and as it is a very good one, I am axious to preserve it from rust. At the same time, I do not care to grease it, as I require to use it for drawing. Any practical suggestions to suit this special case would oblige.—DIRECTOR R. R. L.

[73746.]—**Bursting of Waterpipes by Frost.**—Several letters have appeared in the *Times* lately on this subject, and it has been recommended to use oval pipes—either made in that form or hammered to shape. They are said to become circular in section from the expansion of the water in freezing, and do not burst, because the area of the circle thus formed is greater than that of the original ellipse, which allows for the increased bulk. But so long as the line bounding the bore of the pipe remains unaltered in length, the area it incloses remains unaltered also, into whatever figure it may be bent. Are these oval pipes efficient, and if so, why? For the reason given above cannot be the true one.—SENEX.

[73747.]—**Pulleys.**—Will any of your readers kindly inform me what size pulleys I shall require to drive a band saw, drilling machine, wood-lathe, grindstone, and a small paint-grinding mill? Engine wheel is 3ft.—CARRIAGE BUILDER.

[73748.]—**Escapement.**—I have the movement of an old Dutch clock which is in good order, except the escapement and pendulum, which are missing. The escape wheel has 36 teeth, with a pinion of 7 teeth. Can any reader kindly tell me the shape of the escapement so that I may replace.—PENDULUM.

[73749.]—**Gas-Engine.**—Would some reader well up in gas-engines kindly inform me? 1. How long at a stretch can an engine be run (2-man Bisschop), without being overheated? 2. What would be results of working it after that time? 3. The pressure of gas being very low in daytime in town where I live, the engine only just working when valve is full on (I mean valve on top of large gas-bag), would it be of any advantage to have a valve with a larger way? The engine works well at night when pressure is greater.—H. R.

[73750.]—**Moon's Perigee.**—Will "F.R.A.S." kindly tell me how to find the moon's perigee? I am fairly puzzled over the matter. In *Whitaker's Almanack*, I find moon in perigee Jan. 12th, 2h. M., and again, Feb. 9th 1h. A., making a period of 29 days, 11 hours. Again, April 7 1h. A., to May 5th 9 M. = time, 28 days and 22 hours; whilst from May 5th to the 31st., 9h. A. are only 25 days, 21 hours. Why is this difference?—KARL.

[73751.]—**Chord of a Segment.**—How can I find the chord of a segment when knowing the diameter of the sphere, and the height of the segment?—PERPLEXED SPHERE.

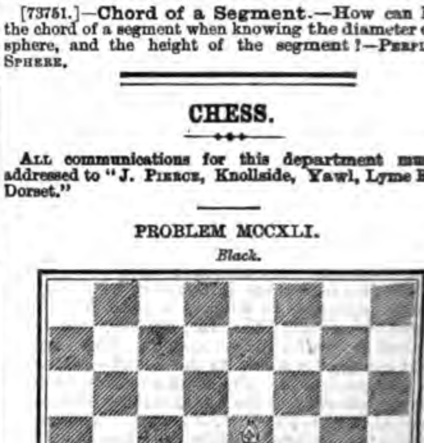
## CHESS.

◆

ALL communications for this department must be addressed to "J. PIERCE, Knollside, Yawl, Lyme Regis, Dorset."

### PROBLEM MCCXLI.

*Black.*



*White.* [7 + 8

**White to play and force Black to mate in two moves.**

SOLUTION TO 1239.

| *White.* | *Black.* |
|---|---|
| 1. Q-Q 2. | 1. Any. |
| 2. Q mates. | |

### NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1239 by J. Humble, H. Fellows, A. Fellows, Lieut.-Col. Ryan, J. Kistruck, D. Mackay, J. H. Eastwood, Biene, C. P. P., W. L. Martin, W. Gleave, E. Perrin, F. J. Wardale, and W. A. Clark; to 1238 by J. H. Eastwood, D. Mackay, C. P. P., F. W. N. Lambert, E. H. Ryan, and J. Kistruck; to 1237 by J. H. Eastwood.

J. HUMBLE.—If in 1237, K-K 2, P-B 8 (Kt) (ch).

F. W. N. LAMBERT.—No.

G. W. WARRY.—In 1238, Black is to mate White.

L. C. H.—There is no second solution to 1237. If 1. R-K R sq, P-B 8 (Kt), and if 2. Kt-B 2 (ch), Kt-Kt 6.

E. H. RYAN.—We have not received from you the solution either to 1235 or 1237.

he English Mechanic
D WORLD OF SCIENCE AND ART.
FRIDAY, FEBRUARY 20, 1891.

## CENT RESEARCHES ON THE IN- LUENCE OF TEMPERING UPON HE CHARACTER OF STEEL.

HIS last decade of the 19th century may be fairly held to usher in the age of el. Notwithstanding the marvellous de- opment of the iron trade in this and other ntries since we discarded the old stage- ch and took to travelling by rail, it y safely be affirmed that the uses of n, and that important modification of it, el, will be largely extended—indeed, we y say vastly more extended—than at sent. There is no really just ground for rehension lest there should be any over- duction of this valuable metal.

he increasing use of machinery and the id growth of railway systems are creating ever-widening demand for iron and steel, ecially for the latter. Steel rails have, ler equal conditions, proved to be about ht times more durable than rails made of ught iron, whilst the difference in prime t between steel and wrought-iron rails is at all proportional to this difference of ability. And in every department in ich such metal is used, the superiority of l has been amply demonstrated. It may said that the day of steel has arrived, and t this substance is destined to exercise an portant influence upon the destinies of the nan race.

he growing importance of steel in the nomy of manufactures has necessarily racted the attention of scientific men. No ger is steel made by empirical, or, at t, little-understood processes; every phase its manufacture is now coming under the luence of science. There are amongst the ding lights of science many men who are dying the questions suggested by the aracter of this metal, with all the resources which modern knowledge is capable. ese, like Roberts-Austen, Moissan, Spring, mond, the Le Chateliers, &c., are now appling with the difficulties which practical tallurgists have met with, and making ge contributions to our knowledge of the nstitution of steel. They are recognising at a common substance which is per- ps the most precious that manufacturing ngland possesses, is not to be regarded as neath their investigation. Who shall say w much the progress of England might forwarded if others in the ranks of scientific en, instead of spending their energies upon earches into the nature of obscure and re chemical substances, were to direct those ergies into channels leading towards com- ercial advancement?

One of the most recently-published papers n scientific matters is one by Mons. H. e Chatelier, who has been studying the in- ence of temper upon the electrical resist- nce of steel. As any reader of this paper hould know, when steel is heated to redness, d then plunged while red-hot into cold ater, or is otherwise suddenly cooled, it quires great hardness and brittleness. On heating it to redness, and allowing it to ol down slowly, the original softness and alleability are restored, and when it is heated, even far below redness, and after- ards suddenly cooled, it is also softened, the gree of softening within certain limits of mperature being inversely proportional to e temperature. It is, then, possible to com- unicate to the same steel widely differing grees of hardness, and the process by which is is effected is called tempering.

When the steel, before reheating, has its rface brightened, it will, during the ocess of reheating, present a succession of characteristic colours corresponding to different temperatures, and these colours are so constant and definite that they render the use of thermometrical instruments quite unnecessary.

The late Dr. Percy has prepared a table in which the colours are stated in the order of their appearance, with the value of the temperatures that accompany them. Here is an abstract from the table :—

| Temp. Fahr. | Colour. | Uses of the steel. |
|---|---|---|
| 430° | Very pale yellow | Lancets |
| 450 | Pale straw | Best razors and surgical instruments |
| 470 | Full yellow | Common razors, penknives, &c. |
| 490 | Brown | Scissors, cold chisels, hoes, &c. |
| 510 | Brown dappled with purple spots | Axes, plane-irons, &c. |
| 530 | Purple | Table-knives, large shears |
| 550 | Bright blue | Swords, watch springs, &c. |
| 560 | Full blue | Fine saws, augers, &c. |
| 600 | Dark blue | Hand and pit saws |

The tempering of steel has, from a remote period, been known to influence its physical properties. Thus it has long been recognised that steel expands very sensibly when it is hardened, and consequently that its specific gravity becomes less. Reaumur (*vide* "L'Art de Converter le Fer forgé en Acier," 1722, p. 313) computed that during the process of hardening, steel increased to the extent of $\frac{1}{48}$ in volume. This was confirmed by Rinmann, a German metallurgist.

It now appears that the change in the volume of steel induced by hardening varies according to the temperature at which it is heated previously to cooling.

Again, when steel is hardened at a very high temperature, its tenacity and elasticity are affected; it becomes exceedingly brittle.

These changes have been the subject of much investigation by such distinguished metallurgists as Karsten (*vide* his "Eisenhüttenkunde"), Elsner (*vide* "Journal für praktische Chemie"), Caron (*vide* "Comptes Rendus"), and others.

The expansion of steel by hardening is, other things being equal, directly proportional to the degree of carbonisation. This carbonisation of steel is a very important point in its constitution, and exercises a great influence upon the physical and chemical properties.

During the last few years Osmond has studied the chemical constitution of steel very carefully, as also has Prof. Roberts-Austen. They find that there are certainly two varieties well defined and possessing distinctive characteristics.

It will scarcely be suspected, by one who is not well versed in the methods of chemical and physical research, how difficult it is to isolate and properly evaluate the chemical from the physical properties. The investigation is surrounded with difficulties, and not everyone is competent to undertake it.

The temper of steel affects other properties; thus hardening and tempering sensibly modify the fracture which is characteristic of steel. The size of the grain, other things being equal, increases with the temperature to which the metal is exposed before hardening. Thus, when hardened at a cherry-red heat in cold water, steel may present a more or less velvety dull fracture, of which the grain is so fine as to be no longer visible to the naked eye. A higher temperature enlarges the grain. Hardening increases the tenacity within certain limits of temperature; but beyond the limit the reverse is the fact. For each variety of steel there is a particular temperature at which, on cooling in cold water, the maximum tenacity is produced.

A striking alteration in its quality and properties may be brought about by causing even a minute difference in the composition of steel. The presence and content of such elements as carbon, silicon, sulphur, phosphorus, manganese, &c., are well known to affect the quality of steel very sensibly. The amount and condition of these subsidiary constituents in steel is influenced, of course, by the temperature to which it is exposed. Hence, hardening and tempering must exert a very great influence upon the chemical constitution of the metal. Hardened steel is, for instance, much less acted upon by acids than the same steel softened.

It is not the function of this article to enter into and discuss at length the theory of the hardening and tempering of steel, but rather to call attention to the facts that these processes do very seriously affect, for good or for bad, as the case may be, both the physical and chemical constitution of this metal. Their importance cannot be overrated, and it is a matter of congratulation to all who are in any way interested in iron or steel, that at last some of the leading scientists are becoming alive to this importance.

The work of Mons. H. Le Chatelier, to which we have already alluded, has been conducted with a view to discovering what influence temper has upon the electrical resistance of steel. It is only quite recently that it has been suspected that not only is the molecular constitution, &c., of the metal affected by tempering, but also its electrical properties.

We shall give a short abstract of Mons. Le Chatelier's results, as they deal with a most interesting property of steel.

The experiments were conducted somewhat after the manner of those made by Mons. Osmond a short time ago. Wires of steel were used, the dimensions being two millimètres diameter, and 100 millimètres in length; but all the calculations were reduced to read for a wire 1 mètre long and 1 millimètre in diameter. The following table shows the initial resistance before experiment, and also the carbon for the samples of steel examined :—

| | Resistance. | Carbon. |
|---|---|---|
| (1) | $0{\cdot}190^{\omega}$ | $0{\cdot}085^{\omega}$ |
| (2) | $0{\cdot}250^{\omega}$ | $0{\cdot}485^{\omega}$ |
| (3) | $0{\cdot}270^{\omega}$ | $0{\cdot}670^{\omega}$ |
| (4) | $0{\cdot}220^{\omega}$ | $0{\cdot}830^{\omega}$ |

The electrical resistance of the tempered metal is increased by a rise of temperature; but the increase is only produced at a certain well-defined temperature. The effect is sharply evident, and when the temperature is carried beyond this point there is no further increase. The next table gives the mean of the temperature of temper obtained by reheating and recooling, as well as the resistance expressed in the function of its initial value before tempering.

| Temperatures. | Resistances. |
|---|---|
| 750° | 1·13 ohms. |
| 745 | 1·18 |
| 725 | 1·55 |
| 735 | 1·60 |

In these experiments it was observed that brittleness was developed at the same time as the increase in the electrical resistance took place.

The temperature of the temper of steel is about that of the transformation of carbon (730°), and these results confirm the theory formulated by Osmond, which were dealt with in this paper about a year ago.

When the steel is reheated, the electrical resistance decreases by an amount as much more considerable as this temperature is more elevated, and its action more prolonged. It seems that at each temperature there exists a certain limiting state, which can only be obtained in an infinite space of time, but which is very nearly approached in a very short space of time.

The next table gives the resistance of steel

No. 3, tempered in water at 10° C., and annealed for one minute at increasing temperature:—

| Temperatures. | Resistances. |
|---|---|
| 10° | 1·55 ohms. |
| 120 | 1·47 |
| 205 | 1·29 |
| 310 | 1·15 |
| 385 | 1·10 |
| 450 | 1·07 |
| 550 | 1·04 |

Mons. Le Chatelier also investigated the influence exerted by the temperature of the bath used in cooling the heated steel, and these results are tabulated in the original paper, for which we must refer our readers to the Proceedings of the French Academy of Science (*Comptes Rendus*, Vol. CXII. p. 43.)

Mons. Le Chatelier promises to continue these investigations, for he believes that his method of measuring the electrical resistance will afford a means of recognising the state of the carbon contained in the iron, and even of estimating with sufficient accuracy the proportion of it that is transformed in tempered steel. He also states that he will apply this method to the investigation of the mechanical properties of steel. Hence we may shortly expect some exceedingly interesting information which may very likely be full of value to the mechanical and manufacturing world.

J. T. N.

## HOW TO CONSTRUCT A PHONOGRAPH.*

By W. Gillett.

### 1.—Introductory.

IN a scientific journal like the "E.M." it is assumed that the reader is fully acquainted with the theory and action of the phonograph, and therefore no explanation on this part is necessary, and so we proceed at once to the mechanical construction of the instrument in detail. To those few, however, who wish to be enlightened on the *modus operandi*, I have but to refer them to back volumes of this paper, where much information on that part of the subject will be found.

In the phonograph to be described, it is not intended to copy exactly the form given to it by Edison, but a modification designed by the writer. The record is made on the usual wax cylinders, the phonograph proper being built on a brass bed-plate, mounted on six ornamental brass pillars, the space beneath being occupied by the driving-gear and motor, which in this case is a special electro-motor. All the parts of this instrument can be made on any good lathe above $2\frac{1}{2}$in. or 3in. centres, fitted with a compound slide-rest *j*, and the drawings which will be given with these articles will be in exact proportion, and are taken from a phonograph already constructed to this design.

### 2.—Bed-plates and Standards.

For the bed-plate we require a plate of brass $14\frac{1}{2}$in. by 5in., and $\frac{1}{8}$in. thick. If a planing machine is not at hand, it is carefully hammered as flat as possible, and then filed up quite smooth and true. Some $\frac{1}{4}$in. brass tube is now taken and soldered to the under-edge of the plate, the edge being just over the centre of the tube as seen in the sectional view Fig. 1, A; the four tubes thus forming the sides of a rectangle, being joined at the corners by a mitre joint as in B, giving the bed-plate a very finished appearance.

The standards between which the main shaft is mounted are shown in Fig. 2. They are $\frac{3}{16}$in. thick, and may be either castings or cut out of plate brass. The sides are worked up in the same way as the bed-plate, and the edges, after being filed up as even as possible, are finished off on the emery wheel. The holes SS in A are $\frac{3}{8}$in. diam., while those in B are $\frac{5}{16}$in. As it is essential that these holes in both standards should exactly coincide, it is best to drill the holes in one plate first, and then use this as a template for the other; the two being soldered or firmly clamped together the while. The hole *x* in A is tapped with a $\frac{3}{8}$in. plug-tap. The holes *i i* in both plates indicated by the dotted lines are tapped to take $\frac{1}{8}$in. iron screws, which hold them down firmly to the bed-plate. The standard A may have a few holes in the centre, to somewhat take away its heavy appearance. This standard is that at the driving-wheel end of the shaft, and that of B at the cylinder end; it being cut to that particular shape to facilitate the removal and replacement of the wax cylinders, without interfering with the shaft.

A small central standard, Fig. 3, is used to support the shaft temporarily while the wax cylinders are placed in position. It is of $\frac{3}{16}$in. brass, a half-circle of $\frac{13}{32}$in. radius being cut out at the top as shown, and the base having holes *i i*, tapped like those in A and B.

### 3.—Guide-Rods.

These are to support the parts carrying the diaphragm cells, and also to hold the standards firmly together. They are of $\frac{3}{8}$ mandrel-drawn steel. One end of each rod is turned to a shoulder, and a $\frac{5}{16}$in. thread cut on it as in Fig. 4, *a*; the other ends being sweated into a piece of $\frac{1}{2}$in. brass rod, which is turned up and threaded as seen at *b*. One of the guide-rods, B, has a length of square brass tube tightly fitted and soldered on it for about half its length, the corners of the tube at the ends being filled up with small pieces of brass soldered therein. This tube over the rod is shown longitudinally (part section) at *c*; and this end of this rod is drilled and tapped with a $\frac{3}{16}$in. tap for about $\frac{1}{2}$in. in depth, indicated by the dotted lines *d*. Four hexagonal nuts, *n*, are then made, and threaded to fit the end of the rods. It is, perhaps, unnecessary to state that these rods, more especially that one *without* the square tube, must be *perfectly* straight; otherwise the motion of the stylus along the wax cylinders, instead of being parallel to the axis of the shaft, will be at an angle to it, or perform a wavy line; either case being perfectly detrimental to the proper working of the machine.

### 4.—Main Shaft and Mandrel.

We now proceed to the shaft and cone for carrying the wax cylinders. The shaft, Fig. 5, *s*, which is of steel, $\frac{1}{2}$in. diam., is centred at both ends, and if it does not run true is turned up between the centres of the lathe. A screw thread is now cut on it for part of its length, the threads being finished off very smooth and true. The thread of course may be as fine as one likes; but I will assume the ordinary brass gas-thread to be used which runs about 27 threads to an inch. Two brass discs of $2\frac{3}{8}$in. diameter, and $\frac{1}{8}$in. thick, are drilled to fit tightly on the unthreaded portion of the shaft, one of them having a boss, Fig. 5, *b*. These are then sweated firmly on the shaft in the manner shown in section, Fig. 5, and turned down to fit tightly into the ends of the tube, which has previously been turned out slightly as at *a a*. The tube *d* is firmly sweated on to these discs as represented. For the driving-wheel we require one of brass about 4in. diameter as a casting, so that when turned down it should be $3\frac{7}{8}$in. diameter, and $\frac{1}{4}$in. thick. This is sweated on the end of the shaft, the end of which is turned down to form a shoulder *c*, against which the wheel *w* may rest. The shaft complete is now ready for turning up, a V-groove being cut on the driving-wheel to take a gut band. The cylinder must be turned slightly coned, the angle of which will be about right if the small end is $\frac{1}{16}$in. less in diameter than the large end.

### 5.—The "Gate."

This is made of $\frac{3}{16}$in. brass, and has at one end, hard soldered, a piece of $\frac{3}{8}$in. round brass rod (Fig. 6, *a*), drilled centrally with a $\frac{3}{16}$in. hole to take a steel rod, on which the gate is hinged. This hinge-spindle is shown at A, the steel rod *s* being sweated for about $\frac{3}{8}$in. into a short length of $\frac{3}{8}$in. square brass rod, *r*, part of which is turned circular as seen at *c*. The top of the steel rod is turned and threaded to take a milled nut *e*, which keeps the gate down. The hinge-spindle is screwed to the standard B, Fig. 2; the thread of the screws being cut in the square brass on the hinge piece shown by the holes *f f*, which correspond to those lettered the same in B, Fig. 2. After the hinge is secured firmly to the standard, two $\frac{1}{8}$in. holes must be drilled through the standard and about half-way into the square block. The hinge-piece is then unscrewed, and two brass pins which fit tightly into these holes, are then sweated into those in the hinge-piece, projecting about $\frac{3}{16}$in., so as to be flush with the inside surface of the standard, when screwed up in place. These pins' holes are shown in Fig. 6, A, at *g g*. Of course in fixing the hinge for the gate, the centre of the gate should be exactly midway between the centres of the guide-rods, and at the same vertical distance from the bed-plate. This centre hole $g^1$ is drilled so as to have a $\frac{1}{2}$in. thread cut in it.

### 6.—Bearing Centres.

The centre at the driving-wheel end of the shaft is made from $\frac{3}{8}$in. round steel, turned to the shape, and threaded as shown in Fig. 7, A, one end of which is cut into hexagonal form, the other end being turned to a point which is well hardened. This is screwed into the hole *x* in standard A, Fig. 2. The centre which is fixed in the gate is of a more complex character. A piece of $\frac{3}{4}$in. round brass rod about $1\frac{3}{8}$in. long is turned up to the shape as *a* in Fig. 7, B. The interior is bored out with a $\frac{7}{16}$in. drill for 1in. in depth, the remaining piece having $\frac{5}{16}$in. hole. The large hole is threaded internally for a short distance to take a screw-plug, *b*, with part of the head cut hexagonally. This plug has also a $\frac{5}{16}$in. hole through its centre, and this hole, when the plug is screwed up, should be exactly in line with the hole at the opposite end *c*. All this is clearly shown in section at B, the part *c* having a thread cut in it to screw into the central hole in the gate.

A piece of $\frac{5}{16}$in. steel rod, about $2\frac{3}{4}$in. long, D, is turned to a point at one end, while the other end is rounded off, F. This must fit very accurately into the holes in the brass socket, but must be capable of being moved backwards and forwards without any "play," like the piston-rod of a steam-engine, through a well made stuffing-box. On this steel rod, about 1in. from the point, is sweated a brass collar, G, of rather less than $\frac{7}{16}$in. outside diameter. This is for a short spiral spring, *h*, to press against, and forces the steel point E against the centre of the shaft. This point, like the other, is well hardened, and of course this is done before sweating the collar G on to it.

### 7.—Gate-Catch.

The end of the gate requires some fastening which, while being capable of easy and quick adjustment, must be perfectly firm. The method I have devised for this is shown in Fig. 7 at C, D, E. A milled-headed thumb-screw of the size and shape of C, is made to screw into the hole at the end of the guide-rod B, Fig. 4, the threaded part of the thumb-screw being of steel well sweated into the brass head. A collar, D, is turned up and drilled with a $\frac{1}{4}$in. hole, so as to fix smoothly over the boss *c* on the thumb-screw. The flange of the collar, it will be observed, is cut flat at one place, *a*. On this collar, opposite the flat part *a*, and perpendicular to it, is screwed and soldered a $\frac{1}{8}$in. brass pin, *b*, on which is securely fixed a neat little bone handle, *h*, shown in section with the collar at E; the width *w* of the flanged collar is slightly less than the thickness of the gate.

The collar now finished, it is slipped over the boss *c* on the thumb-screw, which is then screwed into the end of the steel rod, as seen in section at F; the end of this rod being filed quite level with the nut *n*, by which it is clamped in the standard S. The gate must be of such a width, that when the flat portion of the collar is vertical, it just swings clear; but when the flat portion is placed horizontally, which is done by moving the handle *h* upwards through 90°, the collar clamps the gate firmly; a very small movement of the thumb-screw sufficing to release or secure the collar.

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## LIPPMANN'S RECENT DISCOVERY IN COLOUR PHOTOGRAPHY.

A FEW days ago the Paris news-letter of a daily contemporary commenced with the following statement:—"The scientific world has been startled by the announcement made by Mons. Lippmann (Professor of Physics at the Sorbonne) at the last sitting of the Academy of Sciences of a new process of photography discovered by him, by which colour throughout the whole range of the spectrum can be reproduced on a sensitive plate, just as accurately (since colours are but numbers of light-waves), as outline or shadow are fixed by the present photographic negative and prints."

Our contemporary is not accurate in saying "the scientific world has been startled"; the scientific world is never startled, since it does not

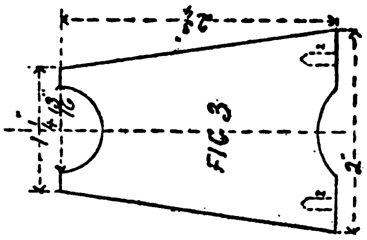


FIG. 3

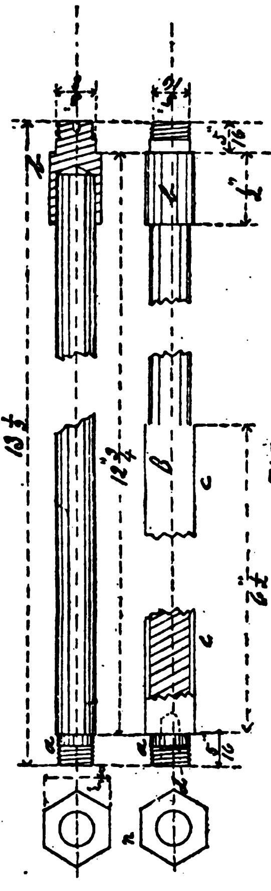


FIG. 4

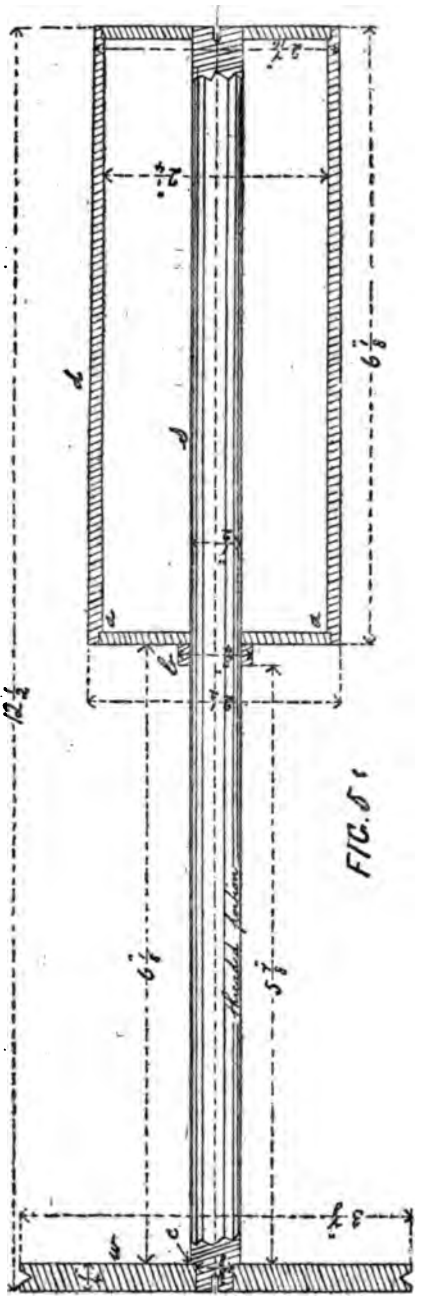


FIG. 5

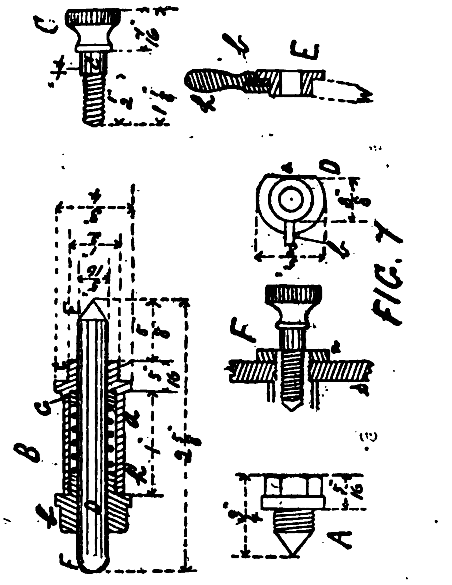


FIG. 7

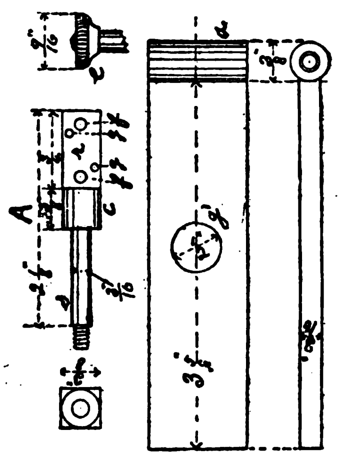


FIG. 6

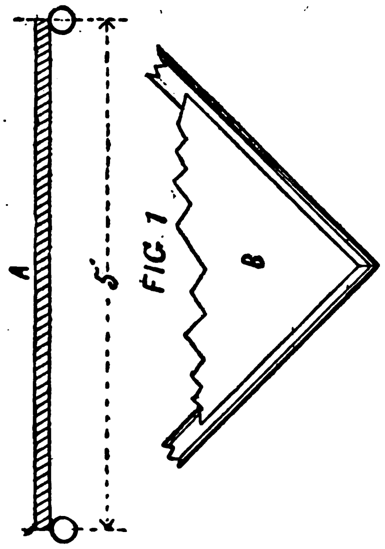


FIG. 1

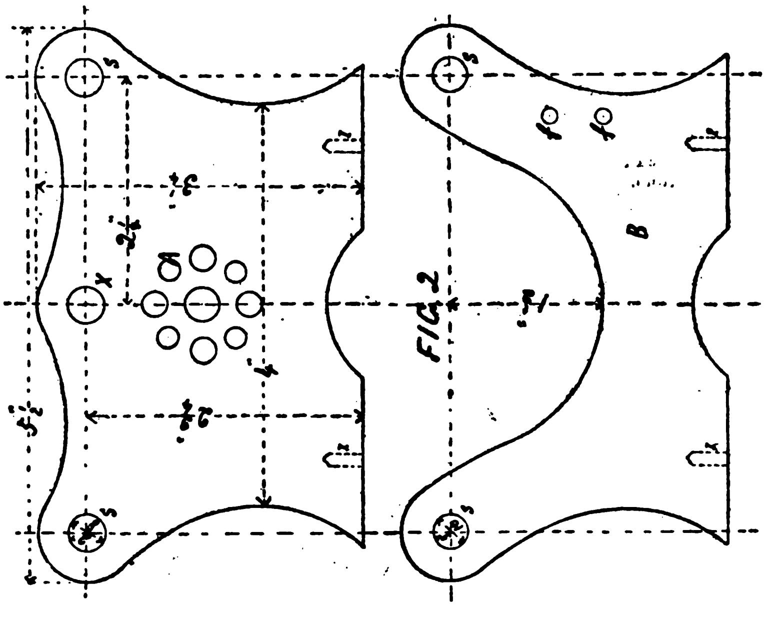


FIG. 2

recognise impossibilities in the same way as the uninitiated. A long procession of remarkable discoveries have, during the past few years, prepared the minds of scientists for almost anything. More especially is it not true in this particular case to say the scientific world was startled, for new discoveries in the art of photography have been made almost every month, and everyone who knows anything at all about it has been quietly looking forward to the time when Nature's own tints shall be faithfully reproduced.

People who are not constantly in touch with scientific progress are apt to be filled with profound astonishment when that progress makes a little leap forward. "Some lucky accident, you know," they say to each other in their ignorance of how little has ever been found out by chance, compared with what has been discovered by long and patient research. When the problem of obtaining permanent photographs which shall represent natural objects in their own natural colours is completely solved, it will be seen to be the result of labour rather than of luck.

It may be worth while to consider what progress has already been made in the art of photography in colours, since so many are talking about Mons. Lippmann's experiments as though they were an entirely new departure.

It has been possible for many years to obtain naturally-coloured photographs; but the tints always faded either when the negatives were treated with the fixing solution or on exposure to light.

In 1810 Dr. Seebeck, of Jena, and another German named Ritter, succeeded in obtaining traces of colour by receiving the coloured spectrum of white light upon a sensitive surface of silver chloride.

Herschel, Daguerre, and Fox-Talbot about 1840 each obtained colour indications in their photographic experiments. Herschel, we read, found that "the spectrum impressed upon a paper spread with the chloride of silver is often beautifully tinted, giving, when the sunshine has been favourable, a range of colours very nearly corresponding with the natural hues of the prismatic spectrum."

Robert Hunt between 1840 and 1850 obtained a considerable amount of success in the production of coloured images by light. His results are recorded in "Researches on Light," published 1844, p. 277. "A paper prepared by washing with barium chloride and nitrate of silver allowed to darken whilst wet to a chocolate colour, was placed under a frame containing a red, a yellow, a green, and a blue glass. After a week's exposure to diffused light it became red under the red glass, a dirty yellow under the yellow glass, a dark green under the green, and a light olive under the blue.

Fairly successful reproductions of colour were made by Edward Becquerel in 1848. Silver chloride of great purity was deposited electrolytically upon a silver plate by an ingenious process, and upon them coloured pictures were easily obtained; but, unfortunately, no means was found of fixing the coloured images so as to resist the action of diffused light. Becquerel's photographs were called *chromo-photos* or *heliochromes*; but they were a failure, although it is said one or two of these "sun-pictures" were obtained that were quite permanent in bright sunshine.

Those whose memory can take them back to the exhibition which was held in London in 1862, may remember a collection of coloured photographs which excited a great deal of attention at the time. They were done by the younger Niepce, and faithfully reproduced the natural colours of the objects they represented. But they faded in daylight, and only lasted a few hours. Niepce's method was a modification of Becquerel's.

Poitevin (vide *Comptes Rendus*, Vol. LXI. p. 11) in 1868, and St. Florent (vide *Bulletin de la Société Française de Photographie*) in 1874, both obtained by different plans some measure of success in colour-photography. The former used paper prepared with silver chloride, bichromate of potash, and sulphate of copper; whilst St. Florent sensitised his paper with silver nitrate, and then with uranium nitrate and zinc chloride acidulated with hydrochloric acid.

In 1865 and 1866 Messrs. R. J. Fowler, J. T. Taylor, and G. W. Simpson obtained coloured images with collodio-chloride of silver films.

Captain W. de W. Abney has done much in investigating the colours obtained upon salts of silver, and his conclusions, which are too voluminous to be quoted here, may be consulted in the *Proceedings* of the Royal Society, Vol. XXIX. p. 190, and Vol. XXXIII. p. 164.

The researches of Carey Lea (vide *American Journal of Science*, 1887) were three years ago confidently expected to result in the discovery of the secret by which colour-photography is to be achieved; but, like many other "confident anticipations," they have been too premature.

It would be interesting to find out how many sanguine "inventors" have rashly rushed to the Patent Office to expend their guineas in the full expectation of having at last accomplished photography in colours; but in spite of all these patents (most of them abortive, it is true), and in spite of all the progress that has been made, the "scientific world," according to our daily contemporary, is still "startled" to hear that a new process of colour-photography has been found.

It is only a few weeks ago that Messrs. Bevan, Cross, and Green described a new discovery of theirs which by competent authorities has been judged likely to work a radical change in the colour of the photographs of the future. With the Editor's permission we propose later on to give some account of this discovery. Suffice it to say that it depends upon the following observed chemical facts, namely: — That primuline and nitrous acid give diazo-primuline, and diazo-primuline —

| | | | | |
|---|---|---|---|---|
| With | β naphthol | gives a | red | colour |
| ,, | Phenol | ,, | yellow | ,, |
| ,, | Resorcin | ,, | orange | ,, |
| ,, | Pyrogallol | ,, | brown | ,, |
| ,, | α naphthylamine<br>hydrochloric acid | ,, | purple | ,, |
| ,, | Amido β naphthol<br>sulphuric acid | ,, | blue | ,, |

Although plates have not yet been prepared by this process sufficiently sensitive for the camera, there is reason to believe that they soon will be.

Having shown that a great deal of progress has been made in the art of photographing colours, and that it is by no means a new or startling idea, we will proceed to examine into Mons. Lippmann's discovery.

Mons. Lippmann has been heard of before in connection with progress in photography. In the issue for August 2, 1889 (Vol. XLIX. No. 1271, p. 473), we called attention to his researches upon the use of coloured glasses in photography, in order to obtain the true effects of light, and to give each colour in the spectrum its true value.

At the weekly meeting of the Academy of Science on Monday, February 9th, Mons. Lippmann gave some account of the results which he has obtained in colour photography. Photographs of the solar spectrum, and of such objects as stained-glass windows, have been made with great clearness. So far these results are not novel, as we have seen, although the process of obtaining them is a novelty. If the colours are entirely permanent, then Lippmann's colour-photography will be a great advance, for up to the present time the difficulty of fixing the colours may be said to have been the great crux that has baffled everyone who has given any attention to it.

Before describing Lippmann's process it may be as well to remind our readers that when a wave of light meets another wave of equal length coming in an opposite direction, the conflicting waves overlap each other, the continuity is broken, and a succession of dark and light intervals is produced. As has been aptly remarked, the two conflicting waves of light might be represented by the two serpents on Mercury's wand, which form a dot at their intersection, and a wide space between each dot. Each is a wavy but continuous line, whilst the two combined give a broken line or "chain."

Now it occurred to Mons. Lippmann that if, instead of sending a continuous wave of light across a sensitive photographic plate, a broken line or "chain" produced by interference be sent across, the silver in the film on the plate would be precipitated in layers about the thickness of a soap-bubble, instead of being thrown down in one mass throughout the film.

By placing a mirror behind the plate, the rays of light are reflected in an opposite direction to that in which they strike the plate; hence there is interference between the rays incident upon the plate and those reflected from the mirror. In the case of the red rays the silver is precipitated in layers of half the thickness of a red wave-length; the blue light similarly deposits the silver in layers which are just of sufficient width apart that only the blue light can pass t
the yellow light causes the silver to d
layers just sufficiently wide apart to allo
passage of the yellow rays only, an
throughout the spectrum. This is th
principle of Lippman's discovery.

He uses gelatino-bromide films for
sitive plate, which, according to the
arrangement, is placed closely against t
ing of a trough filled with mercury
forms a mirror in contact with the plate.

The rays of light pass through the
film as in the old processes; but when th
the other side of the plate they are refle
by the plane mirror-like surface of the
causing interference with other rays
incident to the plate, instead of being abs
a dark background.

It will ill become anyone to pronou
emphatic opinion about Mons. Lippman
covery. He himself only professes to ha
a beginning; and it must be admitt
between the reproduction of a brillia
spectrum or the sharply defined colou
stained-glass window, and the reprodu
the varied tint of a landscape, there
difference. But the process differs
from all previous ones in principle and
plicity of method, and in this there is ho

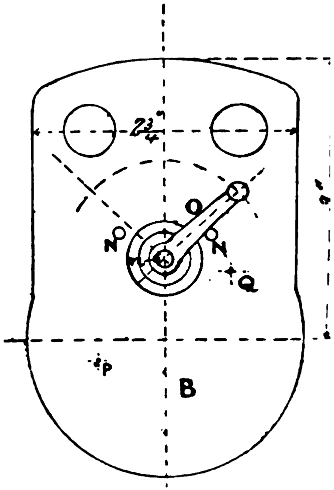
J.

## MODEL LOCOMOTIVE-MAKI

## XVI.

THE boiler, Fig. 72, is the plainest
In a model, even of this small
would be practicable to make a workab
with firebox and a single fire-tube.
would be troublesome, and would not
well as the externally-fired one shown in
This consists of a piece of brass tube,
ends, B C, and diaphragm, D, in cast br

FIG 72



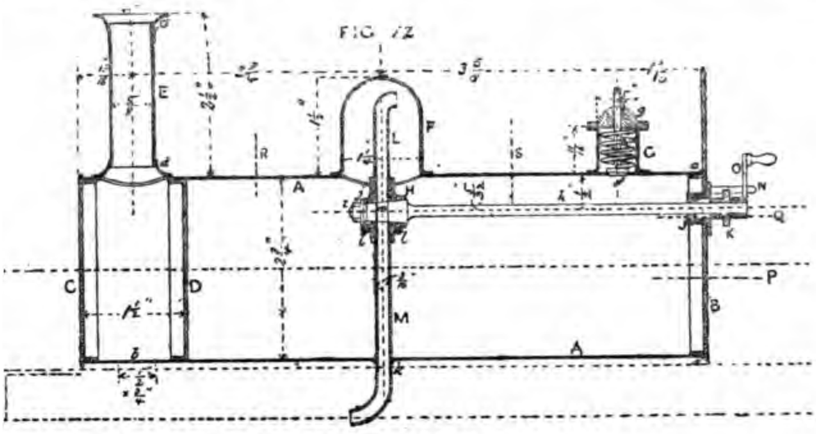
END VIEW

soldered or brazed on. The back disc B i
longed above to form a kind of weather-
and two spectacle holes are pierced in it.

The boiler is too small to permit of riv
Soft-soldering will be safe in so small
using a moderate pressure—say, from 3
45lb.—provided the water is never allowed
short, nor the joints to become burned.
proper thing, however, is to braze with s
Suppose I describe in brief both methods.

Prepare the ends B C and the disc D by
ing in the lathe to make a free, or slightl
fit with the interior of the barrel—that is
should be from $\frac{1}{64}$th to barely $\frac{1}{32}$nd slack
diameter to permit of the running in
solder or spelter. Do not narrow the fla
these castings overmuch, because the broa
surfaces in contact, the more secure will
joint. The middle disc may be secu
direct soldering; but the ends, if flan
shown, must be sweated in. The surfac
are to come into contact must be quite cl
bright, as they leave the lathe, or file, or

To solder the web D, wipe its edges,
corresponding interior surfaces of the bar
spirits of salts, "killed" with zinc; st



LONGITUDINAL SECTION

ɔn end, supporting the disc D at its ıeight upon a cylinder of wood inserted he barrel. Take a stick of solder in the l, and a small, narrow-pointed soldering operly tinned, in the other,—the point solder in contact, and run both slowly ıe edge of the disc, when the solder will l form a series of little lumps or patches the edges in contact. Passing the iron the edges two or three times, using a ıore spirits, if necessary, will cause lder to run and fill up the zone the ring and the barrel, and the copper smooth its surface, and form a neat f solder. The boiler may now be turned lown, and an angular filling of solder be n the opposite side, which will still assist in firmly securing the disc to the

t in the ends by sweating, the surfaces ct are to be wiped over with spirits of ıd then covered with an adherent layer of ın over them with the point of the iron. ls are then thrust into contact with the of the barrel, each in turn, and the flame nsen burner, or of a spirit-lamp applied e solder runs and adheres and cements aces together. As a further security, an filling of solder may be made round the l angles *a a*.

e sweating is done properly, the joints as good as though they were soldered If, however, the solder does not unite the surfaces in contact, it is better to fit in the same fashion as the disc D, that ut flanges.

urfaces of the joints must be cleaned off rm water, and dried, to prevent corrosion ıydrochloric acid.

rd solder, proceed thus :—

ıard solder or spelter should be more han the brass used for the boiler itself. be conveniently used in the form of ɔr of fine granules. Borax, pounded mixed with a little water, is used as the l the solder is mixed with it.

joints to be united having been cleaned ɔing, as in the soldering process, the ɔd borax and spelter are laid around s of the joint, and placed in or suspended r charcoal or coke fire—that of a small here the heat can be regulated by the is the best—or on a lump of charcoal, ted with the blow-pipe flame. In this ıere the surfaces are of moderately large he former will be found the more suit- 'he heat is gradually quickened, not too lest the borax should boil up suddenly lisplace the solder. To prevent this the often burnt first before being mixed with ler. Gradually the borax froths up— loses its water of crystallisation and resently with increase of heat the spelter ıd gives off a blue flame due to the tion of the zinc. Gently tap the work stage to assist the running in of the Then allow the work to cool down. the operation of brazing the heat should as nearly alike as possible all over, to partial or local union only of the surfaces. e is cut out of the bottom of the boiler- . It is for the purpose of allowing the ıaust pipes from the cylinders to pass ıth the chimney.

The chimney E is made most easily with a bit of brass tube for the body, and a crown, *c*, and base, *d*, made as castings, and soldered to the body. The base is extended sufficiently to give surface for soldering on to the boiler barrel.

The dome F is a single casting, and its flange is also soldered on to the boiler barrel. So also is the safety-valve casing C. The patterns for such castings can be made either by solid pattern and core box, or be turned and shaped tenderly from solid hard wood, or be modelled in wax, or be spun and beaten out in lead. The dome G must not be soldered on until the regulator, to be noticed immediately, has been fitted and put in place.

A complete safety-valve can be bought for 2s. or 3s. The one shown is, however, simple, and easily made. The casing G incloses the spring *e*, which is coiled over the valve *f*. The latter has no other seating than the hole cut in the boiler, into which it is ground. The steam passes up through the casing, and there is sufficient length of hole in the cap *g* to afford guidance and steadiness to the valve, destitute as it is of a bored seating and guiding wings. The steam escapes through three or four holes drilled in the casing.

In the event of the valve sticking, it is desirable to be able to get at it and its spring without unsoldering the casing from the boiler. By making the casing in two portions with abutting flanges, this is easily done. The upper part *g* can then be attached to the lower with three $\frac{1}{16}$in. screws.

The regulator, for I suppose it is permissible to call the very simple steam-cock H by that name, is a little plug cock that can be made or bought in this or in some very similar form. If bought, it will be best to substitute a special plug with a long, stiff stem, *h*, to come out through the front of the boiler. If this stem is too slight, there will be a good deal of spring on the length when turning it. There is no gland to the cock, but the plug is tightened with a nut, *i*, only, bearing against a washer, *j*, and the plug is shorter than its shell to allow for taking up of wear, if ever required.

Where the rod is prolonged through the boiler front, it would be sufficient to just drill a hole through that end for it to pass through; but there would be some slight leakage of steam. The proper way is to let the rod pass through a little stuffing-box, I, screwed or soldered into the end B, and fitted with a gland, K, having a hexagon or a milled head, and a bit of fine hempen packing in the stuffing-box around the rod.

The cock H need not be fitted with screw unions. It will suffice to solder the pipes L M into the ends. These bits of copper pipe L and M soldered into the cock, convey the steam from the top of the dome where it is driest to the cylinders. The pipe L is bent over in the dome to lessen as much as possible the splashing of water into the pipe. M is brought down through the bottom of the boiler, as being on the whole the simplest plan to adopt. It might be bent inside the boiler and brought out horizontally through the front end, and so downwards to the cylinder. In the next article the pipe M will be shown bent in the horizontal direction and entering right and left into the steam-chests. Where the pipe leaves the boiler at *k*, it will be necessary to run a little solder round, to prevent leakage from the boiler.

The regulator must have some slight support besides that afforded by the vertical pipe M. One or two bits of copper wire *l l* may be bridged across the boiler, flattened at the ends and soldered to the interior of the boiler tube. A spot of solder just where the regulator rests upon these wires will fix it fast.

When this work is finished, then the dome may be soldered on.

To open and close the regulator, it is only necessary to arrange the stops N N on the front of the boiler in such positions that the hole now in the plug of the regulator shall come either in line with the hole passing from the steam-pipe through the regulator, or against the blank faces of the bore. These extreme positions will be at an angle of 90°.

The handle O can be fitted to a square end filed on the rod *h*, or it may be simply bored, and secured by means of a tiny screw, *n*, tapped half-way into both rod and boss.

Gauge-glass and pressure-gauge are quite out of the question here. The only fittings on the hinder end of the boiler are two cocks, one at P,, to show the water-level, the other at Q for steam. The boiler must be emptied through these cocks. It may be filled through one of the boilers into which the cocks are screwed, or through one of the holes in the safety-valve casing, the spindle of the valve being pulled up the while. Or a water-filler that can be bought for a shilling, can be screwed anywhere in the top of the boiler, say at R.

A whistle may be screwed into the boiler at S. One of the cheap kinds will not cost more than 2s. 6d.

**J. H.**

## AN ELECTRIC EXERCISING MACHINE.*

A NOVEL application of the magneto-electric generator is shown in the accompanying illustrations. As shown in the cuts, a small magneto machine is placed in a wooden case, and is driven by the operator when pulling upon the handle which projects from the box. As will be seen, the straps attached to the handles pass around wheels on the interior of the box, and by means of suitable belting a moderately slow pull upon the handle will give considerable speed to the armature of the magneto. By means of suitable connections the current thus generated is conveyed to the body of the person using the machine, and the strength of

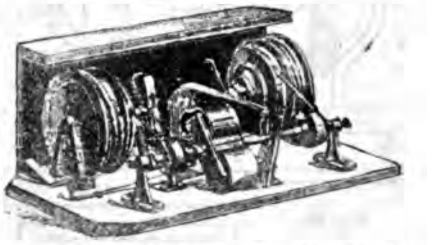


FIG. 1.—Interior of Electrical Exercising Machine.

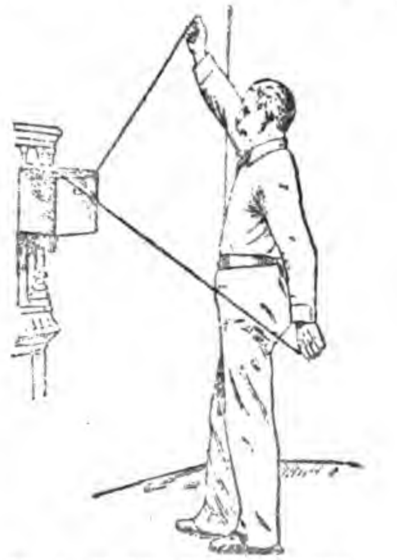


FIG. 2.—Electrical Exercising Machine.

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* From *Electrical World* (N.Y.)

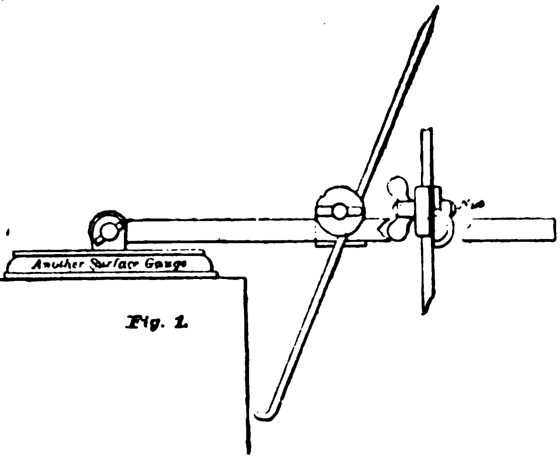


Fig. 1.

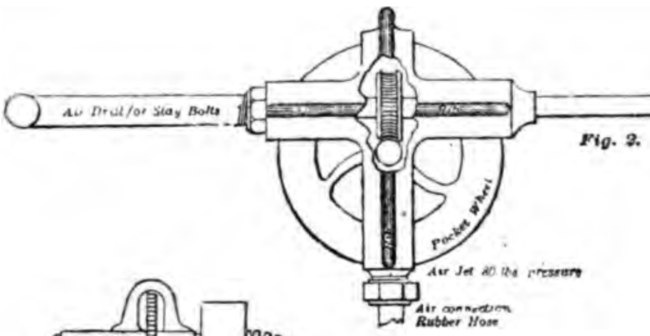


Fig. 2.

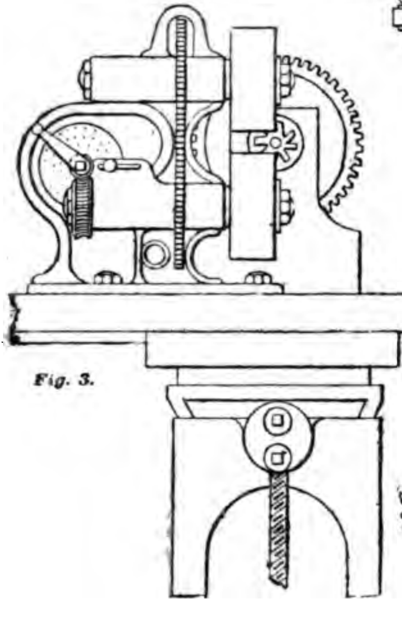


Fig. 3.

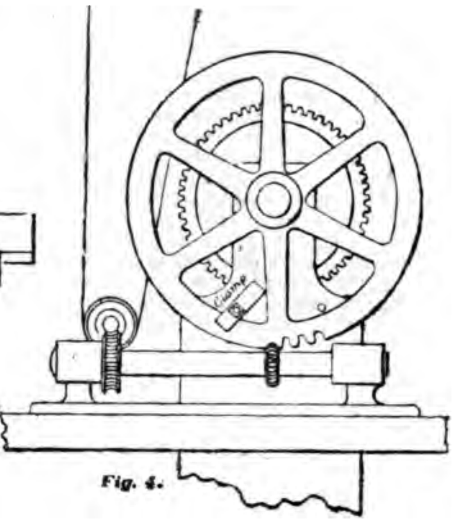


Fig. 4.

the current can be regulated, of course, by the speed with which the handles are drawn out, so that the shock which the person receives can be made as mild as is desired. Fig. 2 shows the box attached to a wall and its manner of use, and Fig. 1 shows the interior arrangement of the machine. A switch is provided so that the current can be entirely cut off if desired, and a regulator is provided affording a different means for reducing the current. By this means, to one of the ordinary forms of exercising is added the stimulation produced by a very gentle electric shock. The machine is manufactured by the American Electric Exercising Machine Company, New York.

## SOME HANDY TOOLS.

THE following descriptions of some handy tools are given by Mr. L. C. Sharp, in the *American Machinist.*

### A Surface Gauge.

Fig. 1 shows a surface gauge. I want to correct the popular delusion that all possible surface-gauges are invented and patented. This one is a dandy, and bears no resemblance to the rest of the family, as will be seen by a close inspection. The base is flat, hard, and ground; the stem is connected thereto by a hinge clamp. The stem is semicircular in section, and clamp nut with needle arranged as shown. This gauge will get anywhere, and occupies a small space when folded up.

### Drill Worked by Air.

Fig. 2 shows a small-speed drill operated by air, which may be used for a variety of purposes, but was mainly designed for drilling stay bolts by hand, as is the custom of many railroad shops which have distributed air-power. The sketch will, I think, show the idea all right. The whole thing is very light and powerful, and will readily drill a ½in. hole The frame is light cast brass. The screw and worm, of course, hard steel. The bearings are conical, and also hard.

This same arrangement constructed upon a larger scale will bore cylinders, either air or water, and may be used for heavy duty—of course, water would be preferable, and most all engine-stalls have a water plug convenient. I do not show an end elevation, as I think the side view will give a general idea of the requirements. The power of this thing will surprise many; if properly constructed, the drive-wheel will run about 5,000 to 7,000 per minute, with 70lb. or 80lb. pressure.

### Dividing Head.

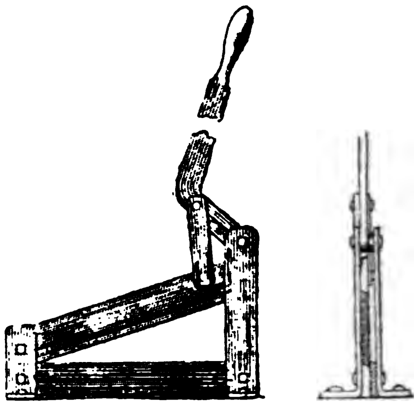
Fig. 3 shows a special dividing head for use on a milling-machine where a large number of gear-wheels are to be cut all one size, such as is used under electric cars. The head shown is solid, for one special size gear. It is obvious, however, that the top may be made adjustable with little trouble. It can be carried still further on the same principle, and be made quadruplex as well, to mill four at a time. It will be seen, of course, where the time is saved over the old way; it utilises both top and bottom of cutter, and, while passing over the width of one gear, two cutters cut four gears in the time of one. With small gears the overhanging arm may be used.

### Milling Gear.

Fig. 4 shows a method of milling a very large gear on a very small milling-machine with hand feed. The cutter is shown mounted on the table, and is driven by a worm. Connected thereto is the driving-pulley, this being driven by a belt to countershaft. The spacing is done by drilling a suitable number of holes in the cone, giving, if the machine is back-geared, a large number of divisions with a few holes. The only thing essential is to keep all the motion one way. Under the clamp and gear are two set-screws that may be set out against the gear to take thrust of clamp. Where nothing better is at hand, these things serve well.

## SHEARS FOR CUTTING IRON.

THE following method of making a cheap pair of shears for cutting iron is described by a correspondent of the *Blacksmith and Wheelwright.* For the frame, he says, I used a piece of iron 2½in. by ½in. Cut two pieces 9in. long, bend them at right angles 3in. from one end and drill ⅝in. holes for the other end. I cut the iron 18in. long, and bend one end of each at right angles 3in. from end. For the shear blades use 3in. by ⅝in. steel (I have used an old cutter-bar off a mower), 20in. long; the lever is 3½ft. long, made out of 1½ by ⅝ iron, which is connected with blade by two pieces, 1in. by ½in., and 6in. long. The figure shows a side and an end



view of the shears when completed. By looking at the illustrations and following the description, any blacksmith can make a pair of these shears.

## THEATRICAL SCIENCE.

AT one of the places of public entertainment in Paris there has recently been given a séance of simulated hypnotism, and we quote from *La Nature* a description of the performances which are carried out in an establishment founded by the famous Robert Houdin. The performances are

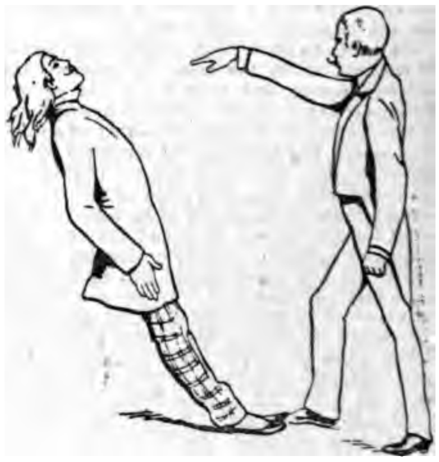


Fig. 1.—Cataleptic Rigidity.

instructive while puzzling, for they show how easily the phenomena of the pathologic state can be imitated. M. Harmington, a disciple of Mesmer, asks for a subject, and finds one in the hall. A young artist named Marius presents himself. M. Harmington makes him perform all sorts of

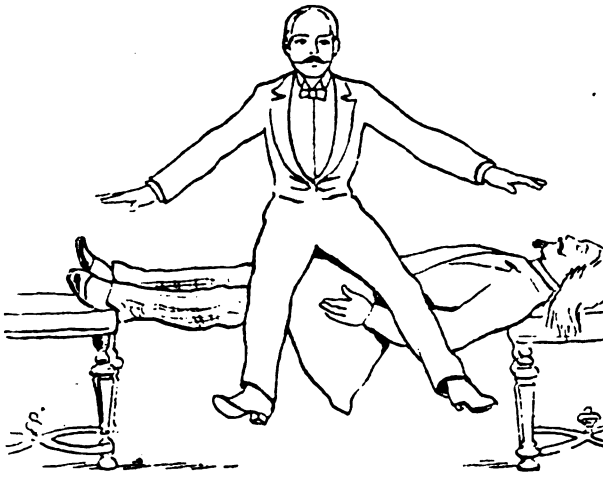


FIG. 2.—Simulated Cadaveric Rigidity.

ant acts, accompanied with a continuous f pantomimes that are rendered the more by the supposed state of somnipathy of the

At the moment at which Marius is finish- nost extraordinary exercises, a policeman breaks in upon the stage, in order to the recent orders relative to hypnotism. imself is subjugated by M. Harmington, wn down by the vibrations of which the us of this terrible magnetiser is the centre. he curtain falls, the representative of is struggling against the catalepsy that is ing him. All the phenomena of induced successfully simulated with much natural- M. Jules David, who plays the part of this pleasing little performance. ertain moment, after skilfully simulated ade by the magnetiser, M. David suddenly as rigid as a stick of wood, and falls in on his heels (Fig. 1). Did not M. Har- run to his assistance, he would inevitably skull upon the floor; but the magnetiser st behind him in order to receive him in

Then he lifts him, and places him upon s just as he would do with a simple board. s the head of the subject upon the seat of he chairs and the heels upon that of the I. David then remains in a state of perfect ty. Not a muscle is seen to relax, and not betrays the persistence of life in him. The n is perfect. In order to complete the ent of the spectators, M. Harmington nself triumphantly upon the abdomen of ect and slowly raises his feet and holds pended in the air to show that it is the nly that supports him, without the need ther point of support than the two chairs

Usually, there are plenty of persons s enough to think that M. David is actually eptic sleep, one of the characters of which ric rigidity.

David's neck is entirely bare, it is not o suppose that the simulator of catalepsy iron corset concealed beneath his clothing. erformed a feat of strength and skill ren- y by the exercise that he has given to the f his vertebral column. This part of the system is greatly developed in the weakest hardy persons. In fact, in order that man a vertical position and execute an infinite multitude of motions in which stability is involved, nature has had to give him a large number of different organs. The muscles of the back are arranged upon several superposed layers, the vertebral column is doubly recurved in order that it may have more strength, and, finally, rachidion nerves issue from each vertebra in order to regulate the contraction of each muscular fasciculus according to the requirements of equilibrium. The trick is so easy that we have seen youths belonging to the Ligue d'Education Physique immediately imitate M. David after seeing him operate but once.

For the sake of those who would like to perform it, we shall add that M. David takes care to bend his body in the form of an arch in such a way that the convexity shall be beneath. As M. Harmington never fails to place himself in the centre of the line that joins M. David's head and heels, his weight is divided into two parts, that is to say, 88lb. on each side of the point of support. The result is that the stress necessary is less than that of a strong man of the Halle lifting a bag of wheat to his shoulder, or of an athlete supporting a human pyramid. The force of contraction of the muscular fibres brought into play in this experiment is much greater than is commonly believed. In his lectures on physiology, Milne-Edwards cites some facts that prove that it may exceed 600lb. per square inch of section.

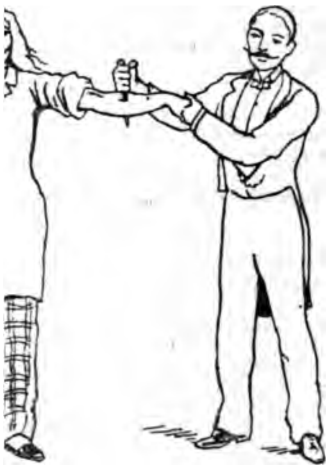


FIG. 3.—The Perforate Arm.

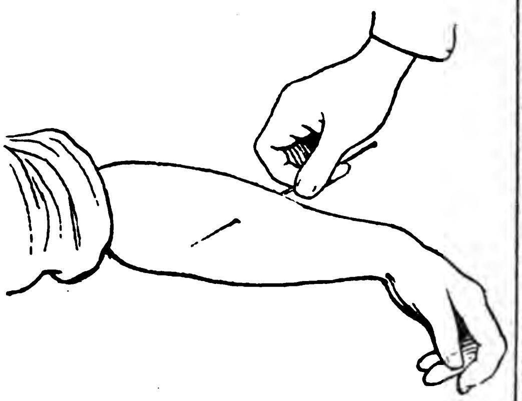


FIG. 4.—An Arm Transpierced by a Needle.

The experiment on cadaveric rigidity is followed by others on insensibility. M. David, without wincing, allows a poignard to be thrust into his arm, which M. Harmington has previously "cataleptised," Fig. 3. This trick is performed by means of a blade divided into two parts that are connected by a semicircle. This process is well-known to prestidigitators, but it might be executed in a genuine manner. In fact, on replacing the poignard by one of the gold needles used by physicians for acupuncture, it would be possible to dispense with prestidigitation. Under such conditions it is possible to transpierce a person's arm. The pain is supportable, and consists in the sensation of a prick produced in the passage of the needle through the skin. As for the muscular flesh, that is of itself perfectly insensible. The needle, upon the necessary antiseptic precautions being taken, may traverse the veins and arteries with impunity, provided that it is not allowed to remain long enough to bring about the formation of a clot of coagulated blood, Fig. 4.

We think it of interest to add that it is necessary that the experiment be performed by a practitioner if one desires to demonstrate upon himself a very curious physiological fact that has been known from the remotest antiquity. It has been employed for several thousand years in Chinese medicine, for opening a passage for the "bad spirits" that produce diseases. For some years past a much more serious use has been made of it in European medicine for introducing electric currents into the interior of the organism. In this case the perimeter of the needle is insulated, and the electricity flows into the organism through the point. We have, says *La Nature*, several times had these operations performed upon ourselves, and this permits us to assert that the above-mentioned facts are absolutely true.

## USEFUL AND SCIENTIFIC NOTES.

**Tobacco Plantation in Russia.**—An official return states that the number of tobacco plantations in Russia last year was 607,582, as compared with 518,335 in 1889, the area under cultivation being about 105,000 acres, as against 90,000 acres in 1889, while the quantity of tobacco grown was about 115,000 tons, or about 29,000 tons more than last year.

DR. G. MEYER, by a comparison of records extending over a number of years, has concluded that the moon has an influence in lowering the height of the barometer in the months from September to January, at the time of full moon, and in raising it during the first quarter. His views are confirmed by the independent studies of Capt. Seemann, of the *Deutsche Seewarte*. No effect has been perceived in the other months.

**Cracks in Metal.**—A crack in a piece of metal is prevented from entending further by the well-known means of drilling a hole where the rent ends; but when the hole is not bored on just that spot, the crack is apt to continue beyond the hole. To facilitate the search of the exact point, *Revue Industrielle* recommends moistening the cracked surface with petroleum, then wipe it, and then immediately rub it with chalk. The oil that has penetrated into the crack exudes and thus indicates with precision where the crack stops.

**Test Paper for Acid.**—BY S. J. HINSDALE, FAYETTEVILLE, N.C.—Cut white filtering paper of neutral reaction in pieces of about 6in. square, and impregnate them with tincture of curcuma (1 part curcuma, 7 parts alcohol, and 1 part water). Place the paper on threads to dry. When dry pass a sheet of it through a bath composed of 40 drops of liquor of potassæ and 100c.c. water. Then immediately pass it through a bath of water (flat earthen dishes are convenient for the baths), and at once place it on a thread to dry. As soon as it is dry cut it in pieces and inclose them in tinfoil. The paper will not bear long exposure to light and air, but will keep well if inclosed in tinfoil. It is much more sensitive than litmus-paper, and will detect acid in a mixture of 1 part of hydrochloric acid in 150,000 parts of distilled water, and will detect carbonic acid in spring water. If the water be boiled to expel carbonic acid, and a yellow colour is produced, some free acid (besides $CO_2$) is shown to be present. The best way to use the paper is to touch it with a glass rod which has been wetted with the liquid to be tested. The paper can be freshly prepared in fifteen or twenty minutes.—*American Druggist.*

**Combustion under High Pressure.**—Mr. W. Hempel, in the *Journal* of the Chemical Society describes a large number of experiments carried out in order to ascertain the influence of increased pressure on the quantity of sulphuric anhydride formed by the combustion of sulphur, and on the quantity of nitric acid produced by the combustion of nitrogen, either alone or with carbon. The combustion of the sulphur was carried out in dry oxygen in iron vessels, that of the nitrogen in steel autoclaves lined with platinum. Ignition was effected by means of a platinum wire heated momentarily to its melting point by an electric current. Five quantitative experiments on the combustion of sulphur in oxygen showed that under a pressure of 40 to 50 atmospheres about half the sulphur is directly oxidised to sulphuric anhydride; under a pressure of 72·5 atmospheres the proportion of sulphuric anhydride produced is considerably less. In the experiments on the combustion of nitrogen, varying quantities of air, oxygen, and electrolytic gas were compressed in an autoclave of 28c.c. capacity, containing a little concentrated potash, and after combustion the nitric acid produced was reduced with ferrous chloride, and estimated as nitric oxide. The results showed that the quantity of nitric oxide obtained increases with the pressure. When, for example, the autoclave is filled with air under the ordinary pressure, oxygen forced in until the pressure reaches 55 atmospheres, then electrolytic gas until a pressure of 211·5 atmospheres is attained, a quantity of nitric acid corresponding to 10c.c. of nitric oxide is produced.

# SCIENTIFIC SOCIETIES.

## ROYAL ASTRONOMICAL SOCIETY.

THE annual general meeting was held on Friday, the 13th, General Tennant in the chair. G. P. B. Hallowes, of 77, Landsdown-road, Didsbury, Manchester; Shin Hirayama, Astronomer at Tokyo Observatory, Japan; R. J. Pearce, M.A., D.C.L., Professor of Mathematics in the University of Durham; and J. M. Stone, of St. John's College, Cambridge, were elected Fellows of the Society.

The report of the council was read. The expenditure has rather exceeded the income of the Society this year, on account of alterations in the library, due to the necessity of making more room for books.

Mr. G. F. Chambers moved, and the Rev. A. Freeman seconded, a resolution that henceforth the meetings of the Society be held at 5 p.m., and that By-law 44 be altered accordingly.

Dr. Schultzer moved an amendment—viz., to have the meetings alternately, one month in the evening and one in the afternoon.

Sir Erasmus Ommaney seconded Dr. Schultzer's amendment, and others having spoken, on the motion being put, the amendment to hold the meetings alternately in the afternoon and evening was lost, and the principal motion was also lost by a small majority. The meetings will therefore continue to be held in the evening.

The following Fellows were elected as officers and council for the coming year:—President, General J. F. Tennant; vice-presidents, Captain W. de W. Abney, Prof. J. C. Adams, Mr. J. W. L. Glaisher, and Mr. E. J. Stone; treasurer, Mr. A. A. Common; secretaries, Mr. A. M. W. Downing, Mr. E. B. Knobel; as foreign secretary, Dr. Wm. Huggins; as council, Sir R. S. Ball, Prof. A. Cayley, Mr. W. H. M. Christie, Hon. Sir James Cockle, Mr. Geo. Knott, Mr. Frank McClean, Mr. E. W. Maunder, Capt. Wm. Noble, Mr. W. E. Plummer, Mr. Isaac Roberts, Mr. E. J. Spitta, Mr. H. H. Turner.

## THE LANTERN SOCIETY.

ON Feb. 9 Mr. J. Traill Taylor read a paper on "Lenses and Condensers for Lantern Work." Mr. Taylor commenced by observing that in his remarks on condensers the light was assumed to be small and intense. At present there was no perfect condenser on the market, and the subject was one that might profitably be worked out further than it had yet been. Mr. E. M. Nelson was the only Englishman who had as yet tackled the subject. In America they had given much more attention to the matter. The back lens of a condenser should be fairly large to include as wide an angle as possible, and as thin as possible on account of the heat, the edges being ground thin for the same reason. The effective diameter of the back lens was considerably less than the diameter of the lens itself, and in the ordinary commercial condenser the margin of the lens to the extent of about ½in. inwards was not utilised. Mr. Taylor showed a drawing of a theoretically perfect condenser to transmit absolutely parallel rays from a small luminant. It was of triple form, and 5in. in diameter. He also described Prof. Morton's triple condenser, which included an angle of 93°, and he gave the curves for both these condensers. In a perfect lantern, the third lens of the condenser (the one farthest from the light) should be removable, and of different focal lengths. The first two lenses would be arranged to give parallel rays, which could then be converged more or less according to the purpose for which they were to be used by the third lens. With reference to lenses, Mr. Taylor said that the Petzval portrait lens was the best form, and explained how the features of field could be improved by increasing the negative aberration of the back lens.

In the discussion which followed, Mr. G. R. Baker referred to the focal lengths of lantern condensers, and Mr. E. M. Nelson mentioned Prof. Abbe's theorem that the intensity of the light at different distances from the condenser varied as the square of the sine of half the angle included.

THE following mixture for the cementing of iron is strongly recommended:—Equal parts of sulphur and white lead with about one-sixth proportion of borax are the constituents of the mixture, and the three should be thoroughly incorporated together so as to form one homogeneous mass. When the composition is to be applied it should be wetted with strong sulphuric acid, and a thin layer of it should be placed between the two pieces of iron to be connected, these being at once pressed together. This cement will hold so firmly as to resist the blows of a steam-hammer, and dry so completely in a few days as to leave no trace of the cement, the work then presenting the appearance of welding.

# SCIENTIFIC NEWS.

THE *Annuaire* of the Bureau des Longitudes de France for 1891 contains, besides the usual matter, several papers of interest to astronomers, and one by MM. Loewy and Schulhof, describing the comets that appeared in the first quarter of the century, and those of 1889, which completes the lists given in previous issues down to the end of last year: which now contain notes of all the known comets of the 19th century.

A supplementary volume to the *Annalen* of the Imperial Observatory of Vienna contains a comparison by Dr. Weiss of the stars in the Oeltzen-Argelander catalogue with those in the Cordoba catalogue and Schönfeld's Southern D.M. The places of more than 18,000 stars are given.

A course of four elementary lectures upon "The Sun" will be delivered in Gresham College, by the Rev. Edmund Ledger, M.A., F.R.A.S., at 6 p.m. on the evenings of February 24th, 25th, 26th, and 27th, 1891. Admission free. Lime-light illustrations.

The death is announced of Dr. Brittan, who, in conjunction with Dr. Swayne, in 1849, published the discovery of the "comma bacillus," and discussed the fungoid origin or character of cholera. Dr. J. Mortimer Granville, writing to the *Times*, says that only a few days ago Dr. Brittan placed in his hands the original papers proving his right to be considered the discoverer of the bacillus which is now known as Koch's comma bacillus. The question of the real discoverer was dealt with by Mr. F. Fowke, F.R.M.S., who, in 1885, published a paper and reproduced the drawings of Drs. Brittan and Swayne, side by side with those of Prof. Koch. Dr. Brittan, who had come to London partly for the purpose of vindicating his claim, died suddenly on Sunday last, of heart-disease.

"Bacteria, and their Products" is the title of a volume in the Contemporary Science Series, which is from the pen of Dr. Sims Woodhead, Director of the Laboratory of the Colleges of Surgeons and Physicians. The work is to be copiously illustrated, and will discuss the causes of hydrophobia, cholera, consumption, diphtheria, &c., and the discoveries of Prof. Koch.

It is stated that the institute on the model of the Institut Pasteur, which it is proposed to establish in this country, will be located at Cambridge.

At a recent meeting of the Linnean Society, Mr. T. Christy exhibited and described some specimens of honey from different parts. "Arbutus honey," from Turkey, is said to produce great drowsiness and sleep; "Eucalyptus honey," from Mount Barker, Adelaide, is said to possess valuable therapeutic properties; and "wool honey," from the Euphrates, which is really honeydew collected from the leaves of oaks, and is deposited by aphides. Mr. J. E. Hurting exhibited a living albino frog (R. temporaria), found in Wiltshire. Albinism is very rare amongst the Batrachia and Reptilia.

The "find" of natural gas at Haverton-hill, near Middlesbrough, has naturally created some excitement in the district, which will, however, probably subside as rapidly as the column of fire which disclosed the presence of gas. It appears that the gas was tapped at about 800ft., in a bore-hole which was being driven below the salt on purpose to ascertain what is beneath. Underneath the salt a blue limestone was found, and, boring through that, there was an uprush of gas, which caught alight from the flames of a stove on the surface, and continued to burn in a column of considerable height for about two hours, when the pressure of the water kept it down. It is intended to case in the well, pump out the water, and have the gas analysed, as there is some doubt whether it is not merely marsh-gas, which is often, if not always, found near salt-beds. There are many bore-holes in the district, and some have been carried much deeper than at Sweet Hill (the name of the spot), without anything more than "flashes" of natural gas. Some few years ago gas was obtained in considerable volume from a bore-hole in the district at a depth of 1,313ft., and an analysis was published, which gave marsh-gas 76·9, ethane 6·3, and nitrogen 16·8.

The alleged discovery of a method of photographing in colours must be looked upon with caution, for M. G. Lippmann, in the paper he presented to the Paris Academy of Sciences, does not claim for his method anything more than is expressed by the phrase, photography of colours. He has used a film sensitised with iodide or bromide of silver, and devoid of grain. Films of various materials have been tried by placing them in a hollow dark slide in such a way that mercury forms a reflecting surface at the back. The camera is placed in the vertical position. The exposure (about two hours) and other operations are performed in the usual way, and then the colours of the spectrum become visible. It is assumed that the incident light interferes with the light reflected from the mercury, and that silver is deposited at places of greatest luminosity, and that laminæ of silver formed at varying distances from the surface of the film give the appearance of the spectrum. It is much too early to form an opinion as to the merits of M. Lippmann's method, but there can be no question as to its interest from a scientific point of view. Details of the processes have not yet been published, but it is essential that the film used should be perfectly free from grain, and it is mentioned that so far the best results have been obtained with an iodised film of albumen.

At a recent meeting of the Institution of Civil Engineers, an important paper on electric mining machinery, by Messrs. L. B. and C. W. Atkinson, was read, in which the authors express the opinion that electricity will in future play an important part in mining, on account of the facility with which it can be taken to the place where the power is required, and because of the economy with which it can be applied compared with compressed air or other means of transmitting power. The authors, who have had several years' experience, described methods which they consider sufficient to obviate risks from inflammable gases. The paper, when issued *in extenso*, will give an impetus to the increasing use of electricity in mines.

It is stated that three of the girls' homes in connection with Mr. Spurgeon's Orphanage at Stockwell "have been rendered uninhabitable owing to the vibration of the South London Electric Railway."

Mr. W. H. Massey reports that the fire at the Cardiff mayoral banquet was caused by one of the electric collar-holders becoming overheated by an arc at the inside terminals, which set fire to paper decorations improperly placed near the fittings.

In a paper read before the New York Electric Club Mr. F. L. Pope stated that experience had shown that the cost of all electric systems of traction was much greater than had been anticipated, the item "repairs" in connection with motor and gearing being larger than was estimated. The electric storage system is stated to be twice as expensive as the overhead system of distributing the current. In concluding, he predicted that within twenty years, if not within ten, there would be a network of underground electrical "solid trains" carrying passengers from the centre of New York to any place within a radius of ten miles in 15 minutes, at a cost of five cents to the passenger. These tunnels will probably be 100ft. below the surface. The objection to the overhead wires in cities will probably help on the proposal to make the tunnels.

The "draft resolutions" are to be submitted to the Electrical Standards Committee to-day (Friday). The C.G.S. system has been adopted in the resolutions; whether it will remain when the units are finally settled may possibly be doubted.

It is stated that there are now 100,000 incandescent lamps of 8-candle-power, and 3,000 arc lamps in Berlin.

It is proposed to transmit 300 horse-power by means of electricity between Lauffen and Frankfort. The potential is said to be 20,000 volts, and preliminary experiments are in progress at the Oerlikon Engineering Works.

It is intended to commemorate the end of the first and beginning of the second century of the Patent system of the United States by holding a celebration in Washington in April next. Mr. J. E. Watkins, U.S. National Museum, Washington, is secretary to the executive committee.

IT has been decided to begin the construction of the great Siberian Railway this year, by laying down a few versts at the further end from Vladivostock.

# LETTERS TO THE EDITOR.

*[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]*

*All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

*All Cheques and Post-office Orders to be made payable to* J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

## A NEW THEORY OF JUPITER AND SATURN — DISCUSSION OF THE TRANSITS OF VENUS, 1761 AND 1769 —GORE'S CATALOGUE OF BINARY STARS—THE GREENWICH ASTRONOMICAL, SPECTROSCOPICAL, AND PHOTOGRAPHIC RESULTS — THE AVERAGE OBSERVER — GEODESY—LIGHTING THE FIELD OF A TELESCOPE — COLD ROOM — ANCIENT LIGHTS—ENGRAVINGS OF BIELA'S COMET—DIFFRACTION—AN INTRA-MERCURIAL PLANET (?) — OBJECT-GLASS—POLARIS—MOON'S PERIGEE.

[32085.]—The Bureau of Equipment of the Navy Department at Washington has just issued two volumes of very great interest and importance, belonging to the series of "Astronomical Papers prepared for the use of the American Ephemeris and *Nautical Almanac.*" The first, which forms Vol. IV. of that series, is entitled "A New Theory of Jupiter and Saturn," and is the production of that very eminent mathematician, Mr. G. W. Hill, to whom the gold medal of the Royal Astronomical Society was awarded in the year 1887. I do not propose to myself the utterly impossible task of popularising here the contents of this remarkable book. It may suffice to remind the beginner that by "a planetary theory" is meant the deduction of the motion of a planet from the theory of gravitation, and to further call to his recollection the curious action and interaction of the two giant planets Jupiter and Saturn on each other, resulting in what is known as their "long inequality"; concerning which Sir George Airy says, in his "Gravitation," that "the calculations necessary to discover the effect of it are probably the most complicated that physical science has ever required." Any good textbook will supply the information that the mutual disturbance of the orbits of these two planets has its origin in the commensurability of a considerable number of their revolutions, seventy-seven of Jupiter's being practically equal to thirty-one of Saturn's. Not only, however, does this form a necessarily prominent feature in Mr. Hill's most masterly treatment of the problem, but the perturbations due to the action of Uranus, Neptune, and the inner planets are all taken into account and calculated, involving, by the way, a change in the accepted masses of Mercury, Venus, the Earth, and Uranus, and an increase of that of Saturn himself. Doubtless Mr. Hill's invaluable labours will speedily be utilised in the computation of ephemerides—at all events, in the country in which they were performed.

The second of the works of which I am speaking forms the fifth part of Vol. II. of the "Astronomical Papers," and is by the honoured director of the American *Nautical Almanac*, Prof. Simon Newcomb, himself. Though rigidly mathematical in its treatment, it addresses, if I may so speak, a somewhat larger public than Mr. Hill's splendid work, consisting as it does of the "Discussion of Observations of the Transits of Venus in 1761 and 1769." It will, of course, be remembered by everyone who is likely to read these lines that in 1822, 23, and 24 Encke discussed these identical observations with great care and diligence, finally deducing from them 8·5776″ as the Solar Parallax. The ·0006″ is imposing—in every sense of the word. The resulting mean distance of the earth from the sun—upwards of 95,000,000 miles—appears in every work on astronomy published for 30 years or more after Encke's results appeared. In 1854, though, Hansen found, from certain motions of the moon, that Encke's parallax must be too small, and fixed it at 8·92″. Subsequently to this, by the employment of two totally different methods, Le Verrier and Foucault deduced values of 8·95″ and 8·86″ respectively. And next—and this is of especial importance in connection with Prof. Newcomb's work—the question was taken up by Mr. E. J. Stone, the Radcliffe Observer at Oxford, who rediscussed the Transit of Venus Observations previously dealt with by Encke, with the very startling result that, instead of their furnishing a parallax of 8·5776″, he obtained one of 8·943″! It should, however, be explained that he arrived at this result by a somewhat different interpretation of the phenomena recorded by the observers as "contacts" to that adopted by Encke. After this, up to the year 1882, a parallax of 8·95″ was adopted in our own *Nautical Almanac.* This was subsequently replaced by 8·848″, a value deduced by Newcomb from all the data available. But now Prof. Newcomb has, as I have said, followed Encke and Stone in an entirely independent discussion of the Transits of Venus of 1761 and 1769, and as he in turn puts *his* interpretation upon what constitutes a "contact," external or internal, of the planet with the sun's limb, he arrives at yet a different result from that of each of his predecessors, his final determination of the parallax being 8·79″, with a probable error of ± ·034″. In connection with this it is noteworthy that Gill, from his observations of Mars at Ascension in 1877, deduced a parallax of 8·78″, and that combining the results of Michelson's and Newcomb's superb measurements of the velocity of light with Nyren's constant of aberration, the solar parallax comes out 8·794″. This all seems to point to the fact that our accepted official parallax is slightly too large, and that we may regard it as 8·80″ with but small chance of error. In conclusion, I may say that, having gone through Prof. Newcomb's fine volume, I do not quite see *how* he comes to differ so materially from Encke in his final result.

In paragraph 15 of letter 32040 (p. 505), I spoke of the contempt with which some of our leading official astronomers (I might have added chiefly since the death of the late Admiral Smyth) have regarded, or professed to regard, the observation and measurement of double stars. Opportunely enough, that well-known observer, Mr. J. E. Gore, F.R.A.S., has just issued, as a reprint from the *Proceedings* of the Royal Irish Academy, "A Catalogue of Binary Stars for which Orbits have been Computed: with Notes," which is well calculated to revive an interest in these remote systems, and to show how really important their study is to the gravitational astronomer. Mr. Gore's notes discussing the discrepancies between various calculated orbits and the results of observation, giving details of proper motions, descriptions of stellar spectra, &c., are very valuable indeed; and I can only wish his excellent pamphlet a very wide circulation.

The Greenwich "Astronomical Results" for 1888, and the "Spectroscopic and Photographic Results" for 1888 and 1889, contain, as usual, much that is instructive and interesting to the astronomer. The wonderfully elaborate precautions adopted to detect and eliminate error cannot fail to strike the student and incipient astronomer. Obviously the phrase "That'll do!" is as utterly banished from the Greenwich vocabulary as was ever the word "impossible" from that of the First Napoleon. Studying such a volume as that lying before me, it is not difficult to arrive at the source of the world-wide reputation enjoyed by, and confidence placed in, the work performed at our Royal Observatory. Among things which will strike the attentive reader are the curious details on page cxxxviii. in connection with the "correction to the assumed co-latitude 38° 31′ 21·90″ from observations in the year 1888"—a correction amounting to + 0·179. In 1887 this was + 0·083; in 1886, + 0·134″; in 1885, + 0·128″; but in 1884 only + 0·004″. At first sight this looks as though the latitude of Greenwich really had diminished since 1884, but it seems more probable that this apparent increase in the co-latitude must have its origin either in the instrument employed or in some undetected error in the method of observation. The Spectroscopic results will be found interesting by all students of the physical structure of the stellar universe; but I am bound to admit that the discrepancies in the results of some of the measures of the rates of motion of stars in the line of sight are pretty startling. Everyone, though, in the smallest degree familiar with stellar spectroscopy knows how extremely difficult it is to compare the spectrum of even a tolerably bright star with that of the substance by the seeming displacement of whose lines its motion is to be measured. Certainly the Greenwich observations form a monument of patience and painstaking. The observations of the positions and areas of spots and faculæ on the sun's disc will possess more interest when a series of years' observations are co-ordinated and discussed as a whole. The various observations indicating corrections to be applied to predicted places in the *Nautical Almanac* call for no special remark.

There is one lesson to be learned from Mr. Blackburn's very interesting letter (32063) on p. 509 which may be well laid to heart by all (and they are legion) who think that conscientious evidence must of necessity be true. It is: that bona fides alone affords no guarantee whatever that a witness is speaking the truth (in the sense of narrating actual objective facts), and that when we are called upon to accept any marvellous tale as gospel, simply because it is vouched for by an honourable, candid, and disinterested person, we may be leaning upon a very broken reed indeed. Everyone accustomed to listen to and sift evidence learns after a time to pick out, as it were, by intuition, the point, or points, upon which otherwise conflicting witnesses are in agreement, and to decide what cannot be true that is discrepant. What sane man has the very slightest faith in the pseudo-miracles at Lourdes; and yet, who can doubt that some of the testimony to them was as honest as that upon which many and many a man has been hanged?

Looking through "Replies to Queries" on p. 510, I note that one (73353) headed "Expansion in Series" contains some geodesical formula. Without hunting back to see to what the original question had reference, I may say that, adopting Colonel Clarke's spheroid as notably more accurate than Bessel's $\frac{a-b}{a} = \frac{1}{293{\cdot}4663}$ of which the log. is $\bar{3}{\cdot}5324418$. Moreover, any one who is content to find the length of a degree of latitude in feet (instead of mètres) in any given latitude $\phi$ may do so by the formula: $364609{\cdot}12 - 1866{\cdot}72 \cos. 2\phi + 3{\cdot}98 \cos. 4\phi$; or that of a degree of longitude by this: $365542{\cdot}52 \cos. \phi - 311{\cdot}80 \cos. 3\phi + 0{\cdot}40 \cos. 5\phi$. Clarke's "Geodesy" in the Clarendon Press series will be found invaluable, while every one engaged in geodetical calculations should send sixpence to General de Lisle, R.E., of Ipplepen, Newton Abbot, for his indispensable tables, computed from Clarke's spheroid.

And, again, in the case of reply 73374, which, like everything that Colonel Markwick writes, is full of instruction for the beginner, I would just say that a tiny disc of writing-paper of the size of the section of a split pea, or a little bit of tin of corresponding dimensions, fastened to a very thin wire bent at an angle of 45°, and placed in front of the object-glass, if lighted from the side in the way described by Colonel M., will illuminate the field of a telescope as brightly as is ever necessary. I used this method when determining the value in arc of the scale of a micrometer fitted to a terrestrial telescope of mine, by transits of circumpolar stars, and it answered capitally. The tiny bit of tin or paper cuts off no appreciable area of the objective whatever. This is the way that transit instruments used to be lighted up before the diagonal reflector and perforated axis were devised.

"Frigid" (query 73668, p. 515), is, I think, quite mistaken as to the cause of his bedroom being cold. Air is a very bad conductor of heat indeed, and if he got close to his slated roof he would find the heat in summer and the cold in winter would be materially aggravated.

"Niobe's" solicitor (query 73671, p. 515) will tell him that twenty years' uninterrupted enjoyment of the light from a window gives an absolute right to it, and constitutes an "ancient light." No one may build near enough to block out or diminish in any way the amount of light he has enjoyed for that period; but, subject to leaving that intact, the freeholder of the waste can build as close as he likes to "Niobe's" premises. Were your correspondent to live to be the age of Methuselah he would never acquire an easement over open land belonging to somebody else.

I can now tell Mr. Hendry (letter 32022, p. 484) that I find that Proctor's "Mysteries of Time and Space" is not in the library of the Royal Astronomical Society at all; but, of course, Guillemin's "World of Comets" is, and, having consulted that work, I can definitely inform my querist that Guillemin's engravings perfectly represent the objects whose names are appended to them. Hence, if Proctor reproduced Fig. 32 from p. 217 of Guillemin's book as a representation of Biela's Comet after division, he did so quite erroneously. Mr. Hendry may see this for himself by studying the reproduction of Struve's original drawing of the duplicate comet, which appears on p. 408 of Vol. I. of the latest edition of Chambers's "Handbook of Astronomy."

And I can also give a rather more definite reply to "F. P." (query 73558, p. 471) now, though I am bound to say that, having looked through Glazebrook's demonstration, I cannot compliment him upon his clearness of exposition. The value of S is correct enough. The long expression is to be multiplied by the shorter one following it; $vt$ does not of necessity signify the line PF, though it may do so; $v$ stands for the velocity of the wave; $t$ for the time from a fixed epoch; but it does not follow that this is when the wave was at P. Apparently $\frac{\lambda}{\sin.\,\theta}$ at the bottom of p. 61 should be $\frac{\lambda}{2 \sin.\,\theta}$.

I am afraid that Mr. Bagster (letter 32066, page 526) will have to try again. Taking his own account of his observation, he, on February 5th, saw "a perfectly round black spot upon" the sun, "approximately $\frac{1}{32}$nd of the apparent diameter" of it; and this he asks us to believe was Vulcan. Very well. On February 5th the sun's diameter was 32′ 30·4″, of which $\frac{1}{32}$nd is, as nearly as may be, 1′ 1″. Adopting Radau's elements of Vulcan, that intra-Mercurial "Mrs. Harris" must have been 80,991,000 miles from us on February 5th; whence, by some very elementary trigonometry indeed, Mr. Bagster may gather that it must really have a diameter of 23,952 miles! To say nothing of the obtrusive visibility of such a gigantic globe in the sky, I wonder what would become of unfortunate Mercury with so near a neighbour of these dimensions? Should this meet the eye of Mr. Maunder, perhaps he can tell us whether there was a spot on the sun on the 5th instant? I once thought myself that I had caught a planet *in transitu* over the sun's disc (but mine was only a wretched affair of some 3″ or 4″ in diameter); but on putting on the highest power that my telescope would bear, I soon found that I had merely picked up a sunspot of curiously circular outline, and without any perceptible penumbra.

The object-glass of which "G. R." speaks in query 73713 (on p. 535) is pretty obviously not aplanatic, being afflicted, more or less, with both spherical and chromatic aberration. The weather cannot *always* be bad when he looks at Rigel and Sirius; but why not try if he cannot see the diffraction rings round some smaller stars?

"B. C." (query 73735, p. 536) will find that Polaris is always due north (at Vancouver Island, or anywhere else) whenever it is on the meridian, either above or below the Pole. If, however—as seems just possible—he wishes to know how far the Pole Star is from the pole of the heavens, it is 1° 16′ 23″ from that point alike at Vancouver and in Venice.

No, indeed, I can *not* tell "Karl" (query 73750, p. 536) how to find the moon's perigee. The subject of the moon's orbit is one of the highest complication. That orbit is not even a re-entering curve. The correct times of lunar perigee for some of the days to which he refers are—April 7th, 10h. a.m.; May 5th, 9h. a.m.; May 31st, 9h. p.m. The perigee, the nodes, the syzygies—everything in the lunar orbit—is perpetually shifting. Perhaps Proctor's "Moon" would give my querist as good a popular elementary notion of this most intricate subject as any work likely to be accessible.

**A Fellow of the Royal Astronomical Society.**

### THE NEW VARIABLE STAR IN AURIGA, AND A NEW RED STAR IN GEMINI.

[32086.]—MR. PACKER (letter 32064, p. 516) has himself fallen into error in attempting to correct Circular No. 29. There is no assertion that the red star is a *nova*. On the contrary, there is little doubt that it is the missing star Birm. I. No. 23. An account of the search for the star is given on p. 166 of the new edition of the Red Stars, where I have suggested that D.M. + 31·1049° is probably Burton's star as mentioned by Birmingham. D.M. + 31·1058°, with which it is identified by Birmingham, is only yellowish. The new variable, if variable it be, precedes D.M. + 31·1058° by some seven seconds, and is about 8′ north of it. In passing, I may state that no circular is issued unless two nights' observations, at least, have been made of the object, whatever it may be. In the present instance, five determinations of the star's place in R.A. and four in Declination were made with the circles of the equatorial. These, however, only read to give seconds in R.A. and one minute of arc. Mr. Lloyd Knott in a letter to me places the star some three seconds *p.* the place given in circular No. 29, while the declination, as far as I can remember—for I have mislaid the letter—is about the same. Observations on the 9th and 12th made here make the star somewhat brighter than on the night it was first detected. As regards the finely-coloured star D.M. + 31·1049°, it is given in the list of Ruddy Stars in the new edition of the Red Stars, and is No. 104 (p. 169). It was first observed 1886, Sept. 30, and observations of it published in Publication No. 1 of this Observatory in the spring of 1887, and is No. 137 of Chambers' "Catalogue of Red Stars" (*Monthly Notices*, Vol. XLVII. No. 6).

A fine red star, mag. 8·2, was detected here last night, Feb. 12. It is apparently: D.M. + 31·1388°, VIh. 32m. 46sec. + 31·35°, mag. 8·1.

The star has a well developed fourth-type spectrum.

**T. E. Espin.**

Tow Law, Darlington, Feb. 13, 1891.

[32087.]—MR. PACKER (letter 32064) is seriously in error in his identification of Mr. Espin's red star of Circular No. 29 of the Wolsingham Observatory with the fine coloured 6·6 mag. star D.M. + 31·1049°. Espin's star *follows* D.M. + 31·1049° by 1m. 26s., and is 7·5′ to the *north* of it. Mr. Packer is also mistaken in his statement that the star D.M. + 31·1049° is "not recorded in any red-star catalogue at present." He will find it duly entered on p. 169 of Mr. Espin's new edition of Birmingham's Red Star Catalogue, and a further reference to it on p. 166 of the same volume. Mr. Espin's discovery has an especial interest as clearing up a difficulty in regard to a red star observed by Burton, and identified by Birmingham (Red Star Catalogue, p. 343) with D.M. + 31·1058°, which *follows* Espin's star by 5s., and is about 10′ to the *south* of it. On February 4 I took some differential observations of Espin's star with D.M. + 31·1049° and 1058, and found its place for 1855·0 to be R.A. 5h. 32m. 42s. Decl. North 31° 57·5.′ The star is *not* in the D.M.

**George Knott.**

Knowles Lodge, Cuckfield, February 14.

### AN INTRA-MERCURIAL PLANET.

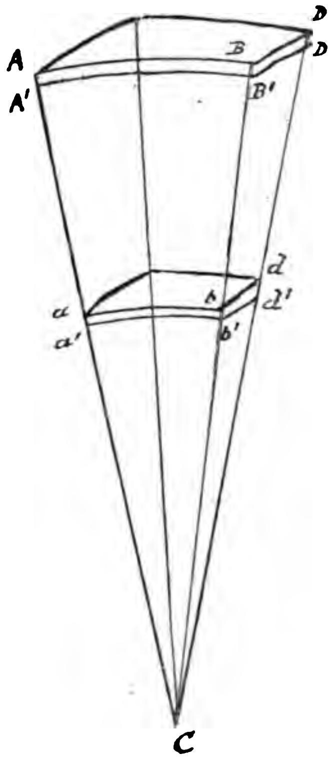
[32088.]—WHILE the object observed by Mr. Bagster on the 5th inst. could not have been the Vulcan of M. Lescarbault, I think it is not less likely to have been a planet on that account. In fact, on examining the facts recorded by Mr. Webb, I think there is more evidence of the transit of an unknown planet in February than in March. Four of the observations which he records were made on the 12th of February, the years being 1820, 1821, 1857, and 1864. On no other day in the year is more than one such appearance recorded. Fritsch made a similar observation on February 7th, 1802. And it is not improbable that an observation by Russell and others on the 29th January, 1860, may refer to the same planet. There are fewer appearances in August, but they are not altogether wanting. On the whole, I think Lescarbault's observation has had the effect of setting observers to watch the sun at the wrong date, and that they will have a much better chance of picking up the intra-Mercurial planet (if there is one) by watching the sun in February and August. I hope someone else observed the sun at the same time with Mr. Bagster.

**W. H. S. Monck.**

16, Earlsfort-terrace, Dublin, Feb. 13.

### TEMPERATURE OF THE MOON.

[32089.]—ACCORDING to the last memoir issued by Prof. Langley, the temperature of the sunlit lunar surface is not so low as Mr. Peal seems to imagine. Prof. Langley thinks that his bolometer measures may be relied on as showing that the temperature in the neighbourhood of the lunar equator rises during the long lunar day to a little above freezing. In the paper referred to by Mr. Peal, I endeavoured to show that the lunar glaciers would descend more slowly than terrestrial glaciers, owing to the weaker action of lunar gravity, so that, assuming a similar slope and a similar temperature, the lunar snows would need to be piled six times as high as on a terrestrial mountain before they would be consolidated into ice, and give rise to a pressure which would cause their icy foundations to commence to slip slowly down the mountain side by the process of regelation described by Prof. Tyndall. I concur with Mr. Peal in thinking that the average lunar temperature is probably below the average temperature at the summit of any terrestrial mountain; but this will only add to the accumulation of snow on the mountain summits by causing the glaciers to slip down more slowly. We shall probably arrive at an approximation to lunar conditions if we consider what would take place at the summit of a terrestrial mountain 35 miles high if terrestrial gravity were reduced to $\frac{1}{6}$th of gravity at the sea-level. Our highest mountains do not continually grow by reason of the snow that is deposited upon them, although the snowfall on a mountain top is much greater than at the sea-level. Thus 12ft. of snow fell last winter at the Lick Observatory on Mount Hamilton, which is only 4,200ft. high, but it was all gone by March, for the direct heat of solar radiation is greater on a mountain summit, and the winds sweeping past bring a greater volume of air to absorb the moisture than at lower levels. There is no reason to suppose that the heat derived from direct solar radiation is any less at the moon's surface than at the earth's; indeed, it must be greater, owing to the difference of absorption in the lunar and terrestrial atmospheres.



"F.R.A.S." will no doubt concur with me that his observation quoted by Mr. Peal of the occultation of a planet without any perceptible distortion of its details, does *not* prove that there is no lunar atmosphere. A deviation of the ray through one second of arc corresponding to a horizontal refraction at the moon's limb of half a second would not perceptibly distort any visible details. We now know that if there were such a deviation of the rays grazing the lunar limb, there would be a deviation of half the amount for rays traversing the lunar atmosphere at a height of 21 miles—that is, at an apparent distance of about 20 seconds from the moon's limb.

"Ja. Ha.," I think, did not understand the proof I gave that the increase of volume of concentric spherical shells of similar thickness corresponds to the decrease of gravity towards a heavy body at their centre. Perhaps the following diagram will make it clearer.

If A B D and *a b d* be two sections of spherical surfaces cut off by four planes passing through the centre C, the area A B D will be to the area *a b d* as the square of their radii, and the volume of thin strata of equal thickness will be in the same proportion; that is, as A C² to *a* C², which is in inverse proportion to the force of gravity towards the centre C. Therefore, if the upper stratum were of the same density as the lower stratum, its weight towards the centre C would be equal to the weight of the lower stratum towards the same centre. If the density of the upper stratum were one-half of the density of the lower stratum, its weight would only be one-half of the weight of the lower stratum. In the case of an atmosphere, it is evident that all the strata vertically above *a b d*, rest upon and tend to compress it.

**A. Cowper Ranyard.**

### THE LIMITATION OF ATMOSPHERES.

[32090.]—MAY I be allowed to point out a further development of my theory, which will be found to be at once startling and suggestive? I think that I can make out a *primâ facie* case against the sun for stripping the earth of its free hydrogen, but must first offer a few remarks on the theories of the limitation of the earth's atmosphere and the diffusion of gases.

I freely admit the reasonableness of the theory that there must be a point where the elastic force and the gravity of the atmospheric particles must balance, although I do not feel called upon to admit that any one of the guesses as to the height at which the balance takes place is worthy of credence. I also recognise the fact that all gases which do not act chemically upon each other at common temperatures become unformly mixed, no matter what their respective gravities may be. If the upper half of a long tube be filled with hydrogen, and the lower half be filled with a heavier gas, the two gases will, after a short time, be found to be thoroughly mixed, or inter-diffused. We are also taught that this law affecting the constitution of gaseous bodies is the principal means by which the atmosphere is preserved in a uniform state, and the accumulation of locally-generated gases and exhalations is prevented. To all this I have no objection to offer as regards the state of affairs at the surface of the earth; but I shall now proceed to show that a different law must hold good in the outlying regions of the atmosphere.

All experiments on the diffusion of gases have been made in our laboratories, and atmospheric observations reach no higher than the mountain peaks, where the balancing point between the gravity of the molecules and the elastic force which keeps them apart has not been reached. We know nothing of the absolute gravities of the molecules of different gases, although for the purposes of argument we may assume that they are proportionate to their recognised atomic weights. It should follow that the various gaseous constituents of the atmosphere must reach their limits of expansibility at different heights in the atmosphere, above which the heavier gases will become incapable of diffusion into the lighter superincumbent gases. The lowermost stratum of the atmosphere may therefore be supposed to consist of a diffused mixture of carbon dioxide, oxygen, and nitrogen; the next stratum will consist of diffused oxygen and nitrogen, and above this there will be a stratum of nitrogen alone. I say nothing at present about aqueous vapour, because it is not a perfect gas, and its diffusion depends on many conditions to which permanent gases are not amenable. The weight of the molecules of aqueous vapour, however, is greater than that of an atom of oxygen, so that the range of the vapour may be presumed to be lower than that of oxygen.

The law of the diffusion of gases in the upper regions of the atmosphere should therefore be modified. The lighter gases should be capable of being diffused downwards, while the heavier gases cannot be diffused upwards beyond the limits of their expansibility.

If hydrogen were a constituent of the earth's atmosphere, it might be expected to be diffused downwards through all the lower strata, as well as to form an additional stratum to a height enormously above that of the nitrogen, so that it might have no limit within the sphere of the earth's attraction, in which case it would pass into the sphere of the sun's gravity.

The spectroscope tells us that hydrogen is the most prevalent of the elements throughout the universe; and yet there is no hydrogen, except as an ingredient of aqueous vapour, in the earth's atmosphere. The sun, on the other hand, has an immense upper atmosphere of free hydrogen—a proof, to my mind, of the limitation of the law of diffusion to which I have referred. The existence of this solar atmosphere of hydrogen, taken in connection with the other considerations set forth, may, be regarded as so much *primâ-facie* evidence that the sun has appropriated the whole of the hydrogen in the Solar system within the orbit of the earth, and possibly much more, if not the whole within the orbits of the superior planets.

The same theory will partly account for the comparative scarcity of oxygen in the sun. The molecules of oxygen being heavy, the earth's atmosphere of oxygen has a limit within the sphere of the earth's attraction, so that the sun cannot despoil the earth of its oxygen. The molecules of nitrogen are not much lighter than those of oxygen, and are also in all likelihood retained by the earth. The atmospheres of the other planets, with the probable exception of Mercury and the possible exception of Venus, may be supposed to be protected to the same extent in a like manner.

In offering these suppositions and the arguments founded upon them for investigation and consideration, I am fully aware that the views which I have submitted are incapable of being fully demonstrated. I feel satisfied, however, that further research will serve to strengthen the position which I have taken up. On some matters of detail, too, I foresee that I may have occasion to modify my own opinions.

I have said that this development of my theory should prove suggestive. Perhaps those who are engaged in researches about the ether will take the hint. The spectroscope reveals the existence of elements in the sun of which we know nothing on earth. If these be gaseous, and of small molecular weight, it is not surprising that the earth is without them. Should any of them be lighter than hydrogen, they may be found anywhere in the sun's atmosphere, as well as in a layer outside the atmosphere of hydrogen. It would also be curious to inquire where the meteoric stones which reach the earth get their occluded hydrogen. These are matters, however, with which I do not at present propose to interest myself.

**Ja. Ha.**

## THE PNEUMATIC CLOCKS OF PARIS.

[32091.] — YOUR correspondent, C. P. Mason (32057), was evidently very much interested with these clocks, and I have no doubt that it will interest him and many readers to know that these clocks are by no means recent innovations.

The city of Paris possesses one of the finest installations of air-compressing plant of any city in the world, and to the general public it will no doubt be interesting to know something about it.

In New York, that city is supplied with high-pressure steam by the New York Steam Company, for motive power, heating, and cooking operations, and in London we have the London and Westminster Hydraulic Power Company that supply water for motive power at very high pressure. In the above cities gas-engines are used; but in the city of Paris, gas-engines work to a very great disadvantage in consequence of the high price of gas, over 6s. per 1,000 cubic feet. The distribution of compressed air for motive power purposes and other uses has been attended with the greatest success in Paris.

At St. Fargeau is situated the central pumping station. At this station the air is compressed and distributed to the city through the mains, which are carried through the sewers of the city.

These sewers are second only to the sewers of ancient Rome, being a remarkable piece of engineering work. I had the pleasure of inspecting them when I was in Paris in 1889, descending into them at the Madeleine and passing through to the Boulevard Sevastopol. The Compressed Air Company supply air to work a motor of $\frac{1}{8}$ up to 30H.P. This form of applying power possesses the advantage of a handy, safe, and clean power, giving very little trouble. You have only to turn on the air, and the motor starts work.

It is a great pleasure for me to record the fact that the boilers, compound condensing steam-engines, with air compressers, at the central station are the work of an English firm, and the working of this plant has given the greatest satisfaction. The company supply air for motors from $\frac{1}{8}$H.P. up to, I believe, 30H.P. These motors are used for working sewing machines, and a variety of purposes that light powers are required, &c., and for the Pneumatic Clock System of Paris. The French scientific paper, *La Nature*, gave a very interesting description of these clocks, from which the *Scientific American* of the 10th July, 1880, gives some interesting extracts—viz., that the entire mechanism of a pneumatic clock system, as in use at present at Paris, consists of three distinct parts—the central clock, the receiving clocks, and the tubes for conveying compressed air to the several receiving clocks. At the central station air is compressed to a pressure of about five atmospheres by means of a double-piston compresser, and is stored in a large tank of about 25 cubic feet capacity. From this main reservoir the compressed air is conducted into a second reservoir, in which its pressure is regulated at seven-tenths of an atmosphere by means of a simple automatic contrivance. Every minute this distributing reservoir is placed in communication with the distributing tubes by means of a distributing clock. The central station is provided with duplicate apparatus, so that if one distributing clock is out of order or disturbed in any way, the other can be set in operation in a few seconds.

The mains are made of wrought iron, are about $1\frac{1}{10}$in. in diameter, and are connected with lead tubes $\frac{3}{8}$in. in diameter, for conveying the air into the houses. The tubes leading to the several stories are $\frac{1}{4}$in. in diameter, and are connected with lead or rubber tubes $\frac{1}{8}$in. in diameter, communicating with the several clocks, and preferably coloured the same as the wall-paper or woodwork of the room, so as not to be easily perceptible. With the pressure of seven-tenths of an atmosphere, and permitting the compressed air to pass through the tubes for twenty seconds, any number of clocks can be operated at a distance of one or two miles from the central station.

The mechanism of the receiving clocks is alike in all cases, and is entirely independent of the size of the dial or the location of the clock. A small bellows, resembling that used in pneumatic call bells, is in communication with the tubes conducting the air from the central office every minute the pressure of the air raises the bellows, and a rod attached to the upper bellows head actuates a lever that engages with a wheel provided with 60 teeth, which is rigidly secured to the minute-hand arbor. The wheel rotates the distance of one tooth every minute, and a weighted pawl on the other side of the dial checks the movement. The hour-hand is rotated by means of the usual dial wheels. By means of a second bellows the clocks may be arranged to strike. Many of the principal hotels, railway stations, public offices, courts, &c., of Paris, are provided with the pneumatic clock, and public pillar or street clocks, which are illuminated at night, have been erected in several parts of the city.

I have no doubt that C. P. Mason noticed these illuminated clocks in the streets of Paris, three-dialled ones; if so, he would observe the inscription, "Système Popp" on the dials. M. Victor Popp is the inventor of this system of working clocks. Visitors to the Paris Exhibition 1889, interested in mechanism, could not well have missed this interesting exhibit of the motors, "Popp System," in the machinery hall.

London, S.E., Feb. 10. **J. Dickinson.**

## IMPROVEMENTS IN BATTERY PLATES.

[32092.]—MANY attempts have from time to time been made to improve the negative plates of batteries in some similar way as we improve the positive or zinc plate by amalgamation.

The efficiency of the platinum plate of the Grove, and the silver plate of the Smee, is much improved by platinisation, and so is the carbon plate of the Bunsen and bichromate. These are, however, expensive improvements, especially at the present high price of that metal. Could not some other substances yield the same results if they coated the carbon, or were chemically deposited on it? The gas-absorbing property of carbon is of the highest degree. Suppose we could imbue it with carbonic oxide or carbonic-acid gas—would it not thereby be converted into a good depolariser? Is there not a possibility of coating a carbon with an oxide of some sort, or with some easily de-oxidising substance? There is a problem for chemists to solve, or, at least, to attempt solving.

The Messrs. Schroeder, of Tooting, I believe have been for some time engaged in trying to improve the efficiency of carbon plates. By what process I do not know; but I have had some plates of theirs which gave remarkably good results; for example, six plates, 7 by 4, clamped with vulcanite slips between them, to three zinc plates of same [size, and plunged into three cells of bichromate solution in series, would render incandescent the blunt ends of carbon rods $\frac{3}{8}$in. thick, and instantly melt $\frac{1}{2}$in. No. 20 platinum wire, and these cells remained very fairly constant for more than one hour.

**A. Caplatzi.**

## FRESH PROGRESS IN COLOUR PHOTOGRAPHY.

[32093.]—ON February the 2nd Monsieur Lippmann presented to the French Academy of Science photographic negatives showing that he had succeeded in fixing all the primary colours of the spectrum. At the announcement of the fact the members clustered round the Tribune anxious to examine the proofs of so remarkable a feat; and there they were, exposed in plain daylight—not shrouded in darkness, as all those previously obtained had to be. Monsieur Lippmann, operating with perfectly homogeneous films, lays them on a surface of bright mercury; their extreme tenuity allows the rays that traverse them to be reflected, whereby they become in some mysterious manner fixed. This fixing he inclines to regard as a phenomenon of interference. Should nothing supervene to upset this remarkable achievement, the genius of man may be congratulated over the new secret it has wrung from a concealment-loving Nature. What new fields of industry and fortune it will open up for photography!

**A. Caplatzi.**

## FROZEN WATER-PIPES.

[32094.]—AN article appeared in No. 1350 relative to the above, being an extract from the *Lancet*, reminding people of the danger of frozen water-pipes, in which I fail to see any practicable recommendation. I have a very simple and inexpensive application attached to my water-supply pipes that entirely prevents all risk and anxiety; it is also applied to my sons' houses, which vary in construction. I mention this to show that it is no peculiarity in my house that insures its action. In all houses in this district, and I suppose it will be the same in other parts of the country, the cold-water pipe from the cistern in the upper part of the house down to the boiler, and the exhaust or hot-water pipe from the boiler run together, the hot water-pipe passing the cistern and going out on to the roof of the house. From the latter pipe as it passes near the bottom of the cistern a short pipe is inserted, which goes into the cistern near the bottom, the hot water will now circulate up one pipe, through the cistern, and down the other to the boiler. I have had this simple application in operation some years, and have had no frozen pipes, however low the thermometer has gone. I find a $\frac{1}{2}$in. pipe quite sufficient between the exhaust pipe and the cistern, unless the cistern is unusually far removed from the boiler. It is desirable to have a plain freeway tap in the pipe passing between the exhaust pipe and the cistern to close in open winter weather; it is better to have a key tap, so that the key may be removed during the summer months. I may appear to have been unnecessarily prolix in describing so simple a matter; but I have found in showing it to my friends they have had great difficulty in understanding its operation, which is precisely the same as the circulation in any hot-water pipes for heating hot houses, &c. In building all new houses this circulating pipe should be inserted in the contract, as the difference in cost would then be inappreciable.

**Wm. Grimshaw.**

The Cedars, Sunderland.

## LATHE MATTERS.

[32095.]—IN letter 32054 F. Carre, in speaking of an attachment for serrating circular cutters, mentions that when the guide is the same shape as the cutter-blank tobe cut, the tracer should be the same diameter as the cutter used to serrate the blank. This is not quite the case. The tracer should be the diameter of the cutter used, less double the depth of serrations, for this reason: suppose the tracer to be a gear-wheel turned down to the pitch-line, then it would roll on the pitch-line of the gear it was mated with, which in this case is the template. Suppose the cutter to be the same diameter as the tracer, then it would roll on the blank required to be cut. But we require it to cut out a certain depth of material in the blank to form teeth; then we must increase the diameter of the cutter used to double the depth of serration required. Of course this is beginning at the wrong end, for in practice the size of the cutter used would be determined by the radius of the curves in the blank to be cut. The radius of the cutter should not exceed the radius of the smallest internal curve on the blank plus the depth of serration, otherwise the cutter could not pass round the curves. Then the traces would be the diameter of the cutter less double the depth of serration.

Such being the case I have thought, but not had time to try as yet, whether a disc of the size stated above, slipped on below the cutter used for serration, and using the blank itself for a template, would answer the same purpose. Has anyone tried this plan? If so, with what result?

F. Carre asks for an attachment for serrating cutters, making use of the slides of an ordinary rest. This can only be applied to a screw-cutting lathe. Fix the top slide vertical with angle-plate, with the receiving-plate or tool-holder at right angles to line of centres. Remove the screw, and use a lever and connecting-rod to operate the slide. Use the drill-spindle for cutter, and fasten a guide to the tool-holder, with vertical adjustment to regulate the depth of serration. The cutting or drill-spindle is horizontal, and cutter operates on the blank with its flat face in a vertical line passing through the line of centres. The template to be fixed on a frame fastened to the bed, with sufficient room between the uprights for the saddle to move a sufficient distance, as will be seen later on. The template must have a horizontal adjustment to bring it, the tracer, the cutter, and blank in proper position. In use, say we are serrating a gear-cutter: the blank is on a mandrel turned to shape, and template, guide, and cutter adjusted; let the guide or tracer rest on the highest point of the template, and cut, say, the left side first by traversing the saddle slowly past the blank and template, keeping the slide carrying the cutter pressed down to its work by the lever before mentioned. In order to keep the guide or tracer in contact with the template, cut all the teeth on this side, using a left-hand cutter. Then substitute a right-hand cutter, and serrate the right-hand side.

Worm-cutters could not be serrated with this except on a London Lathe and Tool Co.'s lathe, or one with a revolving nut. In that case the saddle would be traversed by the revolving nut, and always returned to its starting point; then the spindle shifted round the number of holes to the position of the next tooth, the lathe spindle being connected to the leading-screw by same change-wheels as used to cut the worm.

However, I am afraid I am taking up too much space, and conclude by saying that I am, for one—and know of several others who are—looking forward to the article promised by "Earlswood Park" on a heavy drill-spindle, and also the description of the new swivelling frame mentioned by "An Old Correspondent" in letter 32081. I should like some of our friends to take up the matter of cutting spiral gears in the lathe, with gear-cutting attachment. This is a class of gear which we ought to know more about. They seem to be very little understood, except by those whose business it is to produce them. I have lately wanted some, and had great difficulty to procure at a reasonable price.

**D. G. T.**

## MILLWRIGHTING.

[32096.]—I THINK a lot of fellow-millers, readers of this valuable paper, will agree with me that if one of our valued contributors would give us hints on millwrighting as applied to small old-fashioned corn-mills in the country, they would be greatly appreciated. For instance, anyone handy with tools could fix a new pair of stones, put new cogs in wheel if it broke down, and scores of other jobs, just as well as a millwright if they knew how to set about it; and very often better, as millwrights used to new machinery, rollers, &c., in the big mills now working don't seem to know much about the old-fashioned machinery met with in the out-of-the-way mills in the country. Also, what is the best kind of stone for general work? French burr does very well for maize, beans, and other hard corn, but does not cut barley up so well; and, on the other hand, Peak stones will get through a large quantity of barley, but are no good for the hard corn.

**Country Miller.**

## INGROWING TOE-NAILS.

[32097.]—A PAINLESS and efficient remedy for ingrowing toe-nails (see letter 31932) is to apply on the nail a little lard or any other fatty substance, to be kept on by means of a small piece of linen tied round the toe for three or four days, the nail will then become soft and flexible, and so flat as to be easily pared.

Sufferers should try this simple treatment before having recourse to heroic operations prescribed by practitioners and others. Thin and lean people are often subject to this painful nuisance.

Jersey, Feb. 13. **John Binet.**

## ORGANETTES.—IV.

[32098.]—AT the end of my second letter (p. 463) reference is made to the possibility of reversing the action of the organette described, so as to convert it to the American organ (or "suction") principle. In the same way, in the instrument last described we may do away with the pallet-valves and the mechanism for working them, and let the tune-band (which then serves instead of valves) pass

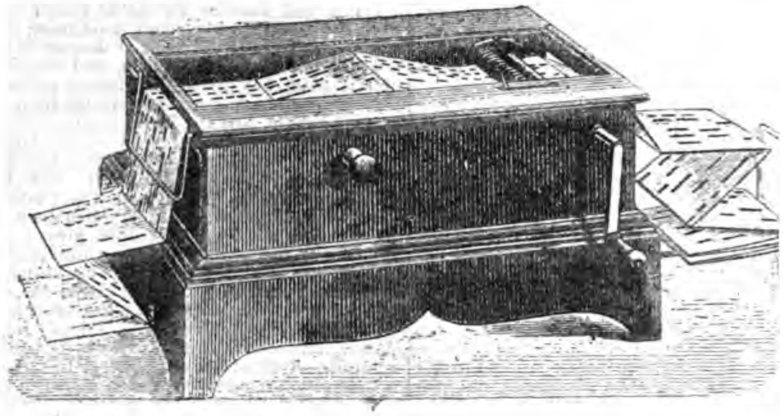


FIG 7

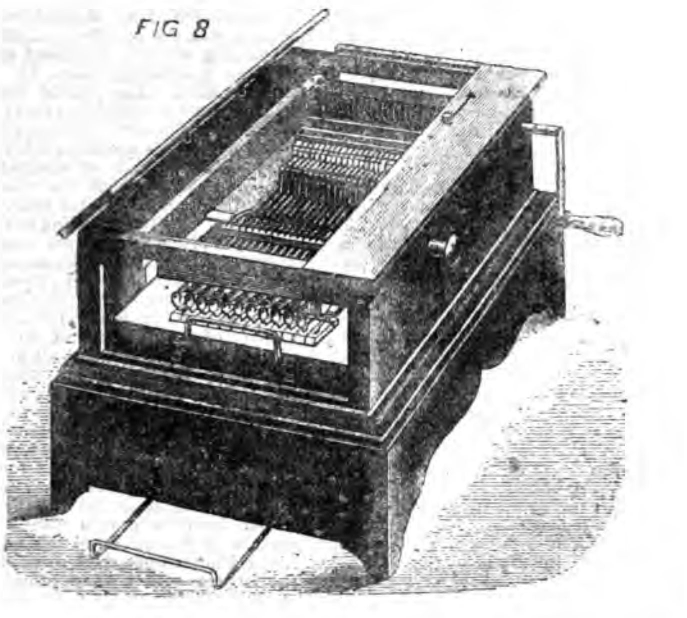


FIG 8

directly over the open tops of the tubes. Two or three (perhaps more) patterns of organettes have been so constructed, but the mode of working will be intelligible without requiring a special woodcut.

In organettes on the "suction" principle there is one point of considerable advantage — viz., the air pressure keeps the tune-band down and prevents leakage, whereas with pressure bellows the air is always trying to force up the band and escape.

The organette now to be described is of French invention, and is carried out in a better and more expensive form than either of the preceding ones. It is made in two sizes—the smaller with 24 notes and the larger with 35, the latter having a row and a half of reeds with a complete chromatic scale. There is also a much smaller instrument by the same maker, but I have no details of its construction. The pattern of which the description will be given is the one with 24 notes. It is on the harmonium principle, with a complete system of pallets, &c., actuated by levers and steel points, which work in the perforations like the "noses" of the levers in the previous illustration, Fig. 6. The external appearance is shown in Fig. 7, and a perspective view of the interior in Fig. 8 (I am indebted to Mons. Thibouville Lamy for permission to use these two illustrations), while Fig. 9 is a longitudinal (diagram) section taken from measurements of the instrument itself, so far at least as the parts are accessible without breaking apart glued joints.

The first peculiarity is in the tune-band, which is folded in zigzag form so as to form a kind of book about 6in. by 4¾in. by, say, 1in. thick, the thickness of course depending on the length of the band and number of folds.

It is placed on a bracket as shown in Fig. 7, and after passing through is folded up on to the second bracket by means of the hanging frame shown (wrongly) above the left-hand bracket—it ought to be shown above the *right-hand* bracket. These brackets are made the one to turn up and the other to slide in, so as to be out of the way when not in use.

The pallets lie in two rows one behind the other; they are 1½in. by bare ½in. by ¼in. thick. They are
not attached in any way to the levers
serve to open them; but each pallet has
standing up, and in these loops the lever
pallet itself being hinged at the end.
being in two rows, the levers which op
necessarily of different lengths; but
pivoted at the half-length (or nearly so
lift of the pallet is the same in each
levers shown are about 8in. long, the i
ones are only about 5½in. The tail
pallet levers are slacked down by
"stickers," and these stickers are at
ends connected to the thin steel- a
B, which terminate in the points C
the perforations in the tune-band. A
shown two of the springs which tend
pallets closed, while E is one of those
stronger) that tend to open them whe
tion allows the lever to move. As the
is thrown on the tune-bands, these are
card (or rather very thin millboard) say

The bellows consist of a pair of
feeders, about 17in. long by 4in. wide,
to four single feeders 8½in. by 4in. T
almost the whole length of the case, and
by two cranks, as usual. The reservoir l
these, and is about 14in. by 3in. The f
keep the wind supply fairly regular; bu
a larger reservoir would be an impr
occasionally the lower reeds are in
supplied with wind. A larger reser
would allow for extra demands in the ca
or of these lowest notes, and would
little defect. The bottom of the reserv
up by the usual coiled spring. There
box which covers in the pallets and
tone of the reeds. This box has later
*only*, which communicate with one c
chambers which, as will be seen (see Fig
exist on each side of the case (as the
channel only occupies the centre 6in. of
These side chambers are closed at to
farther one in Figs. 7 and 8 has the c
along one edge, and the knob seen in f
arm by which this cover can be opened
pression. The cover is closed again
spring. This arm is shown dotted in Fi

The disc-roller that keeps the tune-

# REPLIES TO QUERIES.

*⁎ In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[73052.]—**Yorkshire Coalfields (U.Q.)**—I have not "Miner's" query at hand just now; but, if I remember rightly, he wanted to know "all" about the beds of coal between Scarborough and Whitby. This is rather too large an order. The best thing "Miner" can do is to get all the works on the geology of Yorkshire he can, also a geological map of the district, and study for himself. If he wishes to go into the subject from a miner's point of view, he might find Sopwith's "Geological Models" useful. The beds of coal and shale to which "Miner" refers belong to the inferior oolite of the Jurassic system. In England this system ranges as a broad band across from Dorset to Yorkshire, and swells out into a great thickness in the Yorkshire district. The component strata are subject to great variations in thickness and lithological character. The thick marine series of Cheltenham dwindle down to a few inches in a distance of 40 miles. In Yorkshire the inferior oolite is represented by the upper, middle, and lower estuarine series. The middle estuarine series are composed chiefly of shales, with several beds of sandstone full of plant remains. This is the chief coal-bearing zone of the lower oolite. Only two seams have been found worth working; the thickest does not exceed 2ft. The lower estuarine series is composed mainly of carbonaceous shales, ironstone bands, sandstone with thin coal seams. Seams of coal occur at Brora, in Sutherlandshire, of the same; also in Germany, India, &c. In fact, many foreign coalfields are known to be of Mesozoic age, and later than the Carboniferous era.

W. R. Capps Andrews.

1, Tavistock-terrace, N.

[73371.]—**Slow-Combustion Stove.**—As one who has in years gone by lit many a fire of anthracite, I can say that it is advisable to have a little bituminous coal on the top of the wood; but, given a sufficient draught and a "blower" (which may take the form of a sheet of paper to close the space between the chimney breast and the top of grate), there is no difficulty in lighting a fire with anthracite. A strong draught is required—that is all. As to "slow-combustion stoves," they are all stuff. We burn coal to obtain heat, and the quicker and more thoroughly it can be "combusted" the better, so long as the heat generated is conserved and made to answer the purpose for which the fire is ignited. "Slow combustion" is simply nonsense: the best fire of all is one which burns well, and the best stove is that which is so constructed that it discharges warmed air into the room to be warmed. Anthracite is hard (no doubt about that), but there are coal merchants who will supply it broken to a comparatively small size; so there need be no difficulty on that score; but when burning, it "spits" a good deal, and care must be taken that the sparks do not reach inflammable matter. Anthracite is an excellent coal where what is popularly termed a "fierce heat" is required: it makes little ash, and practically no smoke. Nun. Dor.

[73372.]—**Copper.**—The question as to the effect of copper on steel is one which is a matter for experiment; but there can be no doubt that copper spoils steel as steel, rendering it brittle and incapable of holding an edge. Faraday and Stodart, Mushet (lately dead), and others made experiments on the effect of copper mixed with iron and steel; but as the question can be of only limited interest, I think I may advise the querist to look up Dr. Percy's "Metallurgy." Copper is not an advisable addition to steel, and it is extremely doubtful whether it ever does really alloy with the iron.

Nun. Dor.

[73373.]—**Brass-Melting.**—"More draught" can be obtained by having a higher chimney. The querist seems to be utterly at sea as regards the very principle of draught, which cannot be "sharpened" by reducing the inlet of air, though the air may be directed to the spot at which it is required by preventing it going elsewhere. There are many "make-shift," but none the less useful, brass-furnaces described in back volumes. See April 6, 1888, for instance; but the "fundamentals" are a sufficient height of chimney, and a refractory furnace—that is, one which does not dissipate the heat. Nun. Dor.

[73375.]—**Pointing Pins.**—Pins are pointed by machinery—generally in two operations—the bits of wire being caught between two wheels at each operation, the said wheels either filing or milling the metal into a point, or compressing it. Judging by the wording of the query, the rubbing action would suit the purpose of the querist; but he must have a machine to do the work. No doubt many of the advertisers in this paper could make him a suitable apparatus. I remember seeing a hand-worked affair at the Polytechnic many years ago.

Nun. Dor.

[73389.]—**Cement Floor Dusty.**—This cement floor must have been laid with inferior cement. Get some of the best Portland, clean the floor thoroughly with water, and then float on a thin cream or "slip" of the Portland cement, and give it time to dry. If the traffic is so much that dust is created, cover with a layer of asphalte (Seyssel for preference), but it ought not to be necessary, if really good Portland cement is used with plenty of water. Nun. Dor.

[73390.]—**Re-Tinning.**—I don't see what "amateur" has to do with so simple an operation as re-tinning an iron saucepan. Get the cast-iron goods thoroughly clean, make them very hot—hot enough to melt the tin—put in some grain tin and a little grease (clean), and wipe the melted tin round them with a wisp of tow. If there are many articles to re-tin have a pot of molten tin, and dip the articles in bodily; but they must have "clean" surfaces, and be hot too. Nun. Dor.

[73391.]—**Straightening Drawn Steel Tubes.**—Depends very much on the shape (sectional) of a steel tube how it should be operated on to straighten it; but, of course, querist does not mention the shape. If straight circular, a mandrel can be worked through, and the tube straightened on that by blows of a hammer—that is, if the blows are properly applied. But why not take such a job to the blacksmith? Nun. Dor.

[73395.]—**Compressibility of Water.**—I don't know where Amagat's instrument can be found described, but it may be of some assistance to suggest a search in the books under the head of "Piezometer." If there is a description in Tait, surely that ought to be sufficient after a study of the ordinary forms of manometer. Nun. Dor.

[73403.]—**Boiler.**—This query can be answered by referring back. It is for the querist to determine the pressure at which he desires to work. 2. A patent now costs only £4, plus a shilling for the stamp on the affidavit, and a few pence for the forms. Nun. Dor.

[73413.]—**Petroleum Fuel.**—A good form of burner for dead oils can be seen at a factory near Hackney Wick, and several in back volumes. Admiral Maxse years ago made experiments on gunboats, but they do not appear to have commended themselves to the Admiralty. Petroleum refuse is largely used in the South of Russia for firing locomotives and steamers, but the cost of carriage is too great to render it economical, except when within certain distances. Nun. Dor.

[73417.]—**Train Telegraph.**—To give a description of the methods of electrically interlocking signals and instruments would occupy too much space for illustrations, I should think. They can be seen set out in the various specifications at the Patent Office Library, which is open from 10 a.m. until 10 p.m. Perhaps the querist would find information in Stretton's "Safe Railway Working," Crosby Lockwood and Son. Nun. Dor.

[73418.]—**Cloth Finisher's Brush-over Ink.**—It seems to me that the querist requires what would be a valuable recipe in the cloth-finishing trade. He might find some useful hints in back volumes; but doubtful whether there is anything that will do exactly what he requires.

Manningham.

[73422.]—**Hand-bell Casting.**—Use good moulding-sand, and run the metal hot. Perhaps the fault is in the metal. What is the mixture?

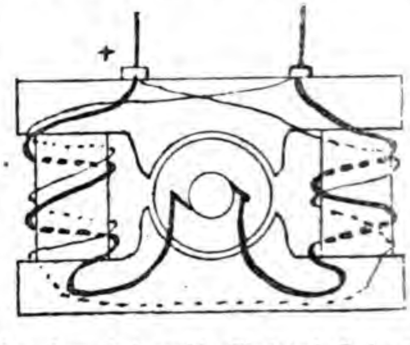
R. T.

[73426.]—**S.N. Telegraph.**—All that is needed is a simple coil of wire and a needle pivoted so as to swing from side to side. See indices of back volumes, or get a look at a single-needle instrument. It is simplicity itself. S. M. L. G.

[73437.]—**Faulty Sewing-Machine.**—Many thanks to "S. M. Mechanic" for his much-needed information. The machine in question is a No. 8 hand-power machine of the new type, having a straight needle and rotary hook. The main shaft runs parallel to the fixed arm. The bobbin sits in the cavity of the rotary hook, and has a circular cap which fits over it. The bobbin and case are held back by the bobbin-holder, which has on its face next the bobbin a very light spring, and below this a projecting screw which prevents the bobbin-holder from being pushed too far back by coming against the frame of the machine. I should like to know how to adjust this screw. Another difficulty is the under-tension. This is worked by a small plate between the teeth and the rotary hook, through which the needle passes, and which is just grazed by a projecting part of the rotary hook when the stitch is drawn tight. This plate may be raised or lowered by means of a screw with milled head. There is no brush on the rotary hook. I have often watched the action of the machine, and seen that nothing was amiss with the time. The machine is also quite new, and not at all worn, and only a year ago I took it to pieces and gave it a thorough cleaning. It does, perhaps, 6in. of perfect work, and then, from some cause, misses two or three stitches, and then does good work again. If I could detect any of the faults mentioned by you, I would alter the time at once; but as it is I am at a loss.

Aktis.

[73443.]—**Field-Magnet Winding of Dynamo.**—Mr. Bottone's pause having lasted a week, here is the reply. I emphatically repeat every statement I made under the above heading on page 489. As I was criticising Mr. Bottone's reply, and he being an electrician, I naturally thought he would be familiar with the usual trade terms; if he is, then his last week's remarks are distinctly unfair, as they consist only of an attempt at ridicule. But now to substantiate my statements. I never said the shunt wire was wound upon the terminals, but that the shunt was "on the terminals"—an expression perfectly understood by every electrician to mean the connection of the shunt winding across the terminals, in contradistinction to the alternative method of connecting the shunt winding across the brushes. I see every day dynamos constructed to run some thousands of lamps, each lighting its pilot lamp only; but I utterly fail to see what such a performance on the part of a compound-wound dynamo has to do with a flaw in one of Mr. Mordey's switchboards, or with the failure of the light on the disconnection of the shunt wire. In any dynamo, be it series, shunt, or compound-wound, if you take away the exciting power, the result in light will be *nil*, and though in a compound-wound dynamo disconnection of the shunt still leaves the series, yet, as the total current for one lamp is but ·6 of an ampère when at full voltage, the voltage is under the circumstances supplied entirely by the shunt winding. I will, however, with the Editor's permission, draw Mr. Bottone's attention to the sketch of a "Manchester" dynamo connection



taken from last week's *Electrical Review* and being one of the diagrams used by Mr. A. B. Blackburn, of Messrs. Mather and Platt's, in his paper read Jan. 24th, 1891, before the Manchester Association of Engineers. This diagram will, I presume, be considered better evidence than if I sent a sketch of one of our own dynamos; and I have purposely selected the "Manchester," because as Mr. Bottone very frequently quotes it in his replies, the presumption is he knows how it is connected up. Please note the shunt *is* connected across the terminals, and that there is no other path for *all* the current from the armature, excepting through the series. Mr. Bottone's remark, "So $\frac{100}{40}$ is really 2·5," is no reply to my criticism, for, seeing it is so, how does the current in the shunt vary, as Mr. Bottone stated it did? The dynamo being compound, the volts are constant, and as he cannot alter the resistance of the shunt, how does the current vary? But perhaps Bottone's law is going to place that of good old Ohm into the dead past. J. W. W. B.

[73478.]—**Specula Grinding.**—The method of grinding specula referred to by "Orion," which appeared in "Ours" some years since as glass on glass, the discs being equal in size, I have not tried; but I have been very successful with a glass tool, smaller than the mirror—so much so, that when getting polish enough to test the curve I have generally found it to be very little beyond the parabola. The ratio of tool to mirror I use is ⅔in. and ⅛in. for each inch of a third, thus: If mirror be 6in. in diameter, the tool will be 4¼in.; if mirror be 9in., tool will be 6⅜in.; if 12in., 8½in. It is important that the mirror should be truly and smoothly edged up. Attention to this will enable "Orion" to get a good surface, when a ragged-edged tool or mirror is an open door to scratches, &c. If he has no lathe, it will be best to make a machine to edge with, and should he get a piece of iron about 20in. long, 1in. broad, about ¼in. thick, bend up 8in. at each end, and drill or punch two holes about 1in. from the ends, the holes to be just large enough to carry a piece of wire ¼in. thick, without shaking, have the wire of length sufficient to bend into a handle at one end, and file the other end square, which should come through far enough to drive into a piece of hard wood, about 3in. in diameter and about 2in. thick, to which can be screwed another disc of wood about ½in. thick, to cement the glass to be edged to the whole: to be screwed to a block of wood. When and turned nice and true, warm the nd glass, and pour just enough melted pitch re of the wood disc, and press on glass, hold- iece of wood to the edge to centre it, and keep the handle till pitch is set. A piece of wood size that it can be cut to ⅓rd of a circle the er that the disc has to be; fasten this to r piece of wood, so that the whole can be nder the revolving disc; but upon the ⅓rd of ay or fix a piece of zinc or hoop-iron bent to ve, and when all is ready, have mixed in a t of sand and water, and turn away and feed . When the glass is turned so that the edge re, use finer feed, flour emery, until it is ground. The disc for tool bevel a little on the at has to grind the mirror, and it is better to f the sharp edges of the mirror as well. When r tool and mirror are finished, get a piece of a foot square, and make one side of it as ly flat as possible, and fasten upon it four ar enough part to allow the mirror to slip in and clamp with thin wedges of bone or ivory. othbrush handles make first-rate ones. The ust not be so thick as to reach up to the face mirror. The cement to fasten the dogs be half pitch and half shellac; if marble can- got, a piece of hard flag, or of plate-glass, ed to a block of wood 1in. or 2in. thick. The ll have to be made thus: Get a disc of wood s than the glass and ½in. thick; fasten to the of it a cylinder of wood, about 2½in. diameter in. long. This is the handle. Now get lb. of lead, and cast a quoit a little smaller e wooden disc, and its internal slip on the er. Make two quoits, one of 4lb. for the grinding, and another of 2lb. for the fine. he wooden part of the tool and quoits being d, warm the glass and pour on the middle of c of wood enough melted pitch, press on the keep the wood in the centre, and when it is im off excess of pitch, and the tool is made. or the grinding. Having the marble flag or n the wooden block on which the mirror is l, and placed upon a suitable stand, say, a ble, or block of wood, or barrel filled with or anything about 4ft. high and can be l round. Get some flour emery—that which found best is the knife-powder of Messrs. and Son, sold in canisters, price sixpence. me into a tumbler-glass with water, stir it up, t about a teaspoonful on the mirror; then put tool and spin it round with the palms of the against the sides of the cylinder, the right rawn towards you, and the left one pushed ou, so that the tool will spin round in the irection as the hands of a watch move, but same time cause the tool to travel round the in a direction contrary to the hands of a . When the emery ceases to bite or goes h, carefully draw off the tool and put on resh; but if possible do not draw the tool off same place every time. Likewise keep the f the tool and mirror together, so that as it will always be more than half over the mirror. ent emery that gathers around the edge of rror must be carefully collected, and put into for from it has to come the different grades grinding. When the rough grinding has n for some time, and it is desirable to know e are getting on, clean off all the emery, he face of the mirror, and when the sun is , place the block or marble with it on at ngles to the sun's rays, and catch the re- cone upon a piece of white card, and measure to the mirror. In order that the unpolished may reflect it, it must be wet evenly all ith water, and it is better to put a little ine in the water, and then it does not soon. The rough grinding must be ued till within about 3 or 4 inches required focus. When that has been d, the mirror and block must be made lean, for when the fine grinding has begun, a f emery, or anything larger than that in use, ratch, and so give trouble. The different of emery for the fine grinding are got thus: savings during the rough grinding are put quart or half-gallon vessel, then filled with ; stir briskly, then count six beats of the and then pour off—that which remains in the is only fit for rough grinding. Now take has been poured off, and add more water; ain, count 12 beats, pour off; what remains . 1. More water and stirring, then 20 beats, nainder No. 2; so on after 30 beats, No. 3; fter 60 beats, No. 4. The fine grinding will be ffectually if each grade be used for about two process same as before, and at the end of each thorough cleaning—in fact, cleanliness is the of the perfect surface. Now, the polishing and g. The tools for polishing and figuring are They are the same size as the mirror, and be better if the face of each were as much as the mirror is concave. But as the tool r grinding is too small, flat tools will have to ich they will nicely do. If care be exercised, wood discs an inch less than the mirror an ick. Do not fix a handle, but, instead, fix ces of wood across the back to take hold of, thus +, about 2in. thick, and 1in. broad. On the face cement a disc of plate glass with pitch; ⅜in. or ¼in. thick will do first-rate; the edges need not be ground if they are nicely cut or snipped round. Mark the face after cementing on with six lines or three diameters equi-distant, radiating from the centre. The use of the lines is to guide in putting on the pitch, which must be tempered with clean tallow, about an ounce of which to the pound of pitch, and when the whole is melted it must be run through coarse muslin, and kept as free from dust as possible. Cardboard boxes to be got at the drapers are excellent things to keep tools and pitch-pan in. To make the pitch tool, have the pitch warm enough to just run, and with a piece of wood shaped nearly like a teaspoon, put along the six lines stripes ¼in. broad in the middle to nothing at each end. Of course, the pitch will have to be piled higher on the end of each stripe,—that is, in the centre,—to make up for the glass tool being smaller. Do not let the stripes of pitch touch each other at the centre if you can help, because it will give you more trouble to cut them to the required shape if they do. Now if you have enough pitch on to reach from the edge to about ¾in. of the centre, wet the face of the mirror well with water, warm the pitch on the tool at a bright fire, mind no dirt flies out upon the tool, and keep turning round while warming. When warm enough to be plastic, and no warmer, lay it upon the wet mirror, slightly move it now and again, so that it may not stick, and when it is cold enough to retain the shape it has taken, then take it off, and with a sharp knife shape each stripe of pitch into canoe shape, with sloping sides, at an angle of 45, and about ¼ or ⅜ broad in the middle to nothing at each end. This is the tool for cutting between centre and the edge; the other must have the stripes of pitch triangular from the edge to within ¼ or ¾in. of the centre, being about ⅜ or ½in. broad at the edge. They may be required to be cut to an obtuse point, and not square—in fact, squares and corners are to be avoided at all times, for they cut. After what I have said with regard to the shape of tools, "Orion" must not expect that they in that shape will give him the true parabola; but he will have to use the Foucault test as he goes on, and measure the zones, and when he has found that more has been taken off between centre and edge, in the centre, or at the edge, than is required, the pitch on the tool must be shaped so that it will cut the least where there is too much off, and more where there is too much on, but at the same time be cutting all over; that is the secret of figuring, and don't have the pitch too hard, or it will chatter, and so cause unevenness. That cannot be detected by the zonal test, but will make plenty of tails and wings for a star; nor too soft, or he will not be able to cut where he likes. I have found when a sovereign, or anything having a milled edged of the same thickness and weight, when stood on a drop of the pitch, and allowed to remain on it—edge on it—for 60 beats of the clock, makes three or four marks, it would do, but that varies with temperature, therefore the pitch will require more tallow in cold weather than warm. The tools being made, the polishing powder is rouge. I use watchmaker's, sold in wood boxes at one shilling per box, and not on one of the many surfaces that I have polished have I found a scratch caused by it. It is called jeweller's rouge, by J. Goddard, Leicester, to be bought at any watchmaker's shop. Having got your rouge, put a teaspoonful into a tumbler glass, and add just enough water to make it like milk for consistency, stir well up, and put on the face of the mirror very little, six or eight drops; if there is too much it flies off the edge, and likewise gathers in radial heaps, and makes radial gutters in the surface. The motions of the polishing tools are not to be the same as the grinding tool, but a compound of rub and rotation can be got by grasping the cross pieces on the top of the tool and stepping round the table or block on which the mirror is fixed, giving it a motion something like the motion given to a pestle when rubbing anything in a mortar; only the stroke must be regulated according to the cutting required. For the tool, with the lanceolar-shaped stripes of pitch used with a short stroke will cut most between centre and edge; if used with a long stroke, the broadest part of the pitch will sweep across the centre and round the outside zone, so make the curve hyperbolic. If carried too far, the other tool—the one with the triangular stripes of pitch—will, if the stroke be short, give a curve of the spheroidal, so by using one tool against the other, and making the pitch upon each according to the cutting required, and making a stroke of suitable length, the parabolic figure can be got. But careful testing all along will be necessary to tell how and what to do.

SIRRAH.

[73494.]—**Rapidly-rotating Spindle.**—Many thanks to "Sphinx" for his answer to my query; but I must demur to his criticism that the speed I mentioned is "absurd." What has been done, can be done; and 800 revolutions per second was the speed at which Foucault rotated his mirror in his classical experiment on the velocity of light (vide Jamin, "Cours de Physique," iii. 3, 229), so that while I quite agree with "Sphinx" that there are difficulties in the attainment of such speed, it cannot be said to be impossible, much less absurd. With regard to the limit imposed by "Sphinx"—viz., 10,000 a minute—if he works the thing out, he will find that the bursting stress in a 4in. brass disc going at 167 revolutions per second, or 10,000 a minute, is 3,300lb. per square inch. Now, Anderson gives the tensile strength of brass of good quality (two parts copper and one part zinc) as 28,900lb. to the square inch. In this case, then, the disc would have to run three times as quickly before it would burst. Again, if we used a steel disc instead of a brass one, we should have at 800 revolutions a bursting stress of 67,700lb. to the square inch, which would give a factor of safety of nearly 2. "Sphinx" further says that a belt velocity of 12,000ft. per minute is about double what I should be able to obtain. Now, firstly, a belt speed of 6,000ft. per minute is not uncommon in the case of wire-rope transmission. *A fortiori*, with a very light cord, say of silk, driving a light, perfectly-balanced spindle, a much higher speed than this could be attained. Further, Unwin ("Elements of Machine Design") says that the speed of the rope in high-pressure transmission is only limited by the strength of the pulley to resist the bursting pressure of centrifugal force. So this argument of "Sphinx's" is simply the former one in another shape. I should like "Sphinx" to advise me, if he will, as to the best way to run such a spindle as I described in my former query, at, let us say, the *highest possible* speed, be it 50 or 800 per second, spindle of steel 1½in. long, ¼in. diameter, coned ends hardened. I thought of making it run in jewels. Would that be the best way, and does "Sphinx" think that for a few minutes the spindle could run without any lubrication.

C. Q. T.

[73495.] — **Ice.** — Would "Marcus C.," who replied to this query on Feb. 6th, kindly say of what material the inner chamber containing the ice should be made?

WINTER.

[73505.] — **Electric Clocks.** — In reply to "G. W. A. F.'s" kind offer to send particulars of a battery that will work for 18 months without attention, I, for one, shall be very glad to have them, as I have tried many experiments with various batteries in vain.

CHRONOS.

[73509.]—**Electric Light Shunt Dynamo.**—Mr. Bottone's reply to my question consists in restating what he calls facts—i.e., that it is the current that produces the light, and not the E.M.F. Now I do not wish to occupy too much space, but would wish only to give the following statement of voltage, current, &c., required for various incandescent lamps:—

| C.P. | Volts. | Ampères. | Watts. |
|---|---|---|---|
| 16 | 100 | ·6 | 60 |
| 16 | 60 | 1·0 | 60 |
| 16 | 80 | ·75 | 60 |
| 7 | 14 | 2·00 | 28 |

These are all Edison-Swan lamps, and he will see that a 14-volt 7c.p. lamp actually requires more current than a 16c.p. lamp of 100, 80, or 60 volts, while 16c.p. is obtained with currents varying very considerably. My statement was that as current cannot exist without E.M.F., it is absurd to talk of work being done by current or E.M.F. only. If work is done, energy must be expended—i.e., both E.M.F. and current—i.e., watts.

J. W. W. B.

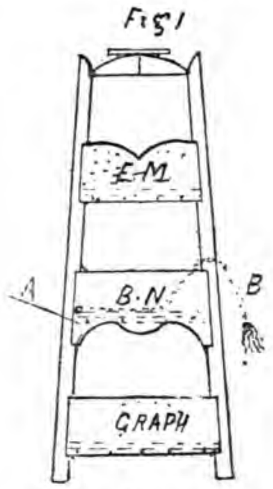
[73557.]—**Rain.**—There is no occasion for me to try the suggested experiment. It is well known that floating solid particles have an influence in determining the precipitation of aqueous vapour.

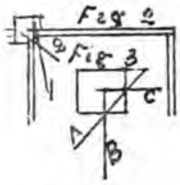
SM.

[73576.]—**Flexible Coupling.**—If the shafts are parallel, the arrangement shown in Fig. 1, p. 532, will do; but the forks at each end of the connecting-piece must be in the same plane, and not at right-angles as shown, or the motion of the driven shaft will be irregular. The cross shown at B would cause an endlong movement of the connecting-piece, and also a "wobbling," or sideway, motion. The same remark applies to Fig. 2, and to the sketch given by "O. D." (The latter looks as if it were copied from Prof. Unwin or from Reuleaux, and I think these gentlemen would be the first to acknowledge that the irregularity of motion of the two shafts coupled by a Hooke's joint is increased by such an arrangement.) The only true construction is shown in Fig. 1 (*b*), where the four joints at the ends of the cross are in the same plane. With this arrangement the intermediate shaft could run in journals if required, but not otherwise. In order that the third shaft should run at the same speed and steadiness as the first, it is necessary (1) that the forks on the second or intermediate piece should be in one plane; (2) that the axes of the four arms of the cross should intersect each other; (3) that the angle between the first and second shaft should be equal to that between the second and third; (4) that the three pieces of shaft should be in one plane.

GLATTON.

[73616.]—**Newspaper Rack.**—This is not a newspaper rack, but a pocketed pedestal for papers or periodicals, &c. It stands upon four feet, and these feet continue right up, as shown. It is made of 1½in. square pine, and the receptacles are made of ⅝in. Fig. 1 is showing it in elevation. The cap upon the top you can put a bust, or any other ornament. You can make it any height you like—say, 7ft. The boxes are not dove-tailed, but cut square, and joggled together. The angles, where they fit in, are taken off, and a recess at right angles made to fit the box, the which see section, Fig. 2, and they are glued and screwed to the frame or pillars with screws, as shown at 1 and 2 in the angle. The bottom is loose boards, resting upon a ledge that is glued and screwed to the box upon the two long sides, as see A, Fig. 1, and to that side is a webbing or fancy braid fixed, as is shown, and extending across to and over the other side (see B) and ending with a tassel. You will see the utility of this arrangement, and you can make some fancy illuminated labels for them. I have made some show as regards the ornamental; but that you can please yourself about. The stretcher at the top is two pieces joggled together to form a cross, and each end is made to fit into a mortise, and glued and bradded into the uprights. Fig. 3 is a section through the post where the boxes fit in. Take the angle off at A for a gauge true and depth of box, then cut out as shown at B and C. I have shown letters upon boxes—ENGLISH MECHANIC, *Building News*, and *Graphic*. One of these, 7ft. high, will pocket a lot of such things, and are always to hand for reference, and can be stood in the corner of any room, or on each side of a sideboard or table, and if stained or lined out with black and white, and varnished with some good varnish, will be found ornamental as well as tidy and useful.





JACK OF ALL TRADES.

[73618.]—**Restoring Leclanche Cell.**—The following method I picked up some years ago from the "E. M.," I think, and have found it answer:—Fit a small tin funnel with a few inches of rubber feeding-bottle tube on the end, on to one of the air-holes in top of porous pot; there is generally a projecting bit of pipe which helps matters. Put the whole on the kitchen sink, and well wash out the porous pot by pouring water into the funnel; the water runs out of the other air-hole. Invert the porous pot, and let it empty. Then pour in through the funnel some solution of permanganate of potash, 20gr. to 1oz. of water. I generally fill the porous pot carefully up with solution. I have had some cells at work four or five years, occasionally thus treated.

Pontesbury, Salop. M. B.

[73628.]—**Equatorial.**—If J. L. Park will turn to Vol. XXXVI. pp. 190, 363, 390, 459, he will find some letters by me which may be of service to him, and if he finds anything in them he cannot understand, and likes to write to me, I will try and make it clear to him. He will find a description of a new equatorial stand on p. 296, Vol. XXXII., with movable hour-circle, and an improved vernier on p. 84, Vol. XXXIV.; but this last is quite beyond the skill of an amateur.

Ramsgate. J. C. LINSCOTT.

[73429.]—**Tempering Springs.**—Make red in the dark, drop into oil, and then reheat until they blaze while lying on a red-hot or black-hot block of iron.

M. S.

[73430.]—**Scraping Surfaces.**—All sorts of shapes are used for scrapers. Any piece of steel will do provided it can be given a sharp edge, and any desired shape. It must be hard, of course.

LONGHEDGE.

[73639.]—**Gas-Engine.**—I have made a horizontal compression, 2¼in. bore, 5in. stroke, with valves for gas and air, and exhaust, similar to "Yarg's." The valves have ¾in. openings, ½in. lift, maximum speed 300, ¼B.H.P. The crank-neck is ⅝in. diameter, ⅝in. wide; bearings, ⅞in. diameter, 1½in. wide, made out of iron. It drives my 4in. lathe. The cylinders of this type of engine must be surrounded by water. I made the water-jacket out of No. 17 B.W.G. sheet-copper.

JOCK.

[73644.]—**Strength of Field.**—I am much obliged to the gentlemen who answered my query. There was a printer's error. It should have been 18 ampères at 50 volts, and not 10 ampères as printed, although latterly I have worked at from 12 to 15 ampères; but as the armature is wound with No. 14, I have no doubt it would stand 20 ampères easily. I don't quite understand why I shouldn't get the same output at half the speed if I make the field doubly intense. With regard to the boiler, I think I was rather misunderstood. I know that if I make the field doubly intense I must use just double the power to do so; but the idea I had in my mind was that the engine would travel at a slower speed, and, as it were, not pump the steam out of the boiler (it has to go now at about 260). With regard to the particulars asked for, it is a 6in. by 5in. deep, 18-cog, best charcoal iron, thoroughly laminated armature, and there are 360 turns on it, two sections in each channel, 36 part commutator; the wire stands up above the cogs a trifle, on account of my wishing to wind it with coarse wire to keep down the R. of Ct. So that the clearance from cogs to pole-face is from $\frac{3}{16}$ to $\frac{7}{32}$, not more, and runs in a bored channel. Area of the two pole-faces together is 72sq.in., length of cores is $8\frac{3}{16}$in. by 3¼in. each. As there is a good amount of wire on, I thought of trying them connected in parallel with one another, and in shunt with armature. The machine sparks a little. Can this be overcome somewhat by making the field more intense.

SLOW-SPEED.

[73649.]—**Bronzes on Leather.**—To "PRACTICAL BOOKBINDER."—I am exceedingly sorry that I can give no information to this querist. I have looked the query over and over again, and as a bookbinder I must give it up. I have never used bronzes on leather, neither have I heard or read of it being used at any time for bookbinding. I am aware it is used by artists, but I have not sufficient knowledge of the process to tender information. You will certainly be able to get bronze powders in London; try Messrs. Berry and Roberts, 21, St. Bride-street, London, E.C. Silver bronze is as common and as easily procured as any other.

PRACTICAL BOOKBINDER.

[73654.]—**Waste of Oil.**—If "Engine Driver" filters the waste oil, he will find no loss of lubricating qualities. Will he advertise his address?

OIL-CAN.

[73668.]—**Cold Bedroom.**—Most bedrooms are cold in winter unless fires are kept, or kitchen or other chimney passes up wall. Look elsewhere than ceilings, as air-space above is more likely to protect from heat or cold. In some old tiled roofs, however, though water-tight, the wind blows right through; here best to board the cockloft so as to form floor. Other causes of cold rooms: draughts of cold air from doors or windows, large window space, thin outside walls, bleak situation, shrunk or ill-fitting floor boards, and the very general custom of plastering the walls direct on the brickwork.

Pontesbury, Salop. M. B.

[73670.]—**Faulty Engine.**—(1) Your cut-off must be very badly arranged, or (2), which is more likely, you have a flaw in your cylinder, where steam escapes; (3) it may be with your piston, which could be remedied by a "piston-ring"; (4) or condensation takes place after cut-off. This must be remedied by passing the steam through a superheating chamber composed of compartment containing red-hot tubes or bars. (2) (3) seem to me to be the most likely. C. E. PEEBLES.

[73684.]—**Egyptian Tamarind Flowers.**—Although addressed to "Eos," I would say the tamarind-tree appears to be a native of India, both East and West. The fruit is dried and sent home, and is used as a gentle purge. However, if "One Troubled" wishes a cure for piles, the following has cured me and many others who have tried it:—Take a piece of the inner or white part of the bark of the elm-tree; dry and grind it to a powder. I do this by cutting it into very short lengths with a pair of good sharp scissors, and, being dry, pass it through a coffee-mill. This does not make a very fine powder, but answers the purpose well. A finer powder is sold in the drug and herb shops by the name of "slippery elm powder." Take a little of the powder and wet it with luke-warm water, which forms a paste or jelly. Apply to the part, with finger or otherwise, on going to bed. If an ordinary case, it will be cured by morning; if not, apply on a second night. Slippery elm will cure inflammation on any part of the body, external or internal. This is a safe, cheap, and effectual cure for young or old. J. F. CARPENTER.

[73693.] — **Clockwork Spring.** — I think "G. H. S." has hit me pretty strong about the spring. Would he kindly give me a sketch of an upright shafting, to be 6ft. by ½in. round, to turn with a handle, small fly-wheel, and two or four cog-wheels? The roundabouts will have bearing round outside. As they run round on wheels, there will not be much weight on shafting.

NEW READER.

[73693.]—**Clockwork Spring.**—While agreeing with "G. H. S.," p. 534, I think it may be interesting to go into the question of size of spring a little. Rankine (p. 304, "Rules and Tables," fifth edition), gives as resilience of a spiral spring $\frac{2{\cdot}463\, n f^2 r d^4}{C}$, which may be reduced to the following expression—

$$\text{Resilience} = \frac{\text{volume in cube inches} \times f^2}{2\,C}$$

$$\text{Where} \quad C = \text{say, } 11{,}000{,}000$$
$$f = 30{,}000;\ f^2 = 900{,}000{,}000.$$

Hence work done in deflecting the spring within safe limits $= \frac{\text{volume} \times 900{,}000{,}000}{22{,}000{,}000} =$ nearly 41 times the volume. The volume to give off ½H.P. for a quarter of an hour, even without friction, would therefore be not less than $\frac{33{,}000 \times 15}{41 \times 2}$ $= 6{,}040$c.in. This would weigh ¾ ton. The above formula would be modified, I think, for a coiled spring like a clock-spring. Perhaps "M.I.C.E." will kindly give the expression for the resilience per cubic inch of such a spring. In a corkscrew-shaped spring subject to end-long compression the wire is twisted. When the same, or a clock-spring, is twisted round the axis of the spring the wire is bent transversely. The spring mentioned on p. 525 contains $\frac{6 \times 310 \times 12}{4} = 5{,}580$c.in. Will "M.I.C.E." say what work can be put into it without impairing its elasticity, supposing it is of good average quality and temper?

GLATTON.

[73695.]—**G.N.R. Locos.**—Mr. C. J. Evans is slightly incorrect in his description of these engines. Subjoined are the *official* dimensions of the "Jubilee" engine, No. 776, which was built for the Newcastle Exhibition in 1887:—Eight wheels; bogie truck to leading wheels, which are 3ft. 11in. in diam.; single drivers 8ft. 1½in.; trailing wheels, 4ft. 7½in.; outside cylinders, 18in. in diam., with a 28in. stroke; boiler pressure, 140lb.; heating surface: fire-box 109sq.ft., tubes 936sq.ft., total 1,045sq.ft.; 174 tubes, 1¾in. diam. outside. The tender runs on six wheels of 4ft. 1½in. in diam., and carries 2,900gals. of water (2,400 in upper tank, and 500 in well), and 5 tons of coal, and, when carrying about 14 tons of water, weighs 33 tons 7cwt. 3qr. The total weight of the engine is 45tons 3cwt., distributed 8 tons 2cwt. on front bogie wheels, 9 tons 9cwt. on rear ditto, 17 tons on driving wheels, and 10 tons 2 cwt. on trailing wheels. Total length over buffers, 22ft. 7in. If your querist will write to me as below, I will send him a fast run with the 10 a.m. from King's Cross.

H. W. ARMSTRONG.

5, Kerrison-road, Battersea, S.W.

[73699.] — **Iceland.** — Allow me to correct an error, a slip of the pen, which I made in my last letter. I ought to have said that the easiest excursion from Reykjavik is to Thíngvellir (not Hveravellir) where the ancient Parliament used to be held, and thence on to the Geysir. From there you can continue your journey on to Hvítárvatn and Hveravellir, which lie considerably farther north.

Charing. J. R. C.

[73703.]—**Astatic Galvanometer.**—I presume the galvanometer referred to is a Silvertown horizontal astatic. The simple reason of the deflection not being reduced when additional resistance was added in series with the galvanometer before the latter was shunted, is that even with all the 45 ohms in, the current from one Daniell's cell is much more than sufficient to deflect the needle hard over—85° is as far as it could go. These instruments should never be used below 30° or above 65°. Your calibration curve is useless; instruments of this class have to be calibrated every time they are used—i.e., they may be used for accurate work, but are useless as volt or ammeters. If you wish to know how to use the galvanometer for measuring currents or E.M.F., I shall be very happy to communicate with you direct, or if our Editor can spare space, to give full directions for measuring by means of what is known as the potentiometer method, a

system I employ daily in my testing rooms for currents of any magnitude, but using mirror galvanometers.
J. W. W. B.

[73704.]—**Red Phosphorus Matches.**—These are not tipped with phosphorus at all: tips are a composition into which chlorate of potash enters, made up with glue. Red phosphorus is in the striking-paper on the box, with sulphide of antimony and glue. No poisonous vapours of phosphorus in manufacture. These matches, if sucked, may produce poisonous effects from other substances, as red-lead or sulphide of antimony, in tipping-compo. Red phosphorus is produced by heating common P in close vessel for many hours at temp. 230° C.; is a red-brown powder, comparatively uninflammable and innocuous. When dry may be handled without fear. Insoluble in carbon disulphide, ether, or turpentine. Specific gravity, 2·14. All these are differences from common P. Heated to 260° C. becomes reconverted into common P. Not used in medicine; cannot say action, but should imagine it is inert. Chemically seems to be inert, but am uncertain as regards this point.

Pontesbury, Salop. M. B.

[73705.]—**Night March.**—I should think that what "F. H." wants is one of the small prismatic compasses made by Stanley. He would then be able immediately to take the bearings of the light in degrees from the magnetic north, and march by the compass accordingly. They are very portable, and can easily be carried in the hand.
SPHINX.

[73706.]—**Black Cement.**—Sulphuret of antimony, reduced to impalpable powder, might do this; but unless you know the metallic constituents of your cement, you cannot make sure of securing the desired colour.
EOS.

[73707.]—**Newtonian.**—There is no advantage in silvering the surface of a right-angled prism, because the reflection is total. The superiority of a flat over a prism depends upon the fact that there is only one surface to grind and polish, whereas in a prism there are three surfaces, and it is, therefore, more difficult to manufacture.
SM.

[73707.]—**Newtonian.**—You cannot get more light from the back surface of a right-angled prism if you silver it, because the whole of the light is reflected under the usual conditions, except what may be absorbed by the material itself. The back surface must, however, be *highly* polished. I think a shellac varnish would be best to use, made with strong spirit; but methylated would be no detriment. You may consolidate the silver film by rubbing with soft wash-leather; but the film must be dry, and would be better warmed before rubbing.
J. C. LINSCOTT.

[73708.] — **High-Speed Model Steamer.**—About four miles per hour.
JACK OF ALL TRADES.

[73709.]—**Coating Firewood with Rosin.**—Why not melt your rosin and slip ends in? There is nothing else but camphene naphtha, or spirit methylated, or turps: but it takes a long time to set.
JACK OF ALL TRADES.

[73709.]—**Coating Firewood with Rosin.**—As rosin is a product resulting from the distillation of turpentine, this is the proper solvent; but it may be too expensive for your purpose. However, only a thin coating is required. The cones of pines and firs are the best of fire-lighters, for the reason that their sap contains natural turpentine, and I have used the splintered wood as torches in my travels.
EOS.

[73709.]—**Coating Firewood with Rosin.**—I should think the best plan would be to dip the sticks in molten rosin, and then lay them on a grating where they would be exposed to sufficient heat to melt off the excess of rosin; but I certainly should not advise "R. G." to go into that business with the idea of making money by it; but I do think, if anyone had the money to put down, a plant for treating old paper to a coat of petroleum and rosin, and then press it into pieces like sticks, there might possibly be money in it.

Ipswich. E. C. M.

[73710.]—**Weights and Measures Act.**—This Act prohibits stamping of weights when the material or mode of construction appears likely to facilitate the commission of fraud. No new weight made of earthenware, porcelain, or china should be stamped if they are found to absorb more than ½ per cent. of their weight of water after immersion for ten minutes. Earthenware weights, however, which are already stamped, and are in use, may continue to be used, unless found to be otherwise incorrect. The Act does not prohibit the use of enamel scale plates.
LIBRA.

[73710.]—**Weights and Measures.**—There is no clause in the Act concerning enamel or any other weights. It merely mentions any "weight, measure, or weighing instrument constructed to facilitate fraud," and in the Model Regulations (1890) a clause is given to the effect that no new weight made of porcelain, earthenware, or china (such as those you mention) should be stamped if they are found to absorb more than ½ per cent. of the weight of water after immersion for ten minutes. Earthenware weights, however, which are already in use and stamped, may continue to be used unless found otherwise incorrect. So that you are at liberty to use the weights, provided the inspector's stamp and the denomination is on them and they are imperial standard weight.
SCALEMAKER.

[73711.]—**Developing Lamp.**—My best lamp, the one which to me is most satisfactory, and never any trouble, consists of an orange-red hock bottle, the bottom of which I cut off with a file. This stands on a Swiss milk tin, the top of which has been cut off level, and the bottom perforated with holes to admit air. This is turned bottom upwards. A small ring is soldered in the centre of this to hold a paraffin candle. I get plenty of light and no fog.
S. BOTTONE.

[73711.]—**Developing Lamp.**—Take a tin box large enough for your purpose, and cut a hole out of the front and sides, either square or with a rounded top, and large enough to give plenty of light; then cut a hole in the base and top of box each 1½in. diam., and over these get a tinsmith to rivet two pieces of tin: that at the top 2in. diam., and that at the bottom large enough to carry the lamp; or, what is much better, a night-light. These pieces of tin must not be riveted close up to the holes, but ought to be riveted by means of tin feet, about ½in. from top and bottom of box; then get him to put three feet underneath the box, so as to admit air; then glue a layer of the red or orange cloth sold by photographers all round the box. All that remains to be done now is to give the box a coat of lampblack and size inside, so that it will not reflect light past the two pieces of tin.
SPHINX.

[73713.]—**Object-Glass.**—I fear the fault is in the achromatism of your glass—certainly not in the air.
LIBRA.

[73713.] — **Object-Glass.**—A star is a more severe test than a planet. There are very few telescopes that will define a star without exhibiting some rays. An easterly wind causes stars to appear triangular. The marginal colour is due to want of perfect achromatisation. It is not of much consequence unless glaringly apparent. It is a very rare thing to get a lens which shows no colour.
SM.

[73715.]—**Electrical.**—On sending the powerful current from the 24 bichromate cells, you broke down the insulation of the fine wire so as to produce a short circuit somewhere. Hence more current now passes, and you get a larger deflection. The inequality of deflection may be caused by the coils not being equal on both sides of needle.
S. BOTTONE.

[73715.]—**Electrical.** — You simply "upset" your galvanometer when you short-circuited 24 bichromate cells through it. Being second-hand, it was probably somewhat old, and the needle but feebly magnetised; but on passing a strong current you re-magnetised it, and consequently, as it is a vertical instrument, you made it more sensitive. With regard to the inequality in deflections, the pivoting and balance are bad.
J. W. W. B.

[73715.]—**Electrical.** — An ordinary detector galvanometer is not intended for a current from 24 bichromate cells unless its quantity be reduced by a shunt, while it would be apt to injure the No. 26 or 28 silk-covered wire with which it is generally wound. The needle of Walter Herbert's instrument was over-magnetised by the strong current, and hence the greater deflection it now stands at. This overcharge the needle will gradually lose, and when that has happened the deflection will probably be as before. The cause why the deviation is not the same on both sides is the non-symmetrical position of the needle with regard to the coils. It is easily remedied by moving one of the coils a little nearer or a little further away.
A. CAPLATZI.

[73715.]—**Electrical.**—As your instrument is a second-hand one, no doubt the pivots of needle-axle have rusted, as the 24 bichromate cells forcibly moved the needle, causing some of the rust to be rubbed off, hence the deflection of 44° by the Leclanché cell afterwards. As regards the unequal deflection, I can only say that the inner magnet does not hang vertical when the front pointer indicates zero—some rust on one side of pivot, which checks the deflection, or the magnet rubs against the inside of bobbins. Of course, the whole might be caused by defective adjustment. If you understand the instrument, take it to pieces, clean pivots with oiled wash-leather, and centre holes with a fine sharp-pointed piece of wood, and adjust the needles, so that both hang vertical with the bobbins when fitted together.
MICK.

[73716.] — **Blackening Steel Wire.** — How would it do to dip it for a few moments into nitric acid, or a coating of platinum black might be deposited on it from an acid solution of platinum.
SPHINX.

[73716.]—**Blackening Steel Wire.**—Put some nut-gall or logwood in vinegar, and dip them in; but you must brush them in powdered lime to free them from grease, and not handle them.
JACK OF ALL TRADES.

[73716.]—**Blackening Steel Wire.**—I think the following will succeed: A little tannin, mixed with a powdered nut-gall, made into a fluid paste with water; stretch the wire, and rub the mixture on it with a damp rag; leave the work for a few hours, and renew the process; afterwards clean, by soaking in hot water; then dry the wire in coils before a fire.
EOS.

[73716.]—**Blackening Steel Wire.**—I have not tried it, but I think nitric acid would do what you require if the steel is a highly carbonised one; at all events, the wire would not be likely to show against a dark background. A modification of Barff's process of forming magnetic oxide might perhaps be devised. Probably Mr. Maskelyne, of Egyptian Hall, St. James's, could give you a few hints.
GLATTON.

[73716.] — **Blackening Steel Wire.**—Should advise "E. A. P." to try the following:—Prepare a solution by dissolving copper wire in nitric acid, weakened by adding, say, three or four parts of water to one of acid. The article to be blackened is heated pretty hot and then dipped into the solution. It is then taken out and heated over a Bunsen burner or spirit-lamp. When the article is heated to the proper temperature, the green colour of the copper first appears, and, as the heat is increased, the article becomes a fine dead black.
J. H. W.

[73718.]—**Vertical Dynamo.**—These machines are generally screwed down to massive iron plates. Iron is not admissible, as it would short-circuit the magnetism.
S. BOTTONE.

[73719.]—**Waterproof Glue.**—Your best plan would be to use three of glue and one of treacle (good town or Russian), and put some decoction of nut-gall in, sugar of lead or sulphate of zinc or alum.
JACK OF ALL TRADES.

[73719.] — **Waterproof Glue.**—Use 60 grains (1 drachm) to the pound of glue. Do not mix more than you can use at one time, as it is no use after it has once set. It should not be exposed to strong daylight until it has got set. Then sun it as much as you like; the more the better.
S. BOTTONE.

[73719.] — **Waterproof Glue.**—In answer to "W.W.W.," a good recipe for insoluble glue is as follows:—Prepare a good quality of white glue in the usual way. Add to the glue when prepared 5 per cent. of bichromate of potash, finely powdered; stir it until the bichromate of potash is thoroughly dissolved. Articles cemented with this glue should be exposed to the light for a few hours to render the glue insoluble. The addition to the above of a little glycerine or molasses will render it flexible.
J. H. W.

[73720.]—**Small Loco.**—The reason of your loco. stopping after running a short distance is probably through not making sufficient steam to supply the cylinders. Try a larger lamp-flame. It does not matter which side the cylinders are placed, provided the ports in cylinders and blocks meet properly. Place the crank-pins at right angles to each other.
F. ASKEW.

[73722.]—**Laboratory.**—The simple mode of doing this is to build an arched recess in the walls, with a shaft to carry off the fumes; a sliding front of thick plate glass is then to be fitted, through which you can watch your operations. A gaspipe is carried into this chamber for a heater; or you can use the powerful double-walled stove of perforated sheet-iron and firebrick, using charcoal fuel.
EOS.

[73722.]—**Laboratory.**—Let the fume closet be made of wood, with glass sides, top, and front, and having a sheet-lead bottom made like a shallow trough, so as to catch any acids, &c., accidentally spilled. The front ought to be fitted with sliding doors similar to an ordinary window, and sliding upwards. From the top of the closet an air-shaft ought to be led out on to the roof, and underneath this a Bunsen burner must be fixed. This, when lit, will give ample ventilation, and as the doors open at the bottom and the fumes rise, they will not find their way into the laboratory at all, and the doors being sliding ones can be opened just enough and no more than is necessary.
SPHINX.

[73722.]—**Laboratory.**—Any kind of cupboard will do. The front should be glazed, and slide up like a sash, or be hinged like French windows, or any you fancy. A method I have employed is to have the glazed front hinged at the top, and reaching only half-way down, the lower portion being in three pieces, each removable by itself, so as to expose a small opening through which the arm can be introduced for manipulating without too much lessening the draught. Simple connection with an ordinary domestic chimney flue will in many cases give a sufficient draught; but it must not be made close to an open fireplace. It is sometimes necessary to provide a special chimney-shaft in which a draught can be obtained by a ring of lighted gas-jets. SM.

[73722.] — **Laboratory.** — The principal consideration in a fume-closet is to have it in connection with a chimney known to have a good draught. The floor ought to be about 2ft. 6in. above the ground, and be constructed of glazed firebrick slabs, inclining only so much to the front as will allow spilled liquids to run off. The back and two sides of glazed firebrick. The front to be also of glazed firebrick, except for about 3ft. above the floor of the closet; this space should be fitted up with tight-fitting glass doors. Framework to be made of zinc or wood, as may be found necessary. The roof should be vaulted with firebrick, with the flue opening at the apex. The chimney is better to have a gentle bend to keep the rain out of the closet.

Plymouth. B.Sc.

[73725.]—**Cleaning Carpets.**—Use curd soap and water, being careful to remove traces of soap with warm water. Proctor's carpet-soap is very good. FREDERICK DAVIS.

86, Newington-causeway, S.E.

[73725.]—**Cleaning Carpets.**—Jeyes' Perfect Purifier I have used much for cleaning tweeds and various wearing apparel, and being very cheap I should think would suit carpet cleaners equally well, as it mixes with water instantly. Price, about 9d. the half-pint; or even less. EOS.

[73724.]—**Surgical Dressings.**—There is no one book taking in all the matters you enumerate. There are, however, plenty of books relating to surgical dressings, &c. English pharmaceutical preparations are prepared in accordance with the "British Pharmacopœia," French preparations according to the "Codex," and so on with other countries. Pharmaceutical science is extensive, and a lot of study will be necessary to make you proficient. You must obtain, as a groundwork, a sound knowledge of chemistry, botany, and materia medica; then this knowledge applied practically is really "Pharmacy"—a science full of technicalities. FREDERICK DAVIS.

86, Newington-causeway, S.E.

[73726.]— **Metal-Casting.**—Why not use a crucible? Then you will be able to melt any hard metal. I don't know any metal hard and dense, excepting it requires as much heat to melt it as would also melt an iron ladle. LIBRA.

[73726.]—**Metal Casting.**—Well, you can make metal as hard as you like by mixing copper with it; but you must put your copper into the tin with a flux (and it must be clean), at a red heat, and, stirring, it will dissolve; and I have cast things so hard that a file will scarce touch them. Experiment a little—say four of tin, one of copper, and lead or lead and antimony six or eight parts, and try. JACK OF ALL TRADES.

[73727.]—**Lithanode Cell.**—The voltage given initially by each cell should be close upon 2·5. I cannot tell what the exact internal resistance of your cells is, without previously testing them, but it would probably be but a small fraction of an ohm. "G. E. S." may calculate the duration of his lithanode with any given current, from the datum that 1oz. of well-charged lithanode should give one ampère-hour, provided the rate of discharge is not high. You must, of course, know the amount of current your 5 c.p. lamp takes, and this you will probably find marked somewhere upon it. The lithanode can, and should be, re-charged after it is exhausted. The E.M.F., in charging, would require to be about 3 volts for each cell in series. No local action occurs on open circuit, but it will, of course, take place upon the zinc, unless it be well amalgamated. A. E. G—T.

[73727.]—**Lithanode Cell.**—Each cell will give, under the circumstances stated, about three volts; hence four cells connected in series would give about 12 volts. The internal resistance will depend on two factors, neither of which you have stated—viz., depth to which the plates are immersed in the acid, and strength of the acid. Suppose the surfaces exposed were 8sq.in. per cell, and the acid were diluted to 1 in 12, you might reasonably expect the resistance to be about ·08 to ·1 per cell. Again, the rate of consumption of zinc and lithanode will depend on the amount of current taken by the lamp. I should think that with an ordinary 5c.p. lamp you would only get six hours' light out of the cells. Unless the zincs were pretty frequently re-amalgamated, I am afraid you would find there would be a good bit of local action, even on the open circuit, if you use sulphuric acid as the excitant.

S. BOTTONE.

[73728.]—**Wimshurst Machine.**—"G. E. S." will find ebonite $\frac{1}{32}$in. thickness is too thin for plates of 19in. diam. Ebonite will answer as well as glass when it is new; but when it is aged it becomes useless. He may expect about 8in. length of spark from 19in. plates: but to get this length he must suitably arrange the sizes of the terminal balls, and also the Leyden jars. If the jars are too large, the spark will be thick, but not long. J. W.

[73728.]—**Wimshurst Machine.**—Ebonite for Wimshurst machines I do not recommend, since the surface soon oxidises. Ebonite $\frac{1}{32}$in. thick for plates 19in. diam. would be a great deal too thin; you could never keep them from warping and buckling. The size of the spark depends more on the number and size of sectors than on the size of the plates. Thus, a 16in. plate machine with 16 sectors will give easily a 3in. spark, but will sometimes fail to start in damp weather; whereas the same-sized plates with 24 sectors will start in any weather, but will not give more than a 2in. spark. Cardboard plates, except as a mere experiment, are a delusion and a snare. S. BOTTONE.

[73728.] — **Wimshurst Machine.** — However threadworn this subject has now become, there are still parties who cannot leave well alone and follow in the footsteps of experience. Vulcanite, pasteboard, and any other kind of plates of soft materials, liable to warp with the least change of temperature or dampness, should never be used either for Wimshurst or other static-electricity machines. True, very effectual machines are made of vulcanite drums or cylinders. This form is not so subject to change of figure as the disc is. These drums could be made quite as efficient of glass as of vulcanite, and perhaps more durable; glass being a harder substance is not so subject to change of figure. Much has been said in praise of the *effectiveness* of induction machines whilst new; but little is published of their *non-permanency*, unless special care is taken of them. I have seen machines giving 5in. sparks when freshly made, from which you could not coax a trace of sparks four months after, do what you like; though, as far as one could see, they were in exactly the same condition, and had never been moved from the room where they first stood. The owner thought it had become polarised; but depolarisation did not amend matters. As far as I know, the cause of this rapid deterioration must be sought in the atmosphere and in the surface alteration of the plates by the powerful induction, as well as in the oxidation of the brushes. When the machine is shielded from the atmospheric influence, it works much longer, and when the spark is lost it can be recovered again by a thorough cleansing and revarnishing of the plates and brushes. These are my own experiences. Others may have made different observations. A. CAPLATZI.

[73730.]—**Unidirection Machine.**—To MR. BOTTONE.—The unidirection machine does not give shocks: it gives a smooth, continuous current, hardly appreciable unless of very high voltage. You would probably feel a shock if you wetted your hands while holding the handles, and got someone to make and break contact while the machine was being driven. No. 36 would give a stronger shock. About a pound of No. 28 will do for your magneto. Bobbins, 1¼in. long by 1½in. diam. when wound. The cell should be 5in. by 2in. S. BOTTONE.

[73732.]—**Motion Wanted for Regulating Punkha.**—If the querist examines the mechanism of those tricycles which have pedal levers connected to belts passing over segmentary wheels on shaft, which segments communicate motion to the shaft by clutches, he will see what he requires. A governor could be fitted to a vertical shaft driven in this way, or by a ratchet-wheel connected to a rack at the end of a link, hinged to punkha, and so long as it ran fast the spindle would be raised; as the speed dropped it would fall, and make contact. Another way would be to fix up a vertical cylinder full of oil or water, with a piston moving in it, the rod passing through stuffing-box. A small pipe, fitted with a cock, connects the two ends, and the rate at which the piston descends by its own weight after being lifted is determined by the opening of this cock. This arrangement is called a "cataract" A valve opening downwards should be fitted on the piston, so that it may be raised quickly and easily, and fall slowly; or if preferred, the piston-rod may be made to slide in piston, and act as a valve. The top of piston-rod must have a head to it, which is tapped upwards by a suitable lever at each stroke of the punkha. If the speed becomes too slow, the piston will sink between two strokes far enough to make contact and ring the bell. GLATTON.

[73733.]—**Winding Shunt Dynamo to Suit Two Different Armatures.**—Take, as your rule, that the resistance of fields must be 400 times that of the armature. Decide upon what voltage you intend your two armatures to give, and keep them within reasonable limits—say 10 volts and 60 volts. Now wind the field-magnets with six distinct strands of wire, and bring both extremities of each six strands to separate binding-screws on a terminal board. Let the total resistance be equal to 400 times that of the running resistance of armature. Now, if all the wires are coupled in series, the resistance will suit your high-voltage armature; but when the wires are coupled in parallel, it will fall to one-sixth, and therefore suit your low-voltage armature. A ½H.P. engine will enable you to get about 350 volts, and this you can get from an armature 4½in. diameter and 3in. deep, wound with about 4lb. of wire. The gauge of wire to be used will depend on whether you want ampères or volts. Read my book, "The Dynamo," seventh edition.

S. BOTTONE.

[73734.]—**Mechanical Punt.**—Why not use an electro-motor and a few accumulator cells?

S. BOTTONE.

[73734.] — **Mechanical Punt.**—Imray would supply electro-motor, &c. The turbine propeller, made by Thornycroft and Co., is about the most satisfactory for very shallow draughts.

GLATTON.

[73734.]—**Mechanical Punt.**—I have been a wildfowler in my young days, with heavy guns, and often wished for an automatic propeller. In deep water a screw worked by the feet when lying down on the bottom might be managed; but in the shallows this could not be done, and I do not know of any improvement on the old "duck's-foot" paddles (split rattan), covered with oiled leather; light and noiseless, with short handles. These have to be dropped when you get within range. EOS.

[73736.]—**Telegraph**.—If you are sure that there is no danger of the cable receiving mechanical injury, and that mischievous monkeys would not get at it, a well-insulated cable would answer. It might even be lead-cased. You can get a heavily-insulated cable at £20 per mile. Lead casing would of course increase the expense considerably, say, £24 per mile. This would be for $\frac{3}{25}$ cable.

S. BOTTONE.

[73737.]—**Water-Power.** — The cubic foot of water flowing per second can be found by the following rule: Two-thirds of the product of the square root of the depth, and 5·4, multiplied by the area of the stream running over the sill, will give the quantity of water flowing per second. Thus, supposing the sill to be 6ft. wide, and the depth of water 9in., the water flowing per second will

$$= \frac{\sqrt{\cdot 75} \times 5{\cdot}4}{\frac{3}{2}} = 3{\cdot}114.$$

This, multiplied by the area of the stream $\cdot 75 \times 6 \times 3{\cdot}114 = 14{\cdot}013$ft. per second: $14{\cdot}013 \times 62{\cdot}5$lb. $= 874{\cdot}8$lb. The indicated horse-power of the stream with 20ft. fall

$$= \frac{874{\cdot}8 \times 20 \times 60}{33{,}000} = 31{\cdot}9 \text{ I.H.P.}$$

This on an overshot-wheel yielding 75 per cent. of effect will be $31{\cdot}9 \times \cdot 75 = 23{\cdot}625$H.P.

Todmorden. W. H. S.

[73737.] — **Water-Power.** — No two experimenters seem to agree as to the quantity flowing over a sill. Having found the cubic feet per minute, multiply by 62·35, which gives weight of water in pounds at 62° Fahr. This, multiplied by the fall in feet and divided by 33,000, gives the H.P. of the water. An overshot wheel is stated by Molesworth to utilise 68 per cent. of this. Box gives a rule which, slightly modified, is as follows:—Water in pounds per minute $= 26{\cdot}7\, d\sqrt{d\, l}$; where $d$ = depth of overflow (measured from still water) in inches; $l$ = length of sill in inches. If weir consists of a thin plate, the above gives the approximate discharge in pounds per minute; if it is a plank 2in. thick, multiply by ·845; if 3ft. thick with level top, multiply by ·712; if 3ft. thick and sloped from 1 in 12 to 1 in 18, multiply by ·76. To get more accurate results, the querist should consult some such tables as those by Donkin and Salter, &c.

GLATTON.

[73737.]—**Water Power.**—First of all, find the quantity of water passing over the weir by the following formula:—$Q = 4{\cdot}012\, A \sqrt{h}$. In which $Q$ = the quantity of water in cubic feet per second; $A$ = area in feet of the water over the top of weir; $h$ = the head of water in feet, measured from the centre of the water over weir to level of still water. Then having got Q, multiply number of cubic feet found by the depth in fall in feet from the centre of the water on top of weir to level of water below weir, and multiply this by 62·4. This will give you the number of foot-pounds of energy per second, and this divided by 550 will give total H.P. of fall. Example: Width of weir 10ft., depth of water over weir from centre to level of still water 6in., fall = 6ft. Then—$Q = 4{\cdot}012 \times 10 \times \sqrt{5} = 28{\cdot}1$c.ft. of water per second. $28{\cdot}1 \times 62{\cdot}4 \times 6 = 10{,}520$ft.lb. of energy per second. $10521 \div 550 = 19{\cdot}1$, IH.P. Roughly, the efficiency of overshot wheels is from 0·7 to 0·8 of the power found as above.

SPHINX.

[73738.] — **Raising Water.** — Ascertain what pressure you have to hand, then write to Bailey's relative to a hydraulic pump.

JACK OF ALL TRADES.

[73738.]—**Raising Water.**—Use one of Ramsbottom's small three-cylinder water engines to drive a pump. The water from the tower will then work the engine, which will in its turn work the pump. These engines give very little trouble, and are both efficient and cheap. SPHINX.

[73738.]—**Raising Water.**—If you are in a windy district, and could provide a tank large enough to take several days' supply, a windmill would be cheaper, unless you get the water under pressure for nothing. In the latter case, perhaps, one of the miniature turbines referred to by Mr. Brown on p. 529 might suit the querist.

GLATTON.

[73740.]—**Locomotive Rails.**—Take pieces of No. 20 B.W.G. wire ¼in. long. Sharpen one end, and bend ⅛in. of the other at right angles. Solder this end in the groove of an old umbrella-rib. Fix them at intervals of 6in. or so, and press the points into boards, taking care to preserve the gauge between the ribs.

GLATTON.

[73740.]—**Locomotive Rails.**—Obtain several lengths of American clock-spring, about ½in. in width, and the stoutest you can obtain; drill $\frac{3}{16}$in. holes about 3in. apart; now turn up the same number of iron pins about ¼in. in diameter; supposing the gauge of loco. to be 2in., then use pieces of rod in 3in. lengths; turn down a ½in. at each end, and tap for nuts; place them between two pieces of spring and tighten up; treat each piece the same, and your rails are complete. You can fix them to a board or sleepers by chairs. If they are to be used for conductors of current they must, of course, be insulated from each other by bushing the holes with ebonite or boxwood. This is the simplest and best way I know of making rails for electric railways.

F. ASKEW.

[73743.]—**Tangye Gas-Engine.**—Write to the makers.

GLATTON.

[73745.]—**Rusting of Steel.**—Send to Sturtevant's, Clerkenwell, and have it nickelled.

JACK OF ALL TRADES.

[73745.]—**Rusting of Steel.**—Keep your rule in powdered quicklime; change the lime from time to time. The steel will keep untarnished for years with this treatment.

S. BOTTONE.

[73745.]—**Rusting of Steel.**—If steel be immersed for a few minutes in a solution of carbonate of potash it will not rust for years, even when exposed to a damp atmosphere.

J. H. W.

[73745.]—**Rusting of Steel.**—You can wipe off the oil before using the scale! You can also keep it buried in quicklime. I have a similar scale, but I do not anoint it with anything. I keep it loose in a drawer, and it does not rust.

SM.

[73745.]—**Rusting of Steel.**—Give it a coat of lacquer composed of 10 grains of clear gum mastic, 5 of camphor, 15 gum sandarac, and 5 of gum elemi dissolved in a sufficient quantity of alcohol to make a thin varnish, and apply it without heat after cleaning the scale.

SPHINX.

[73745.]—**Rusting of Steel.**—Dissolve bleached shellac in pure spirits of wine into a varnish. Take care that the steel surface is perfectly bright and clean, and having previously warmed the metal to blood heat before a fire, quickly and smoothly give it a filmy coating of this solution—it dries very quickly. Or, having warmed the metal as above, rub hard over it with a piece of silk a waterproof coating of indiarubber dissolved in bisulphide of carbon. This also dries very quickly. A mere film of this preparation will last long.

EOS.

[73746.]—**Bursting of Water-Pipes by Frost.**—A circle having an equal periphery to an ellipse has always a greater area. This can be easily proved. Take a canister of elliptical section and fill it to the brim with water. Now bend the mouth in a circle; the level of the water will sink, and leave space for more, conclusively proving that the capacity of the canister is increased.

CALDEMONE.

[73746.]—**Bursting of Water-Pipes.**—This query reminds one of King Charles and the fish. "Senex" is mistaken in supposing the area of a ring remains constant when the shape varies. Let him take a strip of paper, gum the ends together to make a ring, stand it on a plate, and fill it with sand, salt, sugar, or similar material. Then empty it, flatten it, and try to get the same quantity of powder into it. He cannot, of course. Hence the "reason, &c.," is the true one.

GLATTON.

[73746.]—**Bursting of Water-Pipes by Frost.**—What can "Senex" mean by his extraordinary statement that "so long as the line bounding the bore of the pipe remains unaltered in length, the area it incloses remains unaltered also"? If he had simply filled a round tin-pot with water and slightly pinched the top of it out of shape, he would have seen enough to preserve him from cumbering the columns of "Ours" with such nonsense as he has written. It never seems to occur to some people to try a thing for themselves before rushing into print about it.

C. E. FRANK.

[73746.]—**Bursting of Water-pipes, &c.**—Whatever shape the pipes may be will not prevent them bursting during a frost. If the pipes are full of water, and this water freezes, and in so doing expands the pipe beyond its utmost limit, it is bound to burst, although, of course, it is not noticed until the thaw occurs; it is then evident by the escape of water. Water attains its greatest density at 4° C., and freezes at 0° C. Water, therefore, in freezing expands about $\frac{1}{11}$th of its volume.

FREDERICK DAVIS.

86, Newington Causeway, S.E.

[73746.]—**Bursting of Water-Pipes by Frost.**—Oval pipes, when made of soft lead, resist bursting for the reason given by "Senex." He is entirely wrong in saying that, "so long as the line bounding the bore of the pipe remains unaltered in length, the area it incloses remains unaltered also, into whatever figure it may be bent." Unscrupulous publicans who oval their pewter measures without indenting them know this well; but it will be more obvious to "Senex" if he will squash his pipe-flat, and then measure the contained area.

H. B. F.

[73747.]—**Pulleys.**—It is impossible to tell what size pulleys you will require. I suppose you would drive first on to a counter-shaft, and then down to the various machines. If "Carriage Builder" will give me speed of engine and speed he requires to run the various machines at, I will give him size of pulleys required.

SPHINX.

[73749.]—**Bisschop Gas-Engine.**—See reply to 73743.

GLATTON.

[73751.]—**Chord of a Segment.**—Let $a$ = height of chord, and $r$ the radius or half the diameter, and $c$ = the whole length of chord. Then $c = 2 \times \sqrt{r^2 - (r-a)^2}$. Example: Let $r = 6$ and $a = 2$, then $\sqrt{6^2 - (6-2)^2} \times 2 = 8{\cdot}9$, whole length of chord.

Todmorden. W. H. S.

[73751.]—**Chord of a Segment.**—To "PERPLEXED SPHERE."—To find chord of segment when diam. and height are known quantities, $r$ = radius of circle, $h$ = height of segment. The length of half the chord will be, by Euclid, I. 47, $\sqrt{r^2-(r-h)^2}$ $\therefore$ Chord $= 2\sqrt{r^2-(r-h)^2}$. Now $2\sqrt{r^2-(r-h)^2} = 2\sqrt{r^2-(r^2-2rh+h^2)} = 2\sqrt{r(2r-h)}$. Hence it is evident that the chord of a segment is equal to twice the square root of the parallelogram contained by the height of arc and diameter of circle minus height of arc.

J. C. JOHNSON.

# UNANSWERED QUERIES.

◆

*The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.*

Since our last, W. R. Capps Andrews has replied to 73052.

| | |
|---|---|
| 73164. | Gravity Clock, p. 341. |
| 73169. | Hydro-Electro-Motor, 341. |
| 73178. | Ratio, 341. |
| 73181. | Tile Steel, 341. |
| 73183. | Equation of Curves, 341. |
| 73199. | Date of Ring, 342. |
| 73210. | Oxyhydrogen Microscope, 342. |
| 73214. | Mica Grease Lubricants. 342. |
| 73221. | Tentering Gill Holes, 342. |
| 73232. | Expansion Valve, 342. |

A RECENT number of the *Comptes Rendus* contained a paper "On the Artificial Production of a Chromium Blue," by M. Jules Garnier. By heating in a brasqued crucible a mixture of $K_2CrO_4$, 48·62 grammes; fluor spar, 65 grammes; and silica, 157 grammes, the author obtained a blue glass, the colour of which he attributes to reducing action taking place at a high temperature in the chromium salt.

**A Mountain of Pure Silicates.**—A mineral discovery of some value is reported from Kamouraska, in Lower Canada. A Quebec correspondent states that an entire mountain has been found composed of silicates, otherwise known as vitrifiable stone, of a purity certified by the Provincial Engineer to average 98 per cent. This material is used for the manufacture of the finest glass, and is believed to exist nowhere else on the American continent in such purity.

**The Nature of Sciatica.**—Dr. Harrison Mettler, who points out that the nature of sciatica is shown in its etiology and symptoms to be that of a neuritis. Thus its most common antecedents are traumatism, exposure, gout, rheumatism, syphilis, and malaria. The occurrence of tender points in sciatica is accounted for by supposing that the tender points indicate the foci of inflammation. A similar explanation is given of the tenderness in the whole length of the nerve trunk. More unequivocal signs of neuritis are found in the wasting, the occasional reduction of faradaic excitability, long ago described by Anstie, and the altered trophic conditions, such as excessive perspirations and effusion into joints. Regarding the whole question, the author is strongly of opinion that sciatic nuralgia, without actual organic change in the nerve trunk, is a very rare condition.—*Lancet.*

# QUERIES.

◆

[73752.]—**Cricketing Flannels.**—Can any reader inform me what process cricketing flannels undergo when sent to a London shrinker, after having undergone what is known as a shrunk finish in Lancashire? It is an easy matter to shrink flannels, but I notice that those soap-shrunk in London have a much more clothy feel, although they have scarcely lost any measurement either in width or length of the piece. Do they put any kind of filling in to make them firmer in the hand, and if so, what does it consist of?—CRICKETER.

[73753.]—**Sensitised Paper.**—Can anyone tell me how to sensitise the paper for charts of Jordan's sunshine recorder? They appear to be only partially sensitive to ordinary daylight; but when exposed to the direct rays of the sun through the slit after washing in cold water, the sun's rays are indelibly fixed.—METEOR.

[73754.]—**Screws.**—In cutting square-threaded screws, which is the best method of measuring depth of thread? Up to present, have used a rule for depth, but find it very unsatisfactory when I have to cut a nut or box.—SET FAST.

[73755.]—**Accumulators.**—How many, and what size, accumulators shall I require for 30c p. for about 12 hours? Also, what size, how many, and what thickness of plates shall I require, and how long will acid last before it wants renewing? If I wind dynamo with 3lb. No. 22 d.c.c. wire for fields and 1½lb. No. 22 for armature, ring pattern, will it be sufficient for 40c.p. dynamo, shunt wound? Also, how shall I proceed to make a cheap and efficient bath to electroplate banjo rim (brass)? Also, do you fasten battery wires to article to be plated, or how? Also, what do you put in bath, and how long would you let rim stay in?—ANXIOUS.

[73756.]—**Self-acting Blowpipe.**—Would any reader kindly send sketch and dimensions of a self-acting blowpipe, suitable for doing small brazing work with?—AMATEUR.

[73757.]—**Converting Old Naval Telescope into Equatoreal.**—I have an old naval telescope, o.g. about 3¼in., and 3ft. focal length, and would be glad if any reader of the "E. M." would tell me the best and cheapest way of mounting it as an equatoreal, so that it shall be portable and steady; also if water or any other fluid will do for filling glass prisms with, besides carbon disulphide.—INQUIRER.

[73758.]—**Wimshurst Machine.**—I am making a Wimshurst machine with 18in. glass plates. I have seen similar with ebonite plates, having about 40 sectors. Would it answer to make as many sectors on my glass plates, or is it better to have a smaller number, and for what reason?—HOLLAND.

[73759.]—**Electro-Motor.**—Will Mr. Bottone or Mr. Allsop advise me? I have an electro-motor (Manchester type), armature H pattern, laminated, 2¾in. diam. by 3in. long, F.M.'s 3in. long by 1¼in. diam.; have made bobbins of brass tube, and wound each limb with about ¾lb. of No. 22 d.c.c. wire. What gauge wire shall I put on armature, and how much to get the best results from six (pints) bichromate cells? I originally wound the armature with No. 26, but could get no power at all, although it ran fast. —E. M. F.

[73760.]—**Electric Gas-Lighter.**—From a description of the above given in the "E. M." Jan. 9, '85, I am unable to see the connections between the different parts. There is a lighter made now with plates instead of cylinders. Will anyone please explain the mechanism and connections, as I wish to make one? Sketch will oblige.—PIVOT.

[73761.]—**Enamelling Cycles.**—Will some kind reader give any information how stove enamelling on cycles is done? What sort of stove and heat required, or name of any books on the subject?—INQUIRER.

[73762.]—**Grindstone.**—I have a small grindstone 9in. by 2½in., driven by treadle, and kept wet by water dripping on it. After being used for a short time, it has become quite glazed, and will not cut. Can this be remedied by putting anything in the water, or should the stone run quicker?—GRINDSTONE.

[73763.]—**Dull Boiler Surface.**—I have a small boiler, one horse-power, made of wrought-iron plates. I have just painted it black with special asbestos paint, which will stand any amount of heat, but it has dried dead. Could you tell me of any way of putting a polish on, or if there is any other kind of paint which will give a gloss when dry? Of course you will undestand my boiler is not covered with any kind of composition and painted on top of that, but simply on the bare plates.—STUCK FAST.

[73764.]—**Ammeter.**—I should like to make an ammeter on the principle of repulsion as illustrated on page 480 of the "E. M.," Fig. 41, of the last articles, "Electro-Magnet." Will Mr. Allsop or others kindly inform me of the length of coil, size and quantity of wire, and how best to proceed for an instrument to read up to, say, 25 amps.?—B. M.

[73765.]—**Wire Core.**—Will Mr. Bottone kindly tell me the object of using wire instead of solid cores for induction cores, as I have made some with solid cores, and they appear equal in every way to those having wire cores?—B. M.

[73766.]—**Rubber Spring.**—Will some kind reader say if indiarubber loses any of its elasticity, or deteriorates in any way after being kept in water?—STOCKS.

[73767.]—**Safety-Valve.**—Will some kind reader give a method to calculate how far the weight should be from the fulcrum to blow off at 50lb. press? Also is coke cheaper and better than coal for heating a vertical boiler, with two cross tubes, and about 8ft. high?—STOCKS.

[73768.]—**Water Capacity of Tanks.**—Will some reader kindly give me simple rule for finding the above? Take, for instance, a tank 2ft. 6in. dia., and 5ft. 6in. in height—what would be the capacity of this?—C. W.

[73769.]—**Pressure on Dock Gate.**—Will any correspondent or reader kindly work out the following problem arithmetically, if possible? In an empty dock, the water is level with the sill at the lowermost edge of the dock gate; the level of water on the opposite side of the gate being 10ft. above the sill. The dock gate is 10ft. wide; find the pressure in pounds on the dock gate. If the water were at a level of 5ft. in the dock, the level outside being the same as before, how much would the pressure on the gate be relieved?—SCIENCE BOY.

[73770.]—**To Mr. Bottone.**—Would you be so kind as to give me sizes and weight of wire for two armatures of following dimensions?—Dia. of armature 1⅞in., length 2⅝in. The groove in armature is 9-16in. deep, and 1in. from each end, leaving a centre-piece ⅝in. by ⅜in. I have pole-pieces for F.M.'s, and would like to know what size and weight of round or square iron I should put on them, also size and amount of wire? Both armature and F.M.'s are cast iron. The pole-pieces are 2⅛in. deep by ⅞in. wide, with a groove of ⅞in radius.—AGRESTIC.

[73771.]—**Self-Induction.**—A coil of wire is said to have a coefficient of self-induction which is proportional to the square of the number of turns of wire. What is this coefficient, and if the current varies—the number of turns remaining the same—is the coefficient altered? I cannot understand it from my textbook.—HOMEWORK.

[73772.]—**Setting Transit Instrument.**—The writer of Astronomical Notes occasionally gives the method of ascertaining local mean time at various stations east and west of Greenwich. Will he kindly answer me this question? I want to set a transit instrument due south, and being situated 2 degrees West of Greenwich, will I be right if I assume that a star will be on my meridian eight minutes after it has passed that of Greenwich?—AMATEUR.

[73773.]—**Dynamo-Winding.**—I have an armature 4in. diam., 4in. deep, built up with discs of the following dimensions:—4in. diam. over all, 2⅝in. diam. inside, width of web ⅝in., 8 cogs, space between cogs ½in., depth of cogs ⅞in. Can you oblige by telling me:—1. What will be the largest gauge of wire I can put on to obtain about 50 volts? 2. The quantity and gauge of wire for fields as a compound-machine, or if the machine is too small as a shunt? The field cores are 4in. by 2in., and the coils must not exceed 6in. by 4in. when finished—what length of core will be necessary to take the wire?—M. M.

[73774.]—**Curling-Stones.**—How can they be made keener? Mine are Douglas Water stones. Are they capable of being made as keen as some of the lighter-coloured kinds? Their shape is also different from any of the other stones I have seen—not so flat one side; in fact, is a continuous curve. What is there for or against the different shapes?—LOCK TAY.

[73775.]—**Manillas.**—Can anyone tell me how to colour manillas (South African coinage)? They bear a pale bluish-green bloom through which the bronze is visible. It is not the usual antique green—that I can produce readily enough. It is not only a different colour, but is not a continuous coat.—SM.

[73776.]—**Parrot.**—I have a large green parrot from British Honduras, turned two years old, and is troubled with much sneezing lately, and one of its nostrils has become enlarged and inflamed from cold I believe. Would any of "ours" who knows give me a good remedy?—LES DENTS.

[73777.]—**Painting Zinc.**—Will "Sigma" give us particulars of the special preparation he uses before painting zinc work, as I find that ordinary lead paint soon peels off?—W.

[73778.]—**Gravity Cells.**—Which is the best way to keep them in order—that is, for best current and preventing the formation of copper on the copper plates at the bottom of the cell? The kind I refer to have the zinc hooked on to the edge of the cell with seven prongs projecting out into the solution. The copper is formed by three strips riveted in the centre and bent outwards, to one of which is fixed the wire running out of the top of the cell. I use sulphate of copper for charging. If Mr. Allsop replies, would he kindly state when his book on electrical testing is likely to be published?—JAS. M. BEESLEY.

[73779.]—**Battery for Electric Lamp.**—Will some kind reader inform me how to make up a chromic-acid battery, amount of acids, &c., required, with four or five carbons and zincs in it, for a small electric watch lamp, 2½c.p.?—ARGALL, Truro.

[73780.]—**Electro-Motor.**—In last week's issue, Feb. 13, page 523, in the description of a small electro-motor, it says use wire No. 13 B. and S. gauge. What does B. and S. signify? Also will an ordinary twelve-divisioned commutator do instead of a disc, &c., as stated on page 523? Also can you give me dimensions, &c., of a chromic-acid battery? I want it to last a month or two at most. I am going to use an ordinary brown stone jar, and have a porous cell indside. I want to know amount of chemicals. Also what amount of No. 24 and No. 36 B.W.G. must I use for the primary and secondary coils of an induction coil to give (1) a ¼in. spark, (2) a ½in. spark?—R. H. OWEN.

[73781.]—**The Moon and Felled Timber.**—Here in Dominica it is customary to fell trees for economical uses between certain phases of the moon (the best time being between last quarter and new moon), otherwise the wood becomes pricked by minute insects, something like L. terebrans, causing rapid deterioration. Has the moon any influence on the sap of the trees, or are the phases merely coincident with other natural phenomena in the trees themselves?—EDWD. FADELLE, Dominica, Jan. 29, 1891.

[73782.]—**Bulbs.**—I have been told that plants which are propagated by bulbs do not produce seed. Is this true? I have tried to get seed from lilies by placing pollen on the stigma, but have failed. On the other hand florist's catalogues offer for sale hybrids of bulb-producing plants, and how can hybrids be obtained except by means of seed? If it is possible to get seed, can anyone tell me how and what time of year I must sow it, and how long it would take a seedling to flower? Are any common bulbs poisonous? I have heard that the Japanese eat the bulbs of the lily. Can anyone tell me how they cook them, as I have a fancy to eat some lily bulbs?—ÆSTHETE.

[73783.]—**Stringing Pearls.**—Will anyone conversant with the process kindly describe how to string real pearls, and state what description of thread is the strongest and most suitable? Real pearls have extremely small boring-holes, and there is a particular knack of threading them on strong thread.—B.

[73784.]—**Lacquering Repousse Brasswork, Indian.**—Will anyone kindly describe the whole process of lacquering repoussé brasswork from beginning to end—i.e., the cleaning of the article, the pickling of the articles, and the composition of the pickle, the composition of the lacquer, how applied, and the exact temperature of the article at the time of applying the lacquer?—B.

[73785.]—**Boot Protectors.**—Will some kind reader tell me the way to make a self-adhesive boot protection for soles of boots that will stand heat and water, similar to leather? I find guttapercha affected by heat, and water bringing it off when put on.—A.G.

[73786.]—**Brass Band.**—Will some kind reader inform me how to arrange hymns for a small brass band? I have seen music written by bandmasters of different bands, and should be extremely obliged if anyone could tell me how to do same. I should require such tunes as are in Sankey's songs and solos. Any information will be gladly welcomed.—G. W. H. RORDER.

[73787.]—**Tannic Acid.**—Will Mr. Grey, "F. C. S.," or some other practical reader inform me what quantity of tannic and gallic acids can be extracted from 1lb. of galls? I cannot find this information in any work which I have access to.—TANNIN.

[73788.]—**Tree-Stump.**—Will some reader kindly tell me how to blow out tree stumps with powder? I have used various charges of blasting powder up to 1½lb., but have only succeeded in splitting the stumps. Auger holes 2in., about 18in. deep? What is an ordinary charge?—H. S.

[73789.] — **Wheelwright's Bench.** — Kindly describe wheelwright's bench, method of trimming rough spokes; also proper method of boxing the nave with Collinge bush.—H. S.

[73790.]—**Securing Horse.**—Can any reader tell me of a simple plan of securing a high-spirited horse at night by the roadside, &c., when journeying? How are the cavalry horses secured? Would hobbling the hind legs be a safe plan? Tethering to a pin is out of the question, excepting as extra precaution.—H. S.

[73791.]—**Converting Steam into Gas-Engine.**—I have a very good (steam-engine) cylinder. Will any reader say if it can be made into a gas-engine, and what power? The dimensions are 18in. long, 5in. bore inside. —C. W. S.

[73792.]—**Separating Alcohol from Wine.**—I have heard that by the addition of chemicals to a glass of wine, the alcohol separates from the rest of the liquid, and being lighter than water, rises to the surface where it may be inflamed. Will any reader kindly state whether this is the case, and if so, what are the chemicals necessary for the experiment?—H. T. M.

[73793.]—**Barometer.**—Does commercial glycerine require any further prèparation for use as a barometric column? Will olive or other oils answer for this purpose? Are composite barometers, in which a broad column of mercury is surmounted by a narrow one of glycerine, found to be of any practical value?—DOCTOR.

[73794.]—**Telephone.**—I have made a telephone, according to Mr. Bottone's instructions in "Electrical Instrument-Making for Amateurs," but cannot get it to work. The channels in bobbins are ¾in. wide, instead of 1in., the boxes not being deep enough to allow of their being wider. I have used 10yds. No. 36 cotton-covered wire, instead of silk-covered on each magnet. Would this be the cause of failure, if not, could you tell what is? —W. A. JENNER.

[73795.]—**Dynamo Machine.**—I have made a small dynamo, and I cannot get it to work either as a motor or a dynamo. Dimensions are:—Field-magnets 3¾ by 2⅛ by ⅝, armature (Siemens) 2½ by 1⅛. There are four layers of No. 20 single cotton-covered copper wire on each field-magnet, and about five layers same on armature. Would you kindly advise me what to do to make it an effective machine?—R. BLOXAM.

[73796.]—**Shocking Machine.**—I have made a shocking machine, but it does not shock. Could Mr. Bottone tell me what is wrong? Diameter of bobbins 1⅜in., length 2¼in., magnet 11in. long; each pole 1½in. by ½in.; ¼lb. of rather fine s.c. wire on each bobbin, and insulation is perfect. The magnet and armature are mounted on brass frame, with spring to touch axle of armature twice per revolution. One part of the axle is insulated from the other by wood, each part carrying off one wire of the bobbins.—H. R. H.

[73797.]—**Stove-Pipe Elbows.**—Can any of your readers help me by giving the proper angles for making stove-pipe elbows before they are seamed up? Sketch, with how to strike out, will oblige.—ANXIOUS ONE.

[73798.]—**Silvering Steam Taps.**—Will any reader of this paper kindly inform me if I can silver steam taps and valves with mercury, as I have a good quantity of it by me, and if so, how could I do it, for I have a great number of them to keep clean every day, and being gun-metal and brass they go dull in a few minutes? Any assistance will greatly oblige.—A. J. P.

[73799.]—**Steeling Engraved Copper Plates.**—How are engraved copper plates steeled, and what does the process add to their durability?—METAL.

[73800.]—**Quadratrix of Hippias.**—In an article by H. Schubert, translated in the "Monist" of January, 1891, it is stated that with this curve, assuming it to be drawn mechanically, "the squaring of the circle is solveable with exactitude." Can "E. L. G." tell us the nature of this curve?—PILOG.

[73801.]—**Dynamo.**—Many thanks to Mr. Bottone for reply to query 73510. I have just got your book. I am making size of space for containing wire on each F.M 14in. long, 6in. wide, and 2in. thick, and thickness of metal along centre of pole-piece is 3in. Height of F.M. from top of pole-piece to bottom of F.M. is 18in. Do you think the above space will admit the wire without having too many layers? If dimensions are not right, I will be obliged if you will kindly give proper sizes.—W.

[73802.] — **Grinding Lawn Mowers.** — Would "Lawn Mower," page 531, query 7350, explain more fully his mode of grinding same? I fail to see which travels (and how), the stone or the cylinder. Is overhead motion necessary for it?—A COUNTRY SMITH.

[73803.]—**Separating Laminations.**—I have some 2½in. laminations, H pattern, which are cut out in one piece instead of being in halves as commonly sold. Will any electrical reader kindly tell me the best thing to separate these cardboard or iron washers?—W. MA

[73804.]—**Tempering Small Springs.**—I have a number of small springs to temper, but in doing so they bend all shapes. How can I prevent this trouble? Must I do them one by one.—TROUBLE.

[73805.]—**Adjustment of Refractor.**—A good refractor with equatorial mounting which I have is of very little use for finding an object as at present. I have only a movable tripod stand. I venture to ask one of your experienced correspondents for advice as to the adjustment of such an instrument.—L.

[73806.]—**Model Boiler.**—I have two model boilers each of which is sufficient to work a model launch engine for a short time, but does not keep up steam. Is it practicable and safe to connect the boilers together and arrange the model so as to drive the engine from both? If so, how is this best done?—L.

[73807.]—**Violin Theory and Practice.**—The strings of the violin and the 'cello being tuned to fifths, the key of D on the violin and the key of G on the bass instrument are the only keys in which all the open strings can be used for true intonation. The pitch of the A string is permanent. By avoiding the open strings it can be made right. In the key of F the G string is a comma, or 1-81 too flat. How is the proper pitch or tone to be produced?—A. J. S.

[73808.]—**Trouve's Electric Hand Lamp.**—I have one, which gives a good light, but only lasts about half an hour when charged with bichromate. Can any reader give some other chemical charge that will last much longer time, say, four or six hours? It is one that has five sets of carbon and zinc (3 and 1) in one cell. What candle-power is it?—TROUVE'S LIGHT.

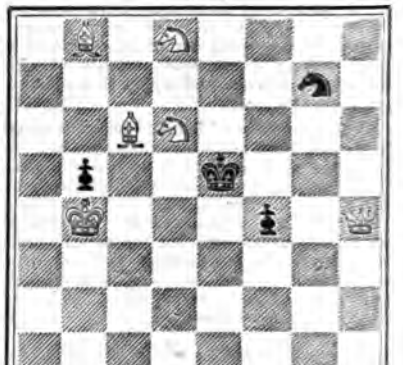
[73809.]—**Model Loco.**—Referring to locomotive by "J. H.," I have started making one about same size as given, but propose making the boiler with real fire-box, water all round. Diameter of boiler, 3in. by 9in., total. I wish to know what thickness of brass to make it to stand 25lb., and if brazing will do?—REAL LOCO.

## CHESS.

ALL communications for this department must be addressed to "J. PIERCE, Knollside, Yawl, Lyme Regis, Dorset."

### PROBLEM MCCXLII.

*Black.*



*White.* [6 - 4

White to play and mate in two moves.

SOLUTION TO 1240.

| *White.* | *Black.* |
|---|---|
| 1. P-Q B 4. | 1. Any. |
| 2. Mates accordingly. | |

### NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1240 by White Knight, W. L. Martin, Biene, W. A. Clark, E. Perrin, G. W. Middleton, W. Gleave (weak), Lieut.-Col. Ryan, H. Fellows, A. Fellows, F. W. N. Lambert (very simple), Link, J. H. Eastwood; to 1239 by F. W. N. Lambert, Link, G. W. Middleton, W. Jay, White Knight, and J. H. Eastwood.

E. PERRIN.—The variation you give in 1238 is what is termed a "short" variation, and is not necessary, on the principle that the less is included in the greater.

G. W. MIDDLETON.—Yes; your score is clear. There are six others.

W. GLEAVE.—You are quite right: it was an oversight. One point would be deducted for each full variation omitted in a sui-mate.

F. W. N. LAMBERT.—See answer above. No.

THE *Schoolmaster's* Problem Tourney is just concluded with the following result:—1. G. Heathcote, Manchester; 2. G. Heathcote; 3. W. A. Clark, E. Molesey. We congratulate both our correspondents on their success.

THE *British Chess Magazine* for February is a good number, full of excellent matter. It contains a most interesting paper by Mr. C. Tomlinson on Simpson's "Chess Divan," as it was some forty years ago; a review of the new "Handbuch" by Prof. Wayte; several games ably annotated between Steinitz and Gunsberg, and in addition to the usual problems, many Chess Curios for Christmas consumption. They are rather late for such fare, but are none the less pleasing.